

DEVELOPMENT OF EDUCATIONAL MANAGEMENT STRATEGIES
FOR ENHANCING SUSTAINABLE INNOVATION ABILITY
OF COLLEGE STUDENTS IN SHAANXI PROVINCE

GUO TINGTING

A thesis paper submitted in partial fulfillment of the requirements for the Degree of
Doctor of Philosophy Program in Educational Management for Sustainable Development

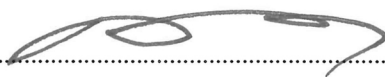
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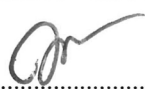

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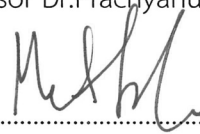
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ABSTRACT

The objectives of this research were: (1) to study the current and desired status of education management for enhancing the sustainable innovation ability of college students in Shaanxi Province; (2) to develop educational management strategies for enhancing sustainable innovation ability of college students in Shaanxi province; (3) to evaluate the feasibility and adaptability of educational management strategies for enhancing sustainable innovation ability of college students in Shaanxi province.

This study employed stratified sampling to select 384 college students for questionnaire surveys, conducted in-depth interviews with 10 experts, organized focus group discussions with 10 experts, and evaluated the developed strategies with 5 experts. All participating experts had more than five years of experience in higher education management and were familiar with college development plans, teaching management practices, and students' specific status. The research instruments included questionnaires, interview form, educational management strategies, and evaluation form. Data were analyzed using percentages, means, standard deviations, the Modified Priority Needs Index (PNI_modified), and content analysis.

The results revealed that the current and desired status of education management for the sustainable innovation ability of college students consisted of three essential aspects: personal traits, the educational and learning environment, and social and external factors, all of which were necessary for development. Based on these findings, educational management strategies were developed, including a clear vision, mission, goals, measures and guidelines for implementing strategies in educational institutions, as well as three strategic dimensions and corresponding measures, including strategies to promote the development of personal traits, optimize the educational and learning environment, and enhance support from social and external factors. Furthermore, the evaluation results indicated that the feasibility and adaptability of the proposed educational management strategies were at high and highest levels, respectively.

Keywords: Development of strategies, Sustainable Innovation ability, College students

ชื่อเรื่อง	การพัฒนากลยุทธ์การจัดการศึกษาเพื่อเสริมสร้าง ความสามารถด้านนวัตกรรมอย่างยั่งยืนของนักศึกษาใน มณฑลฉ่านซี
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ปีการศึกษา	2568

บทคัดย่อ

การวิจัยครั้งนี้มีวัตถุประสงค์เพื่อ 1) ศึกษาสภาพปัจจุบันและสภาพที่พึงประสงค์ของการจัดการศึกษาเพื่อเสริมสร้างความสามารถด้านนวัตกรรมอย่างยั่งยืนของนักศึกษาในมณฑลฉ่านซี 2) พัฒนากลยุทธ์การจัดการศึกษาเพื่อเสริมสร้างความสามารถด้านนวัตกรรมอย่างยั่งยืนของนักศึกษาในมณฑลฉ่านซี และ 3) ประเมินความเป็นไปได้และความเหมาะสมของกลยุทธ์การจัดการศึกษาเพื่อเสริมสร้างความสามารถด้านนวัตกรรมอย่างยั่งยืนของนักศึกษาในมณฑลฉ่านซี

การศึกษานี้ใช้การสุ่มตัวอย่างแบบแบ่งชั้นภูมิเพื่อคัดเลือกนักศึกษา จำนวน 384 คนในการตอบแบบสอบถาม นอกจากนี้ยังได้ทำการสัมภาษณ์เชิงลึกกับผู้เชี่ยวชาญ จำนวน 10 คน จัดสนทนากลุ่มร่วมกับผู้เชี่ยวชาญ จำนวน 10 คน และมีการประเมินกลยุทธ์ที่พัฒนาขึ้นโดยผู้เชี่ยวชาญ จำนวน 5 คน ซึ่งผู้เชี่ยวชาญทั้งหมดที่เข้าร่วมมีประสบการณ์ด้านการบริหารอุดมศึกษามากกว่า 5 ปี มีความเชี่ยวชาญเกี่ยวกับการจัดทำแผนพัฒนาวิทยาลัย การบริหารการเรียนการสอน และบริบทอันเป็นลักษณะเฉพาะของนักศึกษา เครื่องมือที่ใช้ในการวิจัยประกอบด้วย แบบสอบถาม แบบสัมภาษณ์ กลยุทธ์การจัดการศึกษา และแบบประเมินกลยุทธ์ สถิติที่ใช้ในการวิเคราะห์ข้อมูล ได้แก่ ค่าร้อยละ ค่าเฉลี่ย ส่วนเบี่ยงเบนมาตรฐาน ดัชนีลำดับความต้องการจำเป็นฉบับปรับปรุง และการวิเคราะห์เนื้อหา

ผลการวิจัยพบว่า สภาพปัจจุบันและสภาพที่พึงประสงค์ของการจัดการศึกษาเพื่อเสริมสร้างความสามารถด้านนวัตกรรมอย่างยั่งยืนของนักศึกษา ประกอบด้วย 3 ด้านหลัก ได้แก่ ด้านคุณลักษณะส่วนบุคคล ด้านสภาพแวดล้อมทางการศึกษาและการเรียนรู้ และด้านปัจจัยทางสังคมและภายนอก ซึ่งทุกด้านล้วนมีความต้องการจำเป็นในการพัฒนา จากผลการศึกษาดังกล่าวจึงได้นำมาพัฒนากลยุทธ์การ

จัดการศึกษา ซึ่งประกอบด้วย วิสัยทัศน์ พันธกิจ เป้าหมาย มาตรการ และแนวทางการดำเนินงานตามกลยุทธ์ภายในสถานศึกษาที่ชัดเจน ตลอดจนประเด็นยุทธศาสตร์ 3 ด้านและมาตรการที่เกี่ยวข้อง ได้แก่ กลยุทธ์การส่งเสริมการพัฒนาคุณลักษณะส่วนบุคคล กลยุทธ์การเพิ่มประสิทธิภาพสภาพแวดล้อมทางการศึกษาและการเรียนรู้ และกลยุทธ์การเสริมสร้างการสนับสนุนจากปัจจัยทางสังคมและภายนอก นอกจากนี้ ผลการประเมินกลยุทธ์ยังชี้ให้เห็นว่า กลยุทธ์การจัดการศึกษาที่พัฒนาขึ้นนี้มีความเป็นไปได้และความเหมาะสมอยู่ในระดับมาก และมากที่สุด ตามลำดับ

คำสำคัญ: การพัฒนากลยุทธ์, ความสามารถด้านนวัตกรรมอย่างยั่งยืน, นักศึกษาวิทยาลัยในมณฑลसानซี

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Guo Tingting

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Chapter 1

Introduction

Rationale

Against the backdrop of rapid global technological transformation and intensifying international competition in science and innovation, innovation capacity has become a decisive factor underpinning national competitiveness, economic resilience, and sustainable development (OECD, 2018; World Economic Forum, 2020). In the context of the knowledge-based economy, the cultivation of innovative talent is no longer merely an educational objective but a strategic imperative closely linked to national development agendas (UNESCO, 2017; Etzkowitz & Leydesdorff, 2000). As a critical component of the national innovation system, higher education is expected to play a fundamental, strategic, and leading role in fostering innovation-oriented human capital (Marginson, 2016; Liu & Liu, 2021). In recent years, China has explicitly positioned innovation at the core of its modernization drive and has continuously strengthened top-level policy design to promote the systematic cultivation of college students' innovation capabilities (State Council of China, 2021).

Since the implementation of the innovation-driven development strategy, the Chinese government has issued a series of policy documents emphasizing the central role of higher education in nurturing innovative talent (State Council of China, 2016; Ministry of Education of China, 2019). The Opinions on Deepening the Integration of Industry and Education (General Office of the CPC Central Committee and the State Council, 2017) clearly stated that universities should enhance students' innovation and practical abilities through collaborative education mechanisms, highlighting the necessity of synergy between academic learning and industrial practice (Zhou & Li, 2020). The Fifth Plenary Session of the 19th CPC Central Committee (2020) further underscored self-reliance and self-strengthening in science and technology as strategic pillars for national development (CPC Central Committee, 2020). Subsequently, the 14th Five-Year Plan for National Economic and Social

Development emphasized improving higher education quality and building a high-level talent cultivation system that supports scientific and technological innovation (State Council of China, 2021; Yang & Cai, 2022). These policy orientations underscore both the urgency and necessity of systematically examining university-based mechanisms for cultivating innovation capability.

From the perspective of educational governance and talent development, innovation capacity has increasingly become a core indicator for evaluating the quality of higher education and the level of educational modernization (OECD, 2019; Altbach et al., 2017). The Overall Plan for Deepening the Reform of Education Evaluation in the New Era issued by the Ministry of Education (2020) explicitly called for breaking the long-standing examination-oriented evaluation system and incorporating innovation spirit, practical competence, and problem-solving ability into talent assessment frameworks (Ministry of Education of China, 2020; Zhang & Xu, 2021). Similarly, the Opinions on Accelerating the Construction of High-Quality Undergraduate Education and Comprehensively Enhancing Talent Cultivation Capacity (State Council, 2019) emphasized student-centered development, research-based learning, and strengthened practical teaching as essential approaches to innovation cultivation (Guo & Wang, 2020; Huang, 2022). Despite these policy efforts, challenges remain in coordinating curriculum systems, pedagogical approaches, and evaluation mechanisms to translate policy objectives into sustainable educational practices (Li & Shen, 2021).

Theoretically, students' innovation ability is not a single, isolated skill but a multidimensional construct encompassing innovation awareness, creative thinking, methodological competence, and practical application (Amabile, 1996; Sternberg, 2006). Contemporary theories of higher education and innovation learning suggest that innovation capability emerges through continuous interaction between individuals and supportive educational environments (Biggs, 2003; Kolb, 2015). However, in China's higher education practice, the cultivation of innovation capability still faces structural and institutional challenges (Wang & Zhao, 2020). On the one hand, some universities demonstrate inertia in updating educational concepts,

reforming teaching models, and optimizing resource allocation, leading to fragmented or superficial innovation education (Liu, 2019; Chen & Xu, 2021). On the other hand, disparities in regional development, institutional positioning, and disciplinary structures result in uneven innovation support status, affecting both equity and effectiveness (Sun & Li, 2020; Marginson, 2018).

In response to these challenges, the Ministry of Education has promoted large-scale talent cultivation reforms since 2018, including initiatives such as ‘New Engineering,’ ‘New Medical Sciences,’ ‘New Agricultural Sciences,’ and ‘New Liberal Arts’ (Ministry of Education of China, 2018; Wu & Zhang, 2020). These reforms emphasize problem-oriented learning, interdisciplinary integration, practice-based teaching, and student-centered pedagogies as pathways to enhancing innovation capability (Froyd et al., 2012; Li & Huang, 2021). Furthermore, the Opinions on Comprehensively Deepening Educational Reform in the New Era (General Office of the CPC Central Committee and the State Council, 2021) called for stronger institutional coordination and policy guidance to construct an educational ecosystem conducive to continuous innovation (CPC Central Committee, 2021; Zhao, 2022). Nevertheless, the effectiveness of these reforms depends largely on how universities internalize policy directives and translate them into coherent governance mechanisms and everyday teaching practices (Ma & Qiu, 2021).

Against this background, this study systematically examines the cultivation of college students’ innovation capabilities from the perspectives of educational management and policy implementation (Bush, 2011; Fullan, 2016). Drawing on theories of educational governance, innovation education, and talent development, the study analyzes the conceptual connotations, generative mechanisms, and influencing factors of innovation capability within higher education institutions (OECD, 2018; Wang & Liu, 2020). Particular attention is paid to the synergistic relationships among curriculum restructuring, pedagogical innovation, experiential learning, and evaluation reform, which are regarded as core institutional levers for sustainable innovation education (Kolb, 2015; Biggs & Tang, 2011). By identifying key institutional bottlenecks and implementation dilemmas, the study seeks to elucidate pathways

for shifting innovation capability cultivation from policy advocacy to institutional normalization (Zhang, 2022).

The findings suggest that the cultivation of students' innovation ability should adhere to principles of systematization, coordination, and developmental continuity (OECD, 2019; Zhao & Chen, 2021). Innovation education should be embedded throughout the entire talent cultivation process rather than confined to extracurricular activities or short-term projects (Huang & Li, 2020; Wu, 2022). Universities are encouraged to adopt authentic, real-world problems as learning carriers to promote inquiry-based, project-based, and research-oriented learning (Prince & Felder, 2006; Kolmos et al., 2009). Moreover, evaluation and resource allocation mechanisms should be redesigned to provide sustained incentives for innovation-oriented teaching and learning, thereby fostering a stable and supportive educational ecology (Ministry of Education of China, 2020; Yang, 2021).

In conclusion, innovation ability functions both as a cornerstone of national innovation systems and as a core competency for individuals navigating the uncertainties of future society (OECD, 2020; World Bank, 2019). By integrating policy guidance, theoretical reflection, and institutional practice, higher education institutions can better fulfill their mission of cultivating innovative talent while advancing their own quality development (Altbach et al., 2017; Marginson, 2016). Although various policy supports and educational reform initiatives have been implemented in universities to foster college students' sustainable innovation ability, gaps still remain between policy expectations and actual educational outcomes. Therefore, it is necessary to formulate systematic educational management strategies to further optimize innovation cultivation practices.

Specifically, these challenges are mainly reflected in three aspects. First, at the level of individual traits, some college students demonstrate insufficient innovation awareness, limited creative thinking ability, and relatively weak practical application skills, which constrain the continuous development of innovation ability. Second, at the educational and learning environment level, insufficient coordination among curriculum systems, teaching approaches, and evaluation mechanisms, as

well as the limited integration of practical teaching with innovation cultivation, restrict the depth and continuity of innovation development. Third, at the level of social and external support, regional development disparities, insufficient university–industry collaboration, and uneven distribution of social resources create unequal status for innovation cultivation. Addressing these issues through systematic educational management strategies is therefore essential for integrating individual development, optimizing educational environments, and strengthening external support, ultimately promoting the sustainable enhancement of college students' innovation ability, while fostering interdisciplinary collaboration, encouraging active participation in innovation activities, and improving policy support mechanisms to create a more inclusive and supportive innovation ecosystem.

Research Questions

1. What were the current and desired status of educational management for enhancing sustainable innovation ability of college students in Shaanxi Province?
2. What were the educational management strategies for enhancing sustainable innovation ability of college students in Shaanxi Province?
3. What were the levels of the feasibility and adaptability of educational management strategies for enhancing sustainable innovation ability of college students in Shaanxi Province?

Objectives

1. To study the current and desired status of education management for enhancing sustainable innovation ability of college students in Shaanxi Province.
2. To develop educational management strategies for enhancing sustainable innovation ability of college students in Shaanxi Province.
3. To evaluate the feasibility and adaptability of educational management strategies for enhancing sustainable innovation ability of college students in Shaanxi Province.

Scope of the Research

This research was divided into 3 phases:

Phase 1: Studying the current and desired status of education management for enhancing sustainable innovation ability of college students in Shaanxi Province.

Phase 2: Developing educational management strategies for enhancing sustainable innovation ability of college students in Shaanxi Province.

Phase 3: Evaluating the feasibility and adaptability of educational management strategies for enhancing sustainable innovation ability of college students in Shaanxi Province.

The details can be explained as follows:

Phase 1: Studying the current and desired status of education management for enhancing sustainable innovation ability of college students in Shaanxi Province.

Population

According to the latest statistics from the Shaanxi Provincial education authorities, Shaanxi has established a relatively comprehensive, multi-level higher education system encompassing undergraduate institutions, higher vocational colleges, adult higher education institutions, and postgraduate-training universities and research institutes. The total higher education enrollment in the province is approximately 1,926,879 students. Accordingly, all students enrolled in higher education in Shaanxi Province constitute the study population, providing a clear basis for subsequent sampling design and empirical analysis.

The Sample Group

Based on Cochran's (1977) formula, for a population of 1,926,879 students, with a 95% confidence level and a .05 margin of error, the required sample size is approximately 384 participants. Based on, this study adopted stratified random sampling method to randomly select 384 college students from universities in Shaanxi Province as samples. Through questionnaire survey, it focused on studying the current status, desired status for improvement of sustainable innovation ability of college students in Shaanxi Province.

Target group

A total of 10 experts participated in the interview study aimed at examining the current status, desired status and influencing factors related to the sustainable innovation ability of college students in Shaanxi Province. These experts were selected by purposive sampling, and the specific criteria were explicitly as follows below: 1) Having an associate professor or higher title; 2) Engaging in teaching or management work in colleges and universities in Shaanxi Province for more than 10 years; 3) Long-term participation in college students' innovation education, talent cultivation or education management related work, and having relevant research or practical experience.

Phase 2: Developing educational management strategies for enhancing sustainable innovation ability of college students in Shaanxi Province.

Target group

The focus group consisted of 10 experts and aimed to develop strategies for enhancing the sustainable innovation ability of college students in Shaanxi Province. Participants were selected using purposive sampling based on the following criteria: (1) holding the rank of associate professor or above; (2) having at least 10 years of work experience in higher education institutions in Shaanxi Province; and (3) being familiar with innovation education and student development in higher education, with experience in related research projects.

Phase 3: Evaluating the feasibility and adaptability of educational management strategies for enhancing sustainable innovation ability of college students in Shaanxi Province.

Target group

Five experts participated in the evaluation of the feasibility and adaptability of strategies for enhancing the sustainable innovation ability of college students in Shaanxi Province. These experts were selected from colleges and universities in Shaanxi Province. The selection of experts adopted purposive sampling, with the following specific criteria: 1) Holding positions related to education and teaching or student management in colleges and universities; 2) Having more than 10 years of

experience in college education management or teaching, and holding the title of associate professor or above; 3) Having relatively rich teaching, management, or research experience in the fields of college student innovation education, talent cultivation, or education management, and demonstrating a strong understanding of institutional governance and strategic implementation practices.

The variable

1. Independent Variable

Educational Management Strategies For Enhancing Sustainable Innovation ability of College Students in Shaanxi Province, which consisted:

1.1 Personal traits

1.2 Education and Learning Environment

1.3 Social and external factors

2. Dependent Variable

The feasibility and adaptability of educational management strategies For Enhancing Sustainable Innovation ability of College Students in Shaanxi Province.

Contents

1. Studying the current and desired status serves as the basis of this research, which focuses on the sustainable innovation ability of college students by emphasizing three core aspects—personal traits, the educational and learning environment, and social and external factors—and, within this framework, sequentially examines innovation awareness and behavior, time management and psychological state, education and knowledge, campus innovation environment and organizational support, as well as family and social influence. By comparing current status with desired improvements, the study identifies key constraints on the development of college students' sustainable innovation ability and clarifies pathways for its systematic cultivation.

2. Developing educational management strategies focuses on formulating targeted approaches to enhance sustainable innovation ability of college students. Based on the results of studying the current and desired status of sustainable innovation ability of college students through SWOT analysis, PEST analysis, and the

TOWS matrix, strategies were designed from three interconnected dimensions: personal traits, the educational and learning environment, and social and external factors. This content emphasizes the coordinated improvement of internal abilities and external status to support sustainable innovation development.

3. Evaluating the feasibility and adaptability of educational management strategies for college students across diverse educational environments, with particular attention to their alignment with institutional status, resource allocation, and implementation pathways, in order to ensure their effective operation in varied contexts and their sustainable innovation ability, while also considering long-term policy support, stakeholder collaboration, and continuous monitoring mechanisms for improvement purposes.

Time

The study take time from July 2024 to January 2026 and is divided into the following phases:

1. Submitting the first three chapters of the proposal in September 2024.
2. analyzing the current condition of education management for enhancing sustainable innovation ability of college students in January 2025.
3. Formulating strategies and take focus group discussion in March 2025.
4. Evaluating the feasibility and adaptability of educational management strategies in July 2025
5. Summarizing research results, take complete paper, and published research article in January 2026.

Advantages

1. For students

1.1 This research demonstrates that strengthening students' sustainable innovation capability enables them to move beyond passive knowledge acquisition toward active problem identification and value creation, thereby enhancing their sense of agency and learning engagement.

1.2 Through sustained participation in innovation-oriented learning experiences, students develop adaptive thinking, self-regulation, and resilience, which equip them to cope with academic pressure, uncertainty, and failure more constructively.

1.3 Consequently, students gain not only improved academic performance and innovation outcomes, but also stronger employability, career adaptability, and long-term capacity for personal and professional development.

2. For teachers

2.1 This research demonstrates that cultivating students' sustainable innovation capability transforms classroom dynamics from repetitive knowledge delivery to inquiry-driven interaction, enabling teachers to engage in higher-level instructional guidance and experience greater teaching effectiveness and professional fulfillment.

2.2 Through continuous engagement with innovation-oriented students, teachers are better able to integrate teaching with research activities, generate new academic questions from instructional practice, and enhance the coherence between their pedagogical and scholarly work.

2.3 Consequently, teachers benefit not only from reduced instructional and managerial burdens, but also from expanded professional influence, improved career development opportunities, and strengthened long-term occupational sustainability within higher education.

3. For college

3.1 This research demonstrates that cultivating students' sustainable innovation capability enables universities to move beyond short-term performance indicators toward long-term quality-oriented development, thereby strengthening institutional vitality and overall educational effectiveness.

3.2 Through the systematic implementation of innovation-oriented educational practices, universities are able to optimize curriculum structures, enhance teaching–research integration, and build a more dynamic and collaborative educational ecosystem.

3.3 Consequently, universities benefit not only from improved talent cultivation quality and innovation outcomes, but also from enhanced institutional competitiveness, social reputation, and sustainable development capacity in an increasingly complex higher education landscape.

Definition of Terms

Educational management refers a holistic and adaptive system integrating governance, leadership, teaching, and resource coordination, and means a purposeful process for enabling sustainable educational development rather than routine administration. It is widely understood as a mechanism for aligning institutional vision with internal capacities and external demands while balancing autonomy and accountability. At its core, education management emphasizes leadership, systemic coordination, and student-centered governance, playing a decisive role in cultivating students' sustainable innovation ability and enhancing universities' responsiveness to social and technological change. thereby strengthening institutional adaptability, improving policy implementation efficiency, and fostering collaborative networks among stakeholders within evolving global knowledge economies.

Strategy development in education management refers a systematic and evidence-based process through which educational institutions diagnose current status, identify key influencing factors, and formulate coherent courses of action, and means the structured transformation of analytical results into clear visions, goals, and implementable measures. Across the literature, strategy development is consistently understood as a dynamic process that integrates internal strengths and weaknesses with external opportunities and challenges, commonly operationalized through analytical tools such as SWOT, PEST, and related strategic matrices. From this perspective, strategy development emphasizes problem diagnosis, component analysis, and coordinated decision-making rather than abstract governance principles. In educational contexts, it functions as a practical mechanism for aligning management actions with educational objectives, thereby supporting the targeted

improvement of students' sustainable innovation ability and the continuous optimization of educational management practices.

Innovation ability refers a multidimensional competence integrating creative thinking, critical analysis, interdisciplinary knowledge application, and practical execution, and means the capacity to transform ideas and knowledge into effective solutions through inquiry, experimentation, and collaboration. Scholars widely agree that this ability is cultivated in authentic academic and real-world contexts, particularly through research participation and project-based learning. As a core outcome of higher education, college students' innovation ability reflects their adaptability to technological change, problem-solving capacity in complex environments, and long-term competitiveness in innovation-driven and knowledge-based economies, while also encouraging lifelong learning awareness, entrepreneurial spirit, and the continuous exploration of emerging knowledge and technologies.

Sustainable development in higher education refers a long-term, cumulative, and self-reinforcing process through which students' innovation awareness, creative thinking, and problem-solving competence are continuously cultivated across different stages of learning. It means institutionalizing innovation education within stable curricular, governance, and support systems that enable ongoing learning, feedback, and capability renewal rather than one-off interventions. Collectively, these perspectives indicate that sustainable development provides a structural and normative framework for ensuring the durability, continuity, and resilience of students' innovation ability in the context of persistent social, technological, and economic transformation, while promoting inclusive participation, strengthening institutional collaboration, encouraging responsible innovation practices, and supporting adaptive learning environments that respond effectively to emerging global challenges and opportunities.

College students are defined as a distinct educational and social group at a critical transitional stage between adolescence and adulthood, formally enrolled in higher education institutions and engaged in systematic academic learning and professional training. Their identity refers to learners who participate in structured

higher education while gradually developing autonomy, critical thinking, and problem-solving ability. This stage means a key developmental period in which foundational capacities and orientations for future professional and social roles are formed, while students also expand social awareness, cultivate collaborative skills, explore diverse career pathways, and gradually assume greater responsibility for personal development and active participation in broader societal and professional communities.

Research Framework

Figure 1.1 presents the conceptual framework for developing educational management strategies to enhance college students' sustainable innovation ability, with a specific focus on universities in Shaanxi Province. The framework adopts an independent–dependent variable model that integrates theoretical foundations, empirical investigation, strategy formulation, and evaluation processes. It aims to systematically connect educational management practices with the cultivation of innovation capability, ensuring both theoretical coherence and practical applicability while supporting evidence-based institutional decision-making, policy alignment, and long-term educational quality enhancement. Furthermore, it reflects the interaction between internal institutional reform and external socio-economic demands influencing higher education development, highlighting the dynamic relationship between educational transformation and regional innovation ecosystems.

In this framework, sustainable innovation ability is treated as the dependent variable and is conceptualized as a multidimensional construct including innovative thinking, intrinsic motivation, interdisciplinary competence, practical problem-solving ability, continuous learning awareness, and social adaptability. The independent variables mainly include three dimensions: individual traits, educational and learning environment, and social or external factors. These factors jointly influence students' innovation development, while educational management strategies serve as an important mechanism for optimizing these status and facilitating balanced academic, professional, and personal development. Such integration helps cultivate

adaptability, resilience, forward-looking competencies, and responsible innovation awareness required in contemporary knowledge-driven societies characterized by rapid technological change and global interconnectedness.

To systematically formulate appropriate educational management strategies, several analytical tools are employed, as illustrated in Figure 1.1, including SWOT analysis, PEST analysis, the TOWS matrix, and focus group discussions. SWOT analysis is used to identify the internal strengths and weaknesses of universities in Shaanxi Province as well as external opportunities and threats influencing the cultivation of students' sustainable innovation ability. PEST analysis further examines the macro-environmental conditions, including political, economic, social, and technological factors that shape higher education development and innovation-oriented learning. Based on these analyses, the TOWS matrix is applied to integrate internal and external factors in order to generate feasible strategic alternatives. In addition, focus group discussions with experts and stakeholders provide qualitative insights and professional validation, ensuring that the proposed strategies are contextually relevant and practically applicable.

Based on literature review and empirical analysis, strategic development is conducted through systematic analytical tools and expert consultation, resulting in structured educational management strategies. These strategies are organized into five core components—vision, mission, goals, measures, and implementation guidelines—and are further evaluated for feasibility, adaptability, and sustainability within institutional contexts. Overall, the framework provides a comprehensive pathway for aligning educational management with innovation cultivation, supporting continuous policy refinement, institutional innovation capacity, cross-sector collaboration, and the sustainable advancement of higher education practices oriented toward future societal and technological challenges. It also offers a reference model for other regions seeking to strengthen innovation-oriented education management and enhance students' long-term creative competitiveness.

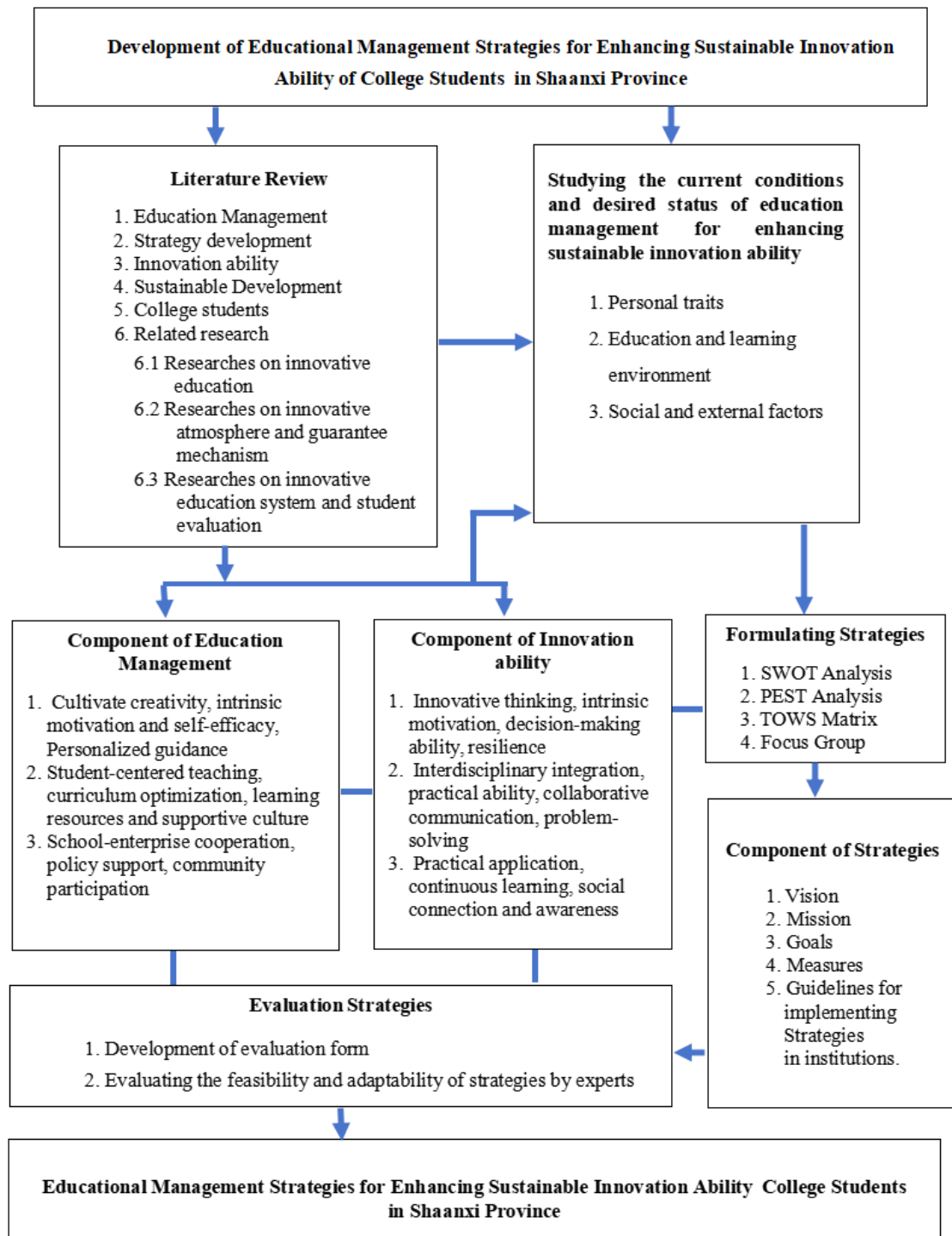


Figure 1.1 Research Framework

Chapter 2

Literature Review

Relevant literature was searched through the network database, and the relevant content of the literature and the purpose of this research, higher education management, strategy research, Innovation ability, and sustainable development were classified, classified and analyzed. The results of the relevant literature search are as follows:

1. Concepts and theories of education management
2. Concepts and theories of strategy development
3. Concepts and theories of innovation ability
4. Concepts and theories of sustainable development
5. Concepts and theories of college students
6. Related research

Concepts and theories of education management

Education management serves as the cornerstone of educational systems, acting as the guiding force that aligns institutional governance, teaching practices, and developmental strategies with the overarching goals of educational quality enhancement and sustainable institutional growth. The details are as follows:

Definition of education management

In the context of innovation-driven and sustainable development, numerous scholars and institutions have explored education management and highlighted its value in cultivating college students' sustainable innovation capabilities. Reviewing existing definitions therefore provides an important theoretical foundation for this study.

Bush (2020) argues that education management refers a strategic and adaptive process concerned with coordinating institutional goals, governance structures, and teaching practices within higher education systems, and means the

purposeful alignment of institutional vision, leadership capacity, and resource allocation to achieve long-term educational development. He emphasizes that education management extends beyond routine administrative supervision and focuses on shaping organizational cultures that encourage innovation, professional development, and continuous improvement. Through effective education management, universities are better positioned to respond proactively to social change, policy reform, and evolving demands for future-oriented talent cultivation.

Hallinger (2020) suggests that education management refers a leadership-driven system that integrates curriculum design, instructional practices, and evaluation mechanisms into a coherent institutional framework, and means the process through which educational leaders guide organizational learning and systematic improvement. From this perspective, education management highlights the central role of instructional leadership in shaping teaching quality and fostering collaborative professional cultures. By promoting evidence-informed and innovation-oriented practices, education management contributes to the development of students' creative thinking and problem-solving capabilities.

Fullan (2021) conceptualizes education management as a dynamic system of deep and sustainable change, arguing that it refers an ongoing interaction among educational policy, leadership practices, and classroom-level innovation, and means a continuous process of capacity building within educational institutions. In this sense, education management prioritizes adaptability to complexity and uncertainty, emphasizing learning resilience, innovation capacity, and long-term developmental outcomes. Rather than focusing on short-term performance indicators, this approach stresses sustainable improvement and system-wide learning.

Marginson (2022) defines education management in higher education as a governance mechanism that refers the strategic coordination of institutional autonomy, public accountability, and innovation capacity, and means balancing academic freedom, resource distribution, and system-level regulation. He argues that effective education management must reconcile competing demands from governments, markets, and academic communities. Through this balanced

governance approach, universities can create supportive status for cultivating students' innovative capabilities while maintaining equity, quality assurance, and sustainable institutional development.

Zhang and Yang (2022) propose that education management refers an integrated governance system that connects teaching reform, faculty development, and innovation practice, and means the systematic design of management structures, incentive mechanisms, and evaluation systems that support interdisciplinary learning. In their view, education management plays a transformative role in shifting traditional teaching models toward innovation-oriented systems. Such systems encourage applied learning, practical experimentation, and the development of students' real-world innovation abilities and sustainable development awareness.

Guo (2023) emphasizes that education management refers a dynamic and student-centered process that adapts to technological advancement and rapid social transformation, and means the coordination of learning pathways, assessment systems, and educational environments to support personalized student development. From this perspective, education management places learners at the core of institutional decision-making and highlights the importance of creativity, critical thinking, and adaptability. This student-centered orientation strengthens students' sustainable innovation capacity and lifelong learning competence.

Li et al. (2024) argue that education management refers a forward-looking strategic system that aligns talent cultivation objectives with regional innovation ecosystems and industrial development needs, and means the coordinated planning and implementation of educational goals, governance mechanisms, and external collaboration. From this perspective, education management not only supports the sustainable development of students' innovation capability but also enhances the societal relevance and long-term impact of higher education by strengthening university–industry–government collaboration.

Zhang Yanhua et al. (2025) said that educational management is a process of organizing, planning, coordinating, controlling and evaluating educational activities to ensure the realization of educational goals. Educational management involves

multiple levels, including school, regional, national and international levels. Effective educational management requires leadership, communication skills, decision-making skills, innovation skills and teamwork spirit. The core goals of educational management are to improve the quality of education, promote educational equity and meet student needs.

In summary, building on the foregoing perspectives, education management refers a holistic and adaptive system integrating governance, leadership, teaching, and resource coordination, and means a purposeful process for enabling sustainable educational development rather than routine administration. It is widely understood as a mechanism for aligning institutional vision with internal capacities and external demands while balancing autonomy and accountability. At its core, education management emphasizes leadership, systemic coordination, and student-centered governance, playing a decisive role in cultivating students' sustainable innovation ability and enhancing universities' responsiveness to social and technological change.

Theories of education management

This literature review, designed for the research project development of educational management strategies for enhancing sustainable innovation ability of college students in Shaanxi Province, examined various theories as detailed below.

1. Classical Management Theory

Classical management theory emerged in the late nineteenth and early twentieth centuries under the influence of industrialization, large-scale organizational expansion, and efficiency-oriented production systems. Its central concern was rationality, standardization, and efficiency maximization. As modern school systems expanded, these management ideas were gradually introduced into education, forming the earliest theoretical foundation of educational management.

Taylor (1911) proposed scientific management as a method for improving organizational efficiency. He emphasized replacing experience-based practices with scientific analysis, advocating standardized work procedures, task decomposition, and clear division of labor. Taylor outlined four principles: scientific job analysis, scientific selection and training of workers, close cooperation between management and

workers, and explicit division of responsibilities. In educational management, Taylor's ideas influenced early practices such as curriculum standardization, teaching supervision, performance evaluation, and administrative control, marking the transfer of industrial efficiency logic into schooling.

Spaulding (1913) was among the earliest scholars to apply scientific management principles directly to educational administration. He reported the implementation of efficiency-oriented management methods in public schools, particularly in instructional supervision, organizational coordination, and performance measurement. Spaulding's work signified the formal emergence of educational management as a distinct field of study and demonstrated that schools could be managed through rational and systematic principles similar to those used in industrial organizations.

Bobbitt (1918) further extended classical management theory into the field of curriculum administration. Influenced by scientific management, he conceptualized education as a process of preparing individuals for predefined social roles through clearly specified objectives and measurable outcomes. Bobbitt advocated task analysis and objective-based curriculum planning, reinforcing the technical and managerial orientation of early educational management and strengthening the efficiency-based model of schooling.

Fayol (1925) shifted the focus of classical management theory from task-level efficiency to organization-level administration. He defined management as a universal process consisting of planning, organizing, commanding, coordinating, and controlling, and proposed fourteen general principles of management to guide organizational coordination and long-term development. In educational management, Fayol's ideas contributed to the development of hierarchical administrative structures, clarified managerial responsibilities across various departments, and supported systematic institutional planning and strategic alignment, thereby enhancing overall organizational rationality, stability, and administrative effectiveness within schools.

Gulick (1937) developed administrative management theory by proposing the POSDCORB framework—planning, organizing, staffing, directing, coordinating,

reporting, and budgeting. Building on Fayol's ideas, Gulick translated abstract management principles into concrete administrative functions and introduced the concept of span of control. His theory was widely adopted in educational administration, particularly in school district governance, budgeting systems, and personnel management, reinforcing the view of educational organizations as formal administrative systems.

Weber (1947) introduced bureaucratic management theory, emphasizing legal-rational authority, formal rules, hierarchical structures, and impersonal relationships. He argued that bureaucracy was the most rational organizational form for modern society. In educational management, Weber's theory influenced the establishment of standardized regulations, formal procedures, and hierarchical governance systems in schools and universities, enhancing administrative stability and predictability while also laying the groundwork for later critiques of rigidity and over-centralization.

In summary, classical management theory in educational management evolved sequentially from Taylor's scientific efficiency principles to Spaulding's early educational applications, Bobbitt's curriculum management, Fayol's administrative rationalization, Gulick's functional coordination, and Weber's bureaucratic organization. Together, these theories established an efficiency-oriented, rational, and structurally organized foundation for educational management, which continues to influence contemporary educational governance despite later theoretical critiques.

2. Behavioral Science Theory

Behavioral science theory in educational management emerged in the mid-twentieth century as a critical response to the limitations of classical management theory. While classical approaches emphasized efficiency, structure, and formal authority, behavioral theorists shifted attention toward human behavior, psychological needs, social relationships, and motivation within organizations. This theoretical transformation marked a fundamental move from mechanical control to human-centered management in educational organizations.

Mayo (1933) is widely recognized as the founder of human relations theory, which laid the foundation for behavioral science in management. Through the

Hawthorne Studies, Mayo demonstrated that workers' productivity was significantly influenced by social and psychological factors rather than solely by physical working status or economic incentives. In educational management, his theory highlighted the importance of interpersonal relationships, emotional support, and informal group dynamics among teachers and staff, suggesting that school effectiveness depends largely on social cohesion and morale.

Lewin (1942) introduced field theory and group dynamics, emphasizing that individual behavior is the result of interaction between personal characteristics and environmental forces. He proposed that leadership styles—authoritarian, democratic, and laissez-faire—produce distinct behavioral outcomes in groups. Applied to educational management, Lewin's work underscored the importance of democratic leadership, participatory decision-making, and positive school climates in shaping teachers' motivation and organizational behavior.

Maslow (1943) developed the hierarchy of needs theory, arguing that human behavior is motivated by a progression of needs ranging from physiological survival to self-actualization. He maintained that higher-level needs can only be activated after lower-level needs are satisfied. In educational management, Maslow's theory provided a psychological foundation for understanding teacher motivation, emphasizing that school administrators should address teachers' security, belonging, and professional development needs in order to foster creativity, commitment, and innovation.

Barnard (1938/1951) conceptualized organizations as cooperative systems sustained by individuals' willingness to contribute and accept authority. He emphasized communication, shared goals, and moral leadership as key factors in organizational effectiveness. In the context of educational management, Barnard's theory highlighted the importance of leadership legitimacy, value alignment, and voluntary cooperation among teachers, administrators, and staff, thereby strengthening organizational cohesion and effectiveness.

McGregor (1960) advanced behavioral science theory by proposing Theory X and Theory Y, which represented two contrasting assumptions about human nature in organizations. Theory X assumes that individuals are passive and require strict control, whereas Theory Y views individuals as self-motivated, responsible, and capable of self-direction. In educational management, Theory Y became the dominant paradigm, supporting participatory leadership, teacher autonomy, professional trust, and innovation-oriented school management.

Herzberg (1966) further refined motivation theory by introducing the two-factor theory, distinguishing between hygiene factors that prevent dissatisfaction and motivators that promote satisfaction and performance. He argued that true motivation arises from intrinsic factors such as achievement, recognition, and professional growth. Applied to educational management, Herzberg's theory emphasized the role of meaningful teaching tasks, professional recognition, and career development opportunities in enhancing teachers' job satisfaction and instructional effectiveness.

Likert (1967/1976) synthesized behavioral research into a comprehensive organizational model by proposing four management systems ranging from authoritarian to participative. Based on empirical evidence, he concluded that participative management was the most effective. In educational management, Likert's participative system reinforced democratic governance, collaborative decision-making, and supportive leadership, contributing to the development of modern school-based management and shared leadership models.

In summary, behavioral science theory in educational management evolved from Mayo's human relations perspective to Lewin's group dynamics, Maslow's motivational psychology, Barnard's cooperative systems, McGregor's humanistic assumptions, Herzberg's motivation theory, and Likert's participative management model. Collectively, these theories shifted educational management from efficiency-centered control to human-centered development, emphasizing motivation, participation, communication, and psychological well-being as essential status for effective and sustainable educational organizations.

3. Systems & Contingency Theory

With the increasing complexity of educational organizations and their environments, behavioral science theory was gradually expanded and complemented by systems theory and contingency theory. These perspectives moved beyond individual behavior and interpersonal relations to emphasize organizational structure, environmental interaction, and situational adaptability, providing a more holistic framework for understanding educational management.

Bertalanffy (1950) laid the theoretical foundation for systems theory through his General Systems Theory, proposing that organizations should be understood as open systems composed of interrelated and interdependent components. He emphasized that systems continuously exchange information, energy, and resources with their environments. Applied to educational management, this perspective suggests that schools and universities function as open systems in which teaching, administration, students, families, and social contexts interact dynamically, and educational effectiveness depends on system coherence and environmental alignment.

Getzels and Guba (1957) were among the first scholars to explicitly apply systems thinking to educational administration. They conceptualized schools as social systems composed of institutional roles and individual personalities. According to their model, educational management effectiveness depends on the interaction between organizational expectations and individual needs. This framework provided an early systems-based explanation of school behavior, bridging organizational structure and human motivation in educational settings.

Katz and Kahn (1966) further developed open systems theory by emphasizing organizational input–throughput–output processes and feedback mechanisms. They argued that organizations survive and develop through continuous adaptation to environmental demands. In educational management, their theory highlighted the importance of feedback systems, communication flows, and adaptive leadership in maintaining institutional stability and promoting continuous improvement within changing policy and social environments.

Lawrence and Lorsch (1967) formally introduced contingency theory by arguing that there is no single best way to manage organizations; instead, effective management depends on the degree of fit between organizational structure and environmental status. They emphasized differentiation and integration as key organizational responses to environmental uncertainty. In education management, contingency theory implies that governance models, leadership styles, and curriculum structures should vary according to institutional missions, student characteristics, disciplinary contexts, and external pressures.

Thompson (1967) expanded contingency thinking by focusing on organizational uncertainty and internal coordination mechanisms. He proposed that organizations adopt different structural arrangements to buffer environmental uncertainty while maintaining internal efficiency. In educational management, Thompson's theory supports flexible administrative structures, decentralized decision-making, and adaptive coordination mechanisms to cope with policy reforms, technological change, and diversified educational demands.

Hoy and Miskel (1996) integrated systems theory and contingency theory into a comprehensive framework for educational administration. They argued that schools are open social systems influenced by technical, managerial, and institutional environments. From this perspective, effective educational management requires situational diagnosis, environmental awareness, and strategic adaptation rather than rigid adherence to universal principles. Their work provided a mature theoretical synthesis that has become foundational in contemporary educational management research and practice.

In summary, systems theory and contingency theory represent a critical advancement in educational management theory by shifting the focus from isolated human behavior to organizational-environmental interaction and contextual adaptation. From Bertalanffy's general systems framework to Getzels and Guba's social system model, and from Katz and Kahn's open systems theory to Lawrence and Lorsch's contingency perspective, these theories collectively emphasize complexity, interdependence, and situational fit. In educational management, they

provide essential theoretical support for flexible governance, differentiated management strategies, and sustainable institutional development in dynamic and uncertain environments.

4. Educational Governance Theory

With the expansion of higher education systems and the increasing involvement of multiple stakeholders, traditional management-oriented perspectives gradually proved insufficient to explain the complexity of contemporary educational decision-making. Against this background, educational governance theory emerged, shifting attention from internal administrative control to multi-level coordination, stakeholder participation, and shared responsibility among governments, institutions, and society.

Rhodes (1997) was among the earliest scholars to articulate governance theory in public administration, proposing the concept of “network governance.” He argued that governance refers to self-organizing, interdependent networks involving governmental, semi-governmental, and non-governmental actors. Applied to education, this perspective suggests that educational decision-making is no longer monopolized by the state but distributed across multiple actors, including universities, communities, and market organizations.

Kooiman (2003) further developed governance theory by defining governance as the interaction between public and private actors aimed at solving complex societal problems. He emphasized that governance is not hierarchical control but a process of negotiation, coordination, and mutual adjustment. In the context of education, this view highlights the importance of collaborative policymaking, institutional autonomy, and stakeholder engagement in shaping educational outcomes.

Pierre and Peters (2005) conceptualized governance as the steering mechanisms through which collective goals are pursued in complex societies. They distinguished governance from traditional management by emphasizing strategic coordination, accountability, and policy coherence. In educational governance, this framework implies that governments increasingly act as ‘steerers’ rather than

‘rowers,’ guiding universities through policy instruments, quality assurance systems, and performance evaluation rather than direct administrative intervention.

Marginson (2011) applied governance theory specifically to higher education, arguing that educational governance refers to the coordination of state authority, market forces, and academic self-regulation. He emphasized that universities operate within multi-level governance structures shaped by national policies, global competition, and institutional autonomy. From this perspective, effective educational governance requires balancing efficiency, equity, academic freedom, and innovation capacity.

Ball (2012) examined educational governance from a critical policy perspective, highlighting the influence of neoliberalism, marketization, and performativity in contemporary education systems worldwide. He argued that governance increasingly operates through policy technologies such as accountability frameworks, benchmarking, and performance indicators designed to regulate institutional performance. In higher education, these governance mechanisms significantly reshape institutional behavior, academic work, and innovation priorities, raising important questions about power, control, equity, and educational values in rapidly changing global contexts.

OECD (2018) proposed a contemporary governance framework that emphasizes evidence-based policymaking, stakeholder participation, and system-level coordination. It defines educational governance as the capacity to align policy objectives, institutional autonomy, and accountability mechanisms to improve quality, equity, and innovation. From this perspective, governance is understood as a dynamic and adaptive process that responds to social change and evolving educational demands, thereby supporting sustainable and innovative development in education systems.

Jessop (2016), from a strategic-relational perspective, argued that governance involves the selective coordination of actors, institutions, and discourses within specific political, economic, and socio-cultural contexts, shaped by power relations and strategic choices. Applied to education, this view suggests that governance

arrangements actively construct institutional priorities by privileging certain interests, values, and forms of knowledge. In higher education, such selective governance influences orientations toward marketization, accountability, innovation, and social responsibility, thereby shaping educational reform and the cultivation of innovation capacity.

In summary, educational governance theory represents a significant shift from traditional education management toward multi-actor coordination, shared responsibility, and system-level steering across complex institutional environments. From Rhodes' network governance and Kooiman's interactive governance to Marginson's higher education governance and OECD's system-oriented frameworks, these theories collectively emphasize decentralization, institutional autonomy, accountability, and stakeholder participation in shaping effective governance structures. In contemporary higher education, educational governance theory provides a critical theoretical foundation for understanding how innovation capacity, sustainable development, and educational quality are shaped through the dynamic interaction of policy, institutions, and society within evolving global knowledge systems.

Table 2.1 A Comparative Table of Educational Management Theories Schools

Theoretical School	Core Focus	Key Figures	Keywords
Classical Management Theory	systems, efficiency, and structure	Taylor, Fayol, Weber	Standardization, Bureaucracy, Efficiency
Behavioral Science Theory	Human nature, emotions, and motivation	Mayo, Maslow	Social Man, Hierarchy of Needs, Informal Organization
Systems & Contingency Theory	Environment, adaptation, and the whole	Woodward, etc.	Open Systems, Tailored Approach, Dynamic Adaptation
Educational Governance Theory	Decentralization, participation, and diversity	(Contemporary)	Principal Accountability, Home-School Collaboration, Autonomous Schooling

Components of education management

Regarding the components of education management, numerous scholars and institutions have explored and proposed diverse perspectives that reflect their value in enhancing educational effectiveness and institutional development, as follows.

Gulick & Urwick (1937) introduced the administrative process widely known as "POSDCORB," which has become a classic cornerstone of management theory. This framework comprises seven core components: Planning, Organizing, Staffing, Directing, Coordinating, Reporting, and Budgeting. These elements serve as the fundamental guidelines for school administration and educational agencies worldwide, ensuring that operations remain systematic, orderly, and highly accountable.

Knezevich (1984) described education management as a social process necessitated by the systematic allocation of resources. He emphasized four critical components: the Management Process, Organizational Structure, Human Resources, and the Educational Environment. Knezevich argued that effective administration must adapt its structure to align with the behavior of individuals within the organization, ensuring that institutional goals remain congruent with contemporary societal needs.

Lunenburg & Ornstein (2011) identified components of education management centered on "School Effectiveness." They prioritized five key elements: Administrative Leadership, School Climate, Curriculum and Instruction, Assessment of Student Learning, and Parental and Community Involvement. These components reflect the perspective that management does not conclude with administrative paperwork but must directly influence the quality of student outcomes.

Hoy & Miskel (2013) presented the components of administration through a "Social Systems Model," categorizing key elements into Structure, Individual, Culture, and Politics. They viewed education management as the art of balancing individual needs with organizational goals, with "Decision Making" serving as the central heart that links all components together. This allows educational institutions to respond to external pressures while maintaining internal standards.

Everard et al. (2015) suggested that modern educational management components should prioritize strategic management and change. Their framework consists of three main pillars: Managing Self and Others, Managing Resources and Teaching, and Managing Change. These scholars argue that in a rapidly changing technological landscape, administrators must possess flexibility and coaching skills to unlock the full potential of their personnel.

Connolly et al. (2019) summarized the components of education management based on "Functional Responsibilities." These include Academic Management, Financial and Physical Management, Human Resource Management, and Stakeholder Engagement. Their research emphasizes the concept of

"Accountability" as an indispensable component in modern educational systems, which demand transparency and measurable performance.

Bush (2020) provides an updated framework for the components of education management through a comprehensive analysis of six theoretical models: Formal, Collegial, Cultural, Political, Subjective, and Ambiguous. In this latest edition, he emphasizes that modern education management must transcend mere administrative tasks by integrating strategic leadership with organizational culture. Bush highlights the necessity for administrators to develop a sophisticated understanding of how these models interact, particularly in fostering a resilient school environment capable of navigating the complexities and rapid transformations of 21st-century education.

Huang et al. (2025) described components of education management were a diversified and comprehensive field, covering various aspects such as organizational management, human resources management, and financial management. These aspects were interrelated and jointly influence the effective operation and development of educational institutions. By comprehensively considering these aspects, education administrators can develop comprehensive and effective strategies to promote improvement and innovation in the education system. As the social and educational environment changes, educational managers need to constantly update and adjust their management methods and strategies to adapt to new challenges and opportunities.

In summary, based on the perspectives of these scholars mentioned above, it can be concluded that the components of education management have evolved from a focus on traditional administrative functions toward a more comprehensive and integrated framework encompassing three interrelated dimensions: personal traits, educational and learning environment, and social and external factors. This evolution reflects a growing emphasis on individual leadership, decision-making, and professional competence at the personal level; on organizational structures, management processes, curriculum and instructional systems, and resource allocation at the educational and learning level; and on policy contexts, stakeholder

engagement, accountability, and responsiveness to social and technological change at the social and external level, collectively highlighting a holistic and dynamic understanding of contemporary education management.

Taken together, the above studies reveal a shared understanding that educational management functions as a multi-dimensional and integrated system rather than a collection of isolated managerial activities. Across different theoretical traditions and time periods, scholars consistently emphasize the interaction among individual-level factors, institutional status related to teaching and learning, and broader social, policy, and environmental contexts. Building on this consensus, the present study organizes the subsequent discussion into three interrelated components of educational management: personal traits, educational and learning environment, and social and external factors. This classification provides a clear and coherent analytical framework for examining how educational management supports students' development and sustainable educational outcomes. To ensure conceptual clarity, the key terms related to these three components are first defined, followed by a review of the relevant theoretical perspectives and empirical studies associated with each dimension, as presented below.

Conceptual Definitions and Theoretical Foundations

In the context of rapid technological change and global competition, cultivating sustainable innovation ability has become a central objective of higher education. This capacity is shaped by the interaction of individual traits, institutional learning environments, and broader social systems. The following sections examine these three interconnected dimensions through key theoretical perspectives.

1. Personal traits

The development of personal traits has become a core focus in contemporary educational research, particularly in the area of sustainable innovative ability. Over time, academic perspectives have evolved from emphasizing self-regulation to integrating motivation, thinking patterns, curiosity, and creativity into a comprehensive psychological framework. The following discussion presents key theoretical contributions.

Zimmerman (2020) emphasized self-regulated learning as a foundational construct in modern education. He defined it as learners' capacity to plan, monitor, and evaluate their own cognitive and behavioral processes across different learning stages. His framework highlights the cyclical nature of self-regulation, including forethought, performance control, and self-reflection phases. This model underscores students' active agency in managing goals, strategies, and motivational states. Within educational management contexts, establishing structured feedback systems, clear performance indicators, and reflective learning mechanisms can systematically cultivate autonomous learners who are capable of adaptive problem-solving and sustained academic development.

Deci and Ryan (2020) further strengthened motivational theory through Self-Determination Theory, emphasizing intrinsic motivation as engagement driven by autonomy, competence, and relatedness. Their theory argues that when these three basic psychological needs are satisfied, individuals demonstrate higher persistence, creativity, and psychological well-being. In educational management practice, autonomy-supportive policies, participatory decision-making structures, and learner-centered evaluation systems can enhance students' sense of ownership and responsibility. Such supportive environments not only increase academic engagement but also contribute to long-term innovation capacity by fostering internally regulated learning behaviors.

Duckworth (2021) introduced grit as sustained passion and perseverance toward long-term goals, particularly in contexts requiring extended effort and delayed rewards. She emphasized that grit involves consistency of interests over time and resilience in the face of failure. This concept broadened educational discussions beyond short-term performance outcomes to long-term developmental trajectories. From an educational management perspective, creating stable learning pathways, mentorship systems, and challenge-based curricula can help students develop persistence and commitment, which are essential qualities for sustainable innovation processes.

Dweck (2021) proposed growth mindset theory, arguing that individuals who believe intelligence and abilities are malleable are more likely to embrace challenges, persist through setbacks, and seek improvement. Her research demonstrates that feedback emphasizing effort, strategy, and progress promotes adaptive learning behaviors. In educational management, assessment systems that prioritize formative evaluation, constructive feedback, and developmental benchmarks help institutionalize growth-oriented cultures. Such systems encourage students to view difficulties as opportunities for mastery rather than indicators of fixed limitations.

Kashdan (2022) conceptualized curiosity as a motivational and cognitive driver of exploration, discovery, and intellectual risk-taking. He highlighted two dimensions of curiosity: interest-driven exploration and deprivation-sensitive curiosity aimed at resolving uncertainty. These forms of curiosity stimulate knowledge acquisition and interdisciplinary engagement. Educational management strategies that integrate inquiry-based learning, open-ended research projects, and cross-disciplinary collaboration can nurture sustained curiosity, thereby strengthening innovative thinking and adaptive learning capabilities.

Kaufman (2023) defined creativity as the ability to generate ideas, solutions, or products that are both novel and contextually appropriate. He emphasized that creativity emerges from the interaction of individual cognitive flexibility, domain knowledge, emotional factors, and environmental support. His perspective bridges psychological and institutional dimensions by recognizing that creative potential requires enabling conditions to flourish. Educational management systems that encourage experimentation, tolerate productive failure, and integrate project-based assessment can provide structural support for creativity development. In this sense, creativity is not merely an individual talent but a cultivated outcome shaped by coordinated management practices.

In summary, the theoretical development of personal traits demonstrates a progressive expansion from self-regulated learning to a multidimensional psychological framework integrating intrinsic motivation, perseverance, growth beliefs,

curiosity, and creativity. These perspectives collectively suggest that sustainable innovation ability is grounded in dynamic and developable psychological characteristics rather than fixed abilities. For educational management, this implies a strategic shift from controlling learning processes to designing supportive systems that cultivate autonomy, resilience, exploratory thinking, and creative engagement. Such an integrated approach provides a solid theoretical foundation for enhancing students' sustainable innovation capacity within contemporary higher education contexts.

2. Education and learning environment

The learning environment and institutional management structure play a decisive role in shaping students' academic development and sustainable innovation capabilities. Over time, academic perspectives have evolved from structural curriculum coordination to educational governance based on an overall ecosystem. The following discussion presents key theoretical contributions.

Ornstein and Hunkins (2018) emphasized curriculum management as a systematic and continuous process aligning instructional planning, implementation, and evaluation with clearly defined educational goals. They argued that effective curriculum management requires coherence among objectives, content organization, instructional strategies, and assessment methods. Their framework highlights the importance of vertical and horizontal curriculum alignment to ensure consistency across courses and academic programs. In the context of educational management, such structured coordination enhances institutional stability, promotes academic standards, and establishes a solid foundation for innovation-oriented teaching practices.

Levacic (2019) expanded this perspective by highlighting resource allocation as a strategic management function influencing institutional effectiveness and educational equity. She defined resource allocation as the deliberate distribution of financial, technological, and human capital to support institutional priorities and learning outcomes. Levacic emphasized that inequitable or inefficient allocation can widen achievement gaps and reduce institutional performance. Within higher

education management, sustained investment in digital infrastructure, faculty development, research facilities, and student support services is essential for maintaining high-quality learning environments and fostering innovation capacity among diverse student populations.

Garrison and Vaughan (2019) introduced blended learning frameworks, defining learning support systems as integrated online–offline mechanisms that enhance flexibility, accessibility, and personalized engagement. Their Community of Inquiry model emphasized the interaction of cognitive presence, social presence, and teaching presence in constructing meaningful learning experiences. This perspective suggests that educational management should coordinate digital platforms, instructional design, and academic support services to create cohesive hybrid environments. Such integration strengthens students' autonomy, collaboration skills, and capacity for innovation in increasingly digital academic contexts.

Hattie (2020, 2021) emphasized teaching organization, feedback quality, and classroom climate as high-impact factors influencing student achievement. Through large-scale meta-analytical research, he identified evidence-based instructional practices that significantly affect learning outcomes. His findings shifted educational management attention toward data-informed decision-making and systematic instructional improvement. By promoting collaborative teaching cultures, structured performance evaluation, and continuous professional development, institutions can enhance instructional effectiveness and create environments conducive to sustained academic and innovative growth.

Hammond (2022) conceptualized the learning environment as a dynamic and interconnected system integrating curriculum, pedagogy, assessment, and equity of access. She emphasized that high-quality education depends on systemic coherence rather than isolated reforms. Her work highlighted the importance of inclusive practices, culturally responsive pedagogy, and equitable resource distribution in supporting diverse learners. From an educational management perspective, fostering institutional alignment and inclusive policies strengthens students' sense of belonging and supports long-term engagement and innovation development.

Ashwin (2023) further expanded the perspective by emphasizing academic cultures and institutional ecosystems that shape students' identity formation and intellectual engagement. He argued that students' experiences in higher education are influenced not only by formal curriculum structures but also by disciplinary traditions, institutional values, and social interactions. Educational management systems that cultivate supportive academic communities, interdisciplinary collaboration, and participatory governance can enhance students' academic identity, critical thinking skills, and innovation awareness. His framework underscores the importance of viewing the learning environment as a holistic ecosystem rather than merely a structural arrangement.

In summary, theoretical development in learning environment and educational management research has gradually shifted from structural curriculum alignment toward integrated, evidence-based, and ecosystem-oriented governance models. Collectively, these scholars demonstrate that sustainable innovation capacity emerges not only from well-designed curricula but also from equitable resource allocation, blended learning systems, data-informed instruction, inclusive policies, and supportive academic cultures. Such comprehensive and coherent management approaches provide a robust institutional foundation for fostering long-term academic excellence and innovation development.

3. Social and external factors

In the context of accelerating globalization, digital transformation, and the development of a knowledge-based economy, the external environment system has become a key force in determining the reform and innovation capabilities of higher education. The theoretical perspective has gradually expanded from an ecological foundation to network structure and innovation ecosystem. The following discussion presents important academic contributions.

Bronfenbrenner (2005) introduced ecological systems theory, emphasizing that learners develop through interactions within nested environmental systems, including the microsystem, mesosystem, exosystem, macrosystem, and chronosystem. He argued that individual development cannot be understood in

isolation from broader social, cultural, economic, and policy contexts. This foundational theory highlighted environmental interconnectedness and the dynamic reciprocity between individuals and their surroundings. In educational management, Bronfenbrenner's framework underscores the importance of aligning family engagement, institutional structures, community partnerships, and national education policies to create coherent developmental support systems that foster sustainable innovation capacity.

Castells (2010) emphasized the rise of the network society, identifying digital infrastructure and information flows as transformative forces reshaping knowledge production, communication, and organizational structures. He argued that power and productivity increasingly depend on connectivity and the ability to participate in global information networks. In higher education, this perspective highlights the strategic importance of digital platforms, open knowledge systems, and technological integration. Educational management must therefore prioritize digital transformation, technological literacy, and network-based collaboration to ensure institutions remain competitive and responsive in the knowledge economy.

Marginson (2018) examined globalization and the evolution of international higher education systems, emphasizing the influence of global rankings, cross-border student mobility, and transnational policy coordination. He argued that higher education institutions operate within a globally stratified system shaped by competition, reputation, and international collaboration. This perspective highlights the importance of strategic positioning, global partnerships, and policy alignment in shaping institutional development. For educational management, Marginson's work underscores the need to balance global competitiveness with national priorities and local educational missions.

Etzkowitz (2018) proposed the Triple Helix model, emphasizing dynamic collaboration among universities, industry, and government as the structural foundation of innovation ecosystems. He argued that knowledge-based societies depend on hybrid organizations, joint research initiatives, and entrepreneurial universities that integrate academic inquiry with economic development. The Triple

Helix framework redefined universities as active agents in technological innovation and regional development rather than isolated knowledge producers. From a management perspective, fostering intersectoral partnerships, research commercialization mechanisms, and innovation-oriented governance structures becomes essential for sustainable development.

UNESCO (2021) highlighted global policy environments, digital transformation, sustainability agendas, and international cooperation frameworks as critical external drivers influencing higher education reform. It emphasized the integration of the Sustainable Development Goals (SDGs), digital equity, and inclusive access into educational planning. UNESCO's policy reports advocate systemic reform that strengthens resilience, promotes lifelong learning, and enhances global knowledge exchange. For educational management, this guidance reinforces the necessity of aligning institutional strategies with global sustainability standards and international quality benchmarks.

Feng and LeiZhou (2021) examined school–enterprise cooperation as an institutionalized mechanism linking talent cultivation with technological innovation and industrial development. They emphasized structured collaboration models, joint curriculum design, internship systems, and applied research partnerships as key components of effective cooperation. Their research demonstrated that sustained interaction between educational institutions and enterprises enhances students' practical competencies, innovation awareness, and employability. In terms of educational management, institutionalizing school–enterprise partnerships strengthens knowledge transfer, supports regional economic development, and creates a mutually reinforcing innovation ecosystem.

In summary, these theoretical perspectives collectively demonstrate that higher education institutions operate within complex and interconnected external systems. From ecological environments and digital networks to globalization dynamics, Triple Helix collaboration, global policy agendas, and school–enterprise partnerships, each framework highlights structural forces beyond the campus that influence educational development. Together, they underscore that sustainable

innovation capacity depends not only on internal management optimization but also on strategic adaptation to broader social, technological, economic, and policy environments.

Principle of education management

Regarding the principles of education management, numerous scholars and institutions have explored and proposed diverse perspectives that reflect their value in promoting educational quality and institutional development, as follows.

Sergiovanni (2018) emphasized that education management should be grounded in moral leadership rather than bureaucratic control. He conceptualized schools as moral communities in which leadership is rooted in shared values, mutual trust, and professional responsibility. From this perspective, effective education management prioritizes human development, ethical commitment, and the cultivation of a collaborative organizational culture, thereby fostering professional integrity, intrinsic motivation, and a shared sense of purpose within educational institutions.

Day, Gu, and Sammons (2019) further argued that successful education management depends on values-driven leadership that actively supports teachers' professional growth, well-being, and sustained career development. They emphasized that people-oriented management recognizes teachers as the core human capital of educational institutions and seeks to create supportive working environments through trust, respect, and professional autonomy. Such leadership approaches enhance teachers' organizational commitment, motivation, and resilience, reduce professional burnout, and strengthen collective capacity, thereby contributing to long-term school improvement, organizational stability, and the continuous enhancement of educational quality.

Caldwell and Spinks (2020) argued that strategic self-management is a fundamental principle of modern education systems in increasingly complex and competitive environments. They conceptualized schools as adaptive and learning-oriented organizations that must respond proactively to social transformation, rapid technological innovation, and intensifying global competition. From this perspective,

strategic governance becomes a core guiding principle of education management, requiring schools to develop clear visions, set long-term goals, and allocate resources strategically. Such governance arrangements enhance institutional autonomy and accountability, strengthen decision-making capacity, and support continuous organizational learning, thereby enabling schools to achieve sustainable development and long-term educational effectiveness.

Leithwood (2020) emphasized that effective education management depends on coherent leadership systems that align institutional vision, organizational culture, policy frameworks, and professional practices. He argued that such coherence enables schools to translate strategic goals into consistent actions across different levels of the organization. System coherence strengthens organizational stability, reduces fragmentation in decision-making and implementation, and enhances collective understanding among educators, thereby supporting sustainable school development and continuous improvement in complex educational environments.

Hallinger (2021) emphasized that instructional leadership remains a central principle of education management in contemporary education systems. He argued that school leaders should actively shape teaching status by setting clear instructional goals, supporting pedagogical innovation, and promoting the consistent use of high-quality instructional practices. Instruction-oriented management also involves monitoring teaching effectiveness, fostering professional learning communities, and providing targeted instructional support. According to Hallinger, such leadership practices directly contribute to improved teaching quality and student learning outcomes, particularly in contexts undergoing educational reform and innovation.

Harris (2021) further highlighted the importance of distributed leadership as a guiding principle of education management in complex and dynamic educational contexts. She argued that leadership should be shared among school leaders, teachers, and professional communities rather than concentrated in formal positions. This approach promotes professional collaboration, strengthens collective responsibility, and encourages the sharing of expertise and innovative practices.

Through distributed leadership, schools can enhance instructional improvement, foster organizational learning, and build adaptive capacity to respond effectively to ongoing educational change.

Hargreaves and O'Connor (2022) emphasized that continuous improvement is a fundamental principle of education management in knowledge-based societies characterized by rapid change and increasing complexity. They argued that schools should function as professional learning organizations that systematically use data analysis, reflective practice, and collaborative inquiry to evaluate performance and inform improvement strategies. Through sustained cycles of learning, feedback, and innovation, such organizations can enhance educational quality, strengthen professional capacity, and support long-term institutional development.

Schleicher (2023) further highlighted the growing importance of evidence-informed policy and practice in education management within increasingly complex education systems. He argued that effective education systems rely on systematic evaluation, international benchmarking, and data-driven decision-making to guide policy formulation and institutional reform. According to Schleicher, evidence-based governance enhances transparency and accountability, improves policy coherence and implementation effectiveness, and supports long-term educational improvement and system sustainability.

In summary, the literature indicates that the principles of education management have evolved from an initial emphasis on moral and people-oriented leadership toward more integrated approaches that incorporate strategic governance, instructional professionalism, distributed leadership, and continuous improvement. As discussed above, scholars consistently emphasize that effective education management should integrate ethical leadership, organizational development, professional empowerment, and evidence-based decision-making. Together, these interconnected principles provide a comprehensive theoretical foundation for understanding how education management can enhance educational quality, strengthen institutional capacity, and support sustainable development in increasingly complex educational contexts.

Factors affecting education management

In contemporary higher education, educational management is influenced by both internal organizational dynamics and external environmental pressures. Factors such as leadership, policy, funding, culture, and global competition interact to affect institutional effectiveness. The following discussion summarizes the main academic perspectives on these interacting forces.

Hallinger (2018) argued that leadership style is a critical internal factor influencing the effectiveness of education management. He defined leadership style as the pattern of behaviors, values, and decision-making approaches adopted by institutional leaders to guide organizational development and instructional improvement. In higher education institutions, leadership style is reflected in strategic vision setting, governance coordination, reform implementation, and faculty motivation mechanisms. Effective leadership can enhance organizational coherence, promote collaborative cultures, and facilitate the translation of strategic goals into operational practices, whereas weak or fragmented leadership may result in policy implementation gaps and managerial inefficiency.

Marginson (2019) argued that national policy environments exert a profound influence on education management practices in higher education. He defined the policy environment as the macro-level institutional and regulatory framework shaped by government priorities, funding arrangements, and accountability mechanisms. In university management, policy environments are reflected in governance structures, performance evaluation systems, quality assurance requirements, and strategic development orientations. These external constraints and incentives shape how universities allocate resources, design academic programs, and balance institutional autonomy with public accountability, thereby directly affecting the strategic capacity of education management.

Teichler (2020) argued that internationalization has become an increasingly important external factor influencing education management in higher education. He defined internationalization as the systematic integration of international, intercultural, and global dimensions into teaching, research, and institutional

governance. In education management practice, internationalization is reflected in international curriculum design, cross-border cooperation, faculty and student mobility policies, and global quality standards. This factor requires education managers to adopt more open, flexible, and globally oriented governance models to respond to international competition and collaboration pressures.

Jongbloed (2021) emphasized that funding mechanisms play a decisive role in shaping education management behavior and institutional priorities. He defined funding mechanisms as the rules, criteria, and models governing the allocation of public and private financial resources to higher education institutions. In education management practice, funding mechanisms are reflected in budget planning systems, performance-based financing, accountability requirements, and incentive structures. These mechanisms influence managerial autonomy, strategic decision-making, and institutional risk-taking capacity, thereby affecting universities' willingness and ability to pursue innovation-oriented reforms.

Enders (2022) argued that organizational culture constitutes a key internal factor affecting education management effectiveness. He defined organizational culture as the shared values, norms, beliefs, and behavioral expectations that shape organizational life within higher education institutions. In universities, organizational culture is reflected in faculty participation in governance, attitudes toward reform, interdepartmental collaboration, and openness to innovation. A supportive and innovation-oriented organizational culture can enhance the sustainability of education management reforms, whereas a conservative or fragmented culture may hinder institutional change and strategic implementation.

Altbach (2023) argued that intensifying global knowledge competition has become a major external force shaping education management strategies. He defined global knowledge competition as the rivalry among higher education institutions for academic reputation, research funding, high-level talent, and global influence. In education management, this competition is reflected in talent recruitment and retention policies, research evaluation systems, international ranking strategies, and institutional branding. These pressures compel universities to

strengthen strategic management capacity, optimize governance models, and continuously adjust development priorities to remain competitive in the global higher education landscape.

In summary, existing studies indicate that education management is influenced by a complex interaction of internal and external factors, including leadership style, policy environment, internationalization, funding mechanisms, organizational culture, and global knowledge competition. These factors jointly shape institutional governance structures, managerial decision-making processes, and the effectiveness of education management practices. Understanding these influencing factors provides an important theoretical foundation for analyzing how education management systems can be optimized to support sustainable institutional development and innovation-oriented talent cultivation.

Concepts and theories of strategy development

Regarding the discussion on strategy development, this section mainly focuses on the conceptual foundations and practical applications of strategy, including the definition of strategy in education management, the theoretical perspectives of strategy, and the methods and steps for formulating effective strategies. The specific contents are presented as follows.

Definition of strategy

Regarding education management strategy, various studies and scholars have put forward insights that highlight its significance in guiding institutional governance and promoting sustainable educational development, as follows.

Teece (2020) defined strategy as an organization's dynamic capability to integrate, build, and reconfigure internal and external resources in response to rapidly changing environments. From this perspective, strategy emphasizes adaptability, learning, and continuous renewal rather than static planning. In the context of education management, strategy refers the capacity of educational institutions to flexibly adjust governance structures, academic systems, and organizational models in response to technological change, policy reform, and

broader social development, and means a long-term orientation toward institutional renewal, innovation-driven growth, and sustainable transformation rather than routine administration or short-term operational efficiency.

Barney and Mackey (2021) conceptualized strategy as a long-term framework for achieving sustainable organizational advantage through the effective configuration and deployment of resources and institutional capabilities. From this perspective, strategy emphasizes alignment between internal strengths and external opportunities to ensure enduring performance. In education management, strategy refers the systematic planning and coordination of leadership structures, curriculum systems, faculty development, and institutional missions, and means using strategic thinking to cultivate distinctive academic strengths, enhance governance effectiveness, and maintain long-term competitiveness and relevance in a globalized and knowledge-driven education environment.

Grant (2021) defined strategy as a coherent and integrated set of decisions that determines how an organization positions itself within its external environment and allocates resources to achieve sustainable performance. This perspective emphasizes consistency, direction, and long-term orientation in strategic decision-making. In education management, strategy refers the process through which institutions articulate development visions, design governance mechanisms, and allocate educational resources, and means providing a clear long-term roadmap that links institutional vision with operational action, supports continuous improvement, and ensures sustainable educational advancement.

Rumelt (2022) argued that strategy is a guiding policy supported by a coherent set of actions designed to address complex and critical organizational challenges. Rather than abstract planning, strategy emphasizes clear problem diagnosis and focused responses. In education management, strategy refers a problem-oriented governance framework that prioritizes the identification of institutional weaknesses and the formulation of guiding principles, and means implementing coordinated reform actions to address key challenges such as

curriculum reform, talent cultivation, quality assurance, and digital transformation, thereby enhancing institutional effectiveness and sustainability.

Wheelen, Hunger, Hoffman, and Bamford (2022) defined strategy as a comprehensive master plan that explains how an organization achieves its mission and objectives through the integrated design of policies, programs, and resource allocation. This perspective highlights the coordinating and guiding role of strategy in complex organizations. In education management, strategy refers a long-term development blueprint that directs institutional planning, academic priority setting, and governance reform, and means aligning institutional operations with national education policies, evolving social needs, and global educational trends to enhance strategic coherence and sustainable development.

Dess, McNamara, Eisner, and Lee (2023) conceptualized strategy as a set of commitments and coordinated actions designed to exploit core competencies and achieve sustainable organizational advantage. This view emphasizes deliberate choices and capability development as the foundation of long-term success. In education management, strategy refers how educational institutions cultivate distinctive academic disciplines, strengthen faculty development systems, enhance research capacity, and promote international cooperation, and means serving as a guiding framework for institutional positioning, academic excellence, reputation building, and long-term competitiveness in the global higher education landscape.

In summary, existing studies suggest that strategy development in education management refers to a systematic and evidence-based process through which educational institutions diagnose status, identify key factors, and formulate coherent courses of action, and means the structured transformation of analysis into clear visions, goals, and implementable measures. Across the literature, it is understood as a dynamic process integrating internal strengths and weaknesses with external opportunities and challenges, often operationalized through tools such as SWOT, PEST, and related strategic matrices. From this perspective, it emphasizes problem diagnosis, component analysis, and coordinated decision-making rather than abstract governance principles. In educational contexts, it helps align management actions

with educational objectives, supporting improvement of students' sustainable innovation ability and optimization of educational management practices.

Components of strategy

Scholars have extensively examined the structural components and implementation logic of education management strategy in contemporary higher education systems. They emphasize that strategic effectiveness depends on the coherent alignment of vision, mission, goals, operational measures, and governance mechanisms. The following perspectives illustrate how strategic intent is translated into institutional practice to support sustainable development and innovation.

Mintzberg (2019) argued that education management strategy is built around long-term strategic intent reflecting institutional vision and mission, supported by organizational structures and management processes. He emphasized that strategic goals should be translated into operational measures embedded in institutional routines, while implementation guidelines help ensure consistency between strategic planning and everyday academic and administrative practices, thereby sustaining long-term institutional development.

Ferlie, Musselin, and Andresani (2020) noted that effective education management strategy integrates institutional vision, mission, and clearly defined goals with governance arrangements and leadership mechanisms. They argued that specific measures and well-designed implementation guidelines are essential for balancing managerial authority, academic autonomy, and accountability, enabling universities to maintain stability while pursuing innovation and reform.

Jarzabkowski (2021) proposed that education management strategy encompasses vision setting, mission clarification, goal formulation, and operational measures developed through continuous strategy formulation, implementation, and enactment. She highlighted that implementation guidelines often emerge from everyday academic collaboration, curriculum coordination, and administrative decision-making, shaping how strategy is actually practiced within institutions.

Paradeise, Reale, Goastellec, and Bleiklie (2021) emphasized that universities establish strategic vision, mission, and goals to position themselves within national

and global higher education systems. They argued that resource governance, institutional differentiation, operational measures, and implementation guidelines collectively influence how institutions allocate resources, enhance competitiveness, and achieve sustainable development.

Christensen, Raynor, and McDonald (2022) stressed that education management strategy should articulate a clear vision and mission while defining achievable strategic goals supported by innovation-oriented measures. They emphasized that flexible implementation guidelines allow institutions to respond to technological change, diversify educational pathways, and continuously strengthen their innovation capacity.

Kezar (2023) highlighted that strategic vision, mission alignment, and goal setting must be reinforced by concrete measures and practical implementation guidelines emphasizing stakeholder coordination, cultural alignment, and change management. She argued that without such alignment, strategies may remain symbolic rather than producing substantive educational transformation.

Su Xi (2025) summarized that core strategic components typically include vision, mission, goals, operational measures, performance indicators, and guidelines for implementation. These elements together form a systematic framework that supports coherent decision-making, effective resource allocation, and sustainable institutional development in education management contexts.

Based on the literature review above, it can be concluded that the components of strategy serve as a fundamental pillar in defining the direction of educational management. This process begins with the establishment of a Vision and Mission to create a clear institutional identity and align the scope of operations. Implementing the vision effectively necessitates defining concrete Goals to ensure that students receive entrepreneurial skill development that addresses the needs of modern society and the labor market. Meanwhile, Measures (indicators or operational actions) function as key mechanisms for monitoring and evaluating success, which aligns with the framework of Su Xi et al. (2025) that emphasizes the importance of an effective evaluation system for sustainability. Consequently, these four components

possess a systemic relationship that assists institutions in allocating internal resources and adapting to external environmental factors efficiently. This ultimately leads to the achievement of the primary objective: cultivating a new generation of entrepreneurs with competitive capabilities and stable long-term growth.

The theoretical basis of the components of the strategy

Education management strategy is commonly structured around five core components-Vision, Mission, Goals, Measures, and Implementation Guidelines. This classification is not arbitrary; rather, it reflects an integrated consensus drawn from classical strategic management theory and contemporary higher-education management research. The theoretical foundations can be explained from several complementary perspectives:

Etzkowitz (2018) argued that higher-education strategy refers to universities' positioning within innovation ecosystems linking academia, industry, and government, and means coordinated vision, mission, goals, and collaborative measures that support innovation capacity development. Implementation Guidelines facilitate institutional partnerships, applied research engagement, and talent cultivation, strengthening universities' roles in economic and technological development, regional competitiveness, and long-term knowledge-based societal transformation.

Mintzberg (2019) argued that strategy refers to long-term direction, organizational positioning, and consistent patterns of action, and means an integrated framework linking institutional aspirations with operational practices. This hierarchical perspective explains why Vision and Mission represent macro-level orientation, Goals function as intermediary operational targets, and Measures together with Implementation Guidelines translate strategic intent into daily institutional activities, ensuring coherence between strategic planning and educational practice.

Drucker (2020) emphasized that strategy refers to a goal-oriented managerial process and means the transformation of institutional purpose into actionable objectives. Within education management, Vision and Mission provide value orientation, Goals clarify expected outcomes, while Measures and Implementation

Guidelines ensure systematic execution, accountability, and performance monitoring, thereby supporting continuous educational improvement.

Kaplan (2021) suggested that effective strategy refers to the alignment of vision, objectives, performance indicators, and execution mechanisms, and means a measurable and monitorable strategic process. In higher education contexts, this justifies incorporating measurable Measures and clear Implementation Guidelines to ensure institutional effectiveness, sustainable innovation development, and evidence-based educational decision-making, continuous performance improvement, accountability transparency, and long-term strategic adaptability within complex governance systems.

Jarzabkowski (2021) proposed that strategy refers not only to formal planning documents but also to everyday organizational practices, and means a dynamic process enacted through academic collaboration, administrative routines, and institutional culture. Accordingly, Measures and Implementation Guidelines are essential components because they operationalize strategic intent and ensure that educational strategies produce tangible learning and innovation outcomes across diverse institutional contexts and stakeholder groups.

Taken together, the division of educational management strategy into Vision, Mission, Goals, Measures, and Implementation Guidelines fonts the combined insights of hierarchical strategic logic, goal-oriented management theory, performance execution frameworks, strategy-as-practice perspectives, and innovation ecosystem theory. This five-component structure ensures both conceptual clarity and operational feasibility, enabling higher-education institutions to align long-term direction with actionable measures and enhance students' sustainable innovation capability.

SWOT, PEST analysis and TOWS Matrix

In contemporary education management, strategic planning requires systematic tools that integrate internal capacity assessment with external environmental analysis. Frameworks such as SWOT, PEST, and the TOWS Matrix provide structured and evidence-based approaches for diagnosing institutional

conditions, identifying environmental influences, and translating analytical insights into actionable development strategies. The following sections review key scholarly perspectives on the definitions and procedural steps of these strategic instruments within higher education governance and sustainable institutional development.

SWOT Analysis

Definition of SWOT analysis

Regarding education management strategy, various scholars have explored the application of SWOT analysis and highlighted its value in supporting institutional governance, strategic planning, and sustainable development. These perspectives reflect the importance of SWOT analysis as a systematic analytical tool for diagnosing internal capacity and external environments in educational institutions, as follows.

Marginson (2020) argued that SWOT analysis refers a strategic evaluation framework applied in education management to examine institutional capacity and external policy environments, and means a systematic approach for understanding how internal governance structures, resource status, and academic performance interact with broader forces such as globalization, international competition, and policy reform. In higher education management, SWOT analysis not only supports long-term strategic planning and clarifies institutional positioning but also means strengthening universities' ability to balance institutional autonomy with external accountability in increasingly complex policy environments.

Altbach, Reisberg, and Rumbley (2020) stated that SWOT analysis refers an institutional diagnostic tool in higher education management used to evaluate organizational strengths and weaknesses in relation to external challenges, and means providing decision-makers with a structured basis for identifying development opportunities while anticipating and managing risks. Through this analytical approach, university leaders can respond more effectively to pressures arising from internationalization, funding constraints, demographic change, and regulatory uncertainty, thereby enhancing institutional resilience and long-term sustainability.

Teichler (2021) explained that SWOT analysis refers a structured strategic method for assessing internal management systems alongside external educational

environments, and means a comprehensive review mechanism that enables education administrators to evaluate institutional performance, academic structures, governance efficiency, and policy contexts in an integrated manner. Consequently, SWOT analysis plays a key role in evidence-based decision-making, as it means supporting informed strategic reform, adaptive governance, and continuous improvement within education systems.

Salmi (2021) emphasized that SWOT analysis refers a comprehensive strategic planning instrument in education management used to diagnose institutional competitiveness and development capacity, and means integrating analyses of organizational resources, leadership capabilities, and external demands into coherent strategic insights. In higher education governance, SWOT analysis therefore means enabling education leaders to design targeted development strategies that support excellence initiatives, capacity building, and institutional upgrading in highly competitive and reform-oriented environments.

Jongbloed, Enders, and Salerno (2022) argued that SWOT analysis refers a strategic management framework applied at both institutional and system levels to evaluate governance arrangements and stakeholder relationships, and means aligning institutional missions with funding mechanisms, accountability systems, and societal expectations. As a result, SWOT analysis has become an important tool for strategic steering and policy coordination, and means facilitating system-level reform and sustainable development in contemporary education management.

Based on the literature reviewed above, education management strategy can be understood as a systematic and multi-level framework integrating vision, mission, goals, operational measures, and implementation guidelines. Vision and mission provide the fundamental direction and institutional identity that shape long-term development priorities, while strategic goals translate these aspirations into concrete and achievable developmental targets. Operational measures function as practical mechanisms for implementation, evaluation, and adjustment, ensuring that strategic intentions can be effectively operationalized. Meanwhile, guidelines for implementing strategies in educational institutions offer procedural direction, coordination

principles, and governance support that facilitate the alignment of organizational structures, academic activities, and resource allocation with strategic objectives. Together, these interrelated components enhance institutional coherence, strengthen innovation capacity cultivation, improve organizational adaptability to external environmental changes, and ultimately support the sustainable and high-quality development of higher education institutions.

Steps to create strategies in SWOT analysis

Regarding education management strategy, various scholars have explored the application of SWOT analysis and highlighted its value in guiding institutional governance, strategic planning, and sustainable development. These perspectives emphasize the importance of a systematic process for transforming SWOT analysis into practical management strategies in educational institutions, as follows.

Sammons, Kington, and Day (2020) proposed that the first step in creating strategies through SWOT analysis is to conduct a comprehensive internal institutional review focusing on leadership quality, teaching effectiveness, governance capacity, and organizational culture. This process is followed by systematically scanning the external educational environment, including policy reforms, technological change, demographic shifts, and evolving social expectations. Through this multi-dimensional diagnosis, education managers are better able to identify performance gaps, anticipate future challenges, and design development strategies that enhance institutional effectiveness, adaptability, and long-term organizational resilience.

Caldwell (2020) emphasized that strategy creation through SWOT analysis begins with clearly identifying core organizational strengths and management weaknesses within educational institutions, such as leadership capacity, resource efficiency, and internal coordination mechanisms. The next step involves analyzing external opportunities and threats arising from funding systems, accountability frameworks, policy pressures, and market competition. By integrating internal and external findings, education leaders can formulate governance and development strategies that improve decision-making quality, optimize resource allocation, and promote institutional sustainability and stable long-term growth.

Levin (2021) argued that SWOT-based strategy development should follow a problem-oriented and action-focused process. The first step is institutional self-assessment, concentrating on management structures, curriculum systems, faculty capacity, and student support mechanisms. The second step involves environmental scanning, particularly higher education policy trends, labor market demands, and societal expectations. The final step is strategic design, where education managers translate SWOT findings into targeted reform plans, implementation pathways, and evaluation mechanisms that directly address identified weaknesses and risks.

Marginson and Considine (2021) argued that strategic formulation in higher education, when informed by SWOT analysis, begins with evaluating internal academic and administrative systems, including governance effectiveness, disciplinary structures, leadership capacity, resource allocation, and quality assurance. This assessment helps institutions identify strengths and structural limitations shaping their potential. The next step analyzes the external environment, such as globalization pressures, international competition, technological change, and policy frameworks. By integrating internal and external analyses, education managers can develop coherent strategies that enhance positioning, support differentiation, improve visibility, and strengthen long-term competitiveness and sustainability.

Tomlinson (2022) further proposed that SWOT-based strategy formulation begins with systematically diagnosing institutional strengths in teaching quality, research capacity, and governance performance through comprehensive data analysis and stakeholder consultation. The second step involves identifying external risks and emerging opportunities closely linked to graduate employability, industry collaboration, technological transformation, and broader social and economic development trends at national and global levels. The final step is strategic integration, where education leaders strategically align institutional missions, development priorities, and long-term objectives with evolving labor market needs and dynamic societal expectations, ensuring both sustained relevance, strategic coherence, long-term institutional sustainability, and continuous adaptive capacity enhancement.

In summary, the above studies demonstrate that creating strategies through SWOT analysis in education management is a structured, iterative, and evidence-based process involving institutional self-assessment, comprehensive environmental scanning, strategic integration, and systematic action planning across multiple governance levels. As discussed, scholars consistently emphasize that SWOT analysis helps education managers clarify strategic priorities, balance internal capacity with evolving external demands, and enhance governance effectiveness, organizational learning, and policy coordination. These perspectives provide a robust and reliable methodological foundation for applying SWOT analysis in education management strategy formulation, performance monitoring, and continuous improvement processes, and for supporting sustainable, adaptive, and resilient institutional development in increasingly complex, uncertain, and rapidly changing educational environments at both regional and national scales.

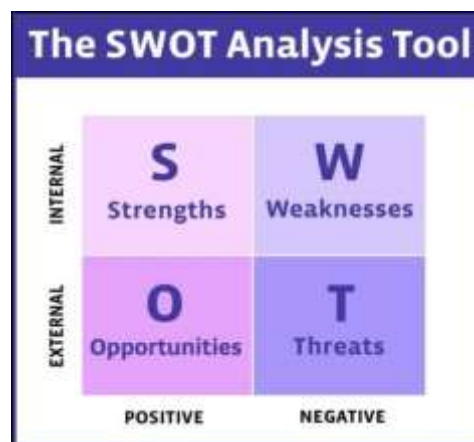


Figure 2.1 SWOT analysis

PEST Analysis

Definition on PEST analysis

Regarding education management strategy, various scholars have emphasized the importance of PEST analysis as a macro-environmental analytical tool for understanding external influences on institutional governance and long-term

development. These perspectives highlight the value of PEST analysis in supporting strategic planning and decision-making in educational institutions, as follows.

Yüksel (2020) explained that PEST analysis refers a macro-environmental scanning framework used to examine political, economic, social, and technological factors affecting organizational development, and means a systematic approach through which education managers can identify external forces shaping institutional strategies, governance priorities, and long-term planning. In education management, PEST analysis therefore means anticipating policy shifts, funding changes, social expectations, and technological disruptions, thereby supporting strategic foresight, proactive adjustment, and effective risk management.

Narayanan and Fahey (2020) argued that PEST analysis refers a structured tool for analyzing the broader external environment in which educational institutions operate, and means enabling education managers to evaluate how political regulations, economic trends, social transformation, and technological innovation influence institutional decision-making and strategic flexibility. By clarifying the interaction between macro-level forces and institutional behavior, PEST analysis means strengthening policy analysis, improving environmental awareness, and enhancing the strategic responsiveness of education management systems.

Morrison (2021) stated that PEST analysis refers an environmental scanning model designed to assess macro-level contextual factors influencing organizational performance, and means providing educational institutions with a forward-looking mechanism to anticipate external risks and emerging opportunities. Through this model, education managers are able to respond proactively through adaptive governance arrangements and innovation-oriented strategies, which means that PEST analysis functions as a core component of strategic management in education systems, especially during periods of rapid policy change and technological advancement.

Grant (2021) emphasized that PEST analysis refers a systematic framework for examining external environmental dynamics across political, economic, social, and technological dimensions, and means helping education leaders understand

uncertainty, complexity, and long-term trends in the external environment. In this sense, PEST analysis means supporting forward-looking strategic planning, informed decision-making, and coherent development pathway selection, and is therefore widely applied in education management research to guide institutional reform agendas and resource planning.

Cummings and Angwin (2022) further proposed that PEST analysis refers a comprehensive external analysis tool for evaluating the macro-environmental forces shaping organizational competitiveness and sustainability, and means enabling educational institutions to align development strategies with policy evolution, economic restructuring, social change, and digital transformation. Consequently, PEST analysis means serving as a fundamental method for environmental scanning, strategic alignment, and risk assessment in contemporary education management.

In summary, the above studies demonstrate that PEST analysis serves as a systematic, anticipatory, and integrative framework for examining the political, economic, social, and technological environments influencing education management. As discussed, scholars consistently emphasize that PEST analysis supports environmental scanning, strategic forecasting, risk identification, and institutional positioning in complex and dynamic contexts. These perspectives provide a robust theoretical foundation for applying PEST analysis in education management strategy and for enhancing the adaptability and sustainability of educational institutions.

Steps of formulating strategy in PEST analysis

Regarding education management strategy, scholars have emphasized that PEST analysis offers a systematic framework for examining external environments and translating macro-level insights into institutional development strategies. The following perspectives illustrate the main steps involved in formulating strategy through PEST analysis.

Camilleri (2020) proposed that the first step in formulating strategy through PEST analysis is to conduct a comprehensive scan of political regulations, economic conditions, social change, and technological development affecting educational

institutions. This step emphasizes systematically identifying macro-environmental factors shaping institutional contexts. The second step evaluates how these factors influence governance, teaching models, and organizational structures, highlighting interaction between external environments and internal management systems. The final step translates environmental insights into strategic objectives guiding long-term planning, ensuring decisions are forward-looking and context-sensitive.

Hittmár, Varmus, and Lendel (2021) argued that strategy formulation using PEST analysis begins with identifying key macro-environmental drivers shaping the education system, such as policy reform, digital transformation, and labor market change. These drivers serve as critical reference points for understanding systemic change and long-term structural evolution in education. The next step is to assess the opportunities and risks created by these drivers, enabling education managers to anticipate potential constraints and leverage emerging development space. Education managers then integrate these findings into strategic planning processes to design adaptive, evidence-based, and forward-looking development strategies that enhance institutional flexibility, competitiveness, and responsiveness.

Rastogi and Trivedi (2021) suggested that the formulation of strategy through PEST analysis follows a structured three-stage process. The first stage is environmental diagnosis, focusing on political, economic, social, and technological trends that significantly influence institutional development and long-term sustainability. The second stage is strategic interpretation, where education leaders analyze the implications of these trends for institutional missions, governance models, and development priorities within dynamic policy contexts. The final stage is strategic design, which aligns institutional development pathways with external environmental conditions, ensuring coherence between strategic intent and contextual realities while enhancing adaptability and strategic effectiveness.

Papulová and Papula (2022) emphasized that strategy formulation through PEST analysis starts with systematic data collection on policy frameworks, economic growth patterns, social expectations, and technological innovation. This process ensures that strategic planning is grounded in evidence rather than assumptions. The

second step involves synthesizing environmental information into strategic insights, supporting informed judgment and strategic clarity. The final step is strategic integration, where education managers align institutional resources, organizational capabilities, and development goals with long-term strategic objectives, thereby enhancing implementation effectiveness.

Rajnoha and Lesníková (2023) further argued that PEST-based strategy formulation begins with mapping macro-environmental trends and uncertainties across political, economic, social, and technological dimensions. This approach highlights the importance of recognizing both stable trends and potential disruptions. The next step is impact assessment, which evaluates how these forces affect institutional competitiveness, governance effectiveness, and long-term development capacity. The final step is strategic choice, where education leaders select development pathways that enhance institutional resilience, adaptability, and sustainable growth in complex and highly uncertain environments.

In summary, the above studies demonstrate that formulating strategy through PEST analysis in education management is a structured and systematic process involving environmental scanning, impact assessment, strategic interpretation, and strategic integration. As discussed, scholars consistently emphasize that PEST analysis enables education managers to understand macro-level political, economic, social, and technological forces and to translate these external insights into coherent institutional development strategies aligned with long-term vision and governance priorities. These perspectives provide a solid methodological foundation for applying PEST analysis as a strategic planning tool in education management and support its relevance, flexibility, and practical applicability in increasingly dynamic and uncertain educational contexts.



Figure 2.2 PEST Analysis

TOWS Matrix Analysis

Definition of TOWS Matrix

Regarding education management strategy, scholars have increasingly emphasized the importance of the TOWS Matrix as a systematic strategic planning instrument for transforming environmental analysis into institutional development strategies. These perspectives highlight the value of the TOWS Matrix in supporting evidence-based governance and long-term educational planning, as follows.

Kaufman and Herman (2018) explained that the TOWS Matrix refers a strategic planning framework that links an organization's internal strengths and weaknesses with external opportunities and threats, and means providing a systematic mechanism for transforming environmental analysis into strategic action. This framework means that education managers are able to formulate proactive and targeted development strategies by aligning institutional capabilities, governance capacity, and resource endowment with changing environmental status. In education management, the TOWS Matrix therefore means supporting rational institutional planning, strategic prioritization, and continuous organizational improvement.

Hill and Westbrook (2019) stated that the TOWS Matrix refers an analytical model that systematically combines internal and external environmental factors to generate strategic options, and means enabling educational institutions to explore multiple strategic pathways under different development scenarios. This model means that institutions can design growth-oriented strategies, reform-oriented

strategies, and risk-avoidance strategies according to their specific strengths, weaknesses, and external pressures. As a result, the TOWS Matrix means providing a structured and flexible foundation for strategic choice and governance optimization in education management.

Pahl and Richter (2020) argued that the TOWS Matrix refers a decision-support tool that transforms situational analysis into concrete strategic choices, and means assisting education leaders in prioritizing development initiatives based on institutional resources, organizational capabilities, and external constraints. Through this tool, education managers are able to evaluate strategic feasibility, balance risks and opportunities, and allocate resources more effectively. Therefore, the TOWS Matrix means playing an important role in strategic planning, policy coordination, and institutional governance within education systems.

Coulter (2021) emphasized that the TOWS Matrix refers a strategic formulation technique that integrates organizational diagnosis with environmental scanning, and means facilitating the translation of analytical insights into sustainable development strategies. This technique means that education managers can move beyond descriptive analysis toward actionable strategic design, ensuring that institutional development plans are coherent, evidence-based, and context-sensitive. In education management research, the TOWS Matrix therefore means serving as an essential instrument for long-term institutional development and strategic renewal.

Eden and Ackermann (2022) further proposed that the TOWS Matrix refers a structured strategic framework that supports the generation, comparison, and evaluation of alternative strategies, and means enhancing the quality and rationality of strategic decision-making through systematic internal–external matching. This framework means that educational institutions can strengthen strategic coherence, improve governance effectiveness, and respond more flexibly to environmental uncertainty. Consequently, the TOWS Matrix means becoming a core component of modern education management strategy and institutional development planning.

In summary, the above studies demonstrate that the TOWS Matrix serves as a systematic and integrative strategic framework for education management. As

discussed, scholars consistently emphasize that the TOWS Matrix supports the transformation of environmental analysis into actionable institutional strategies by aligning internal capacities with external status. These perspectives provide a solid theoretical foundation for applying the TOWS Matrix in education management strategy.

Steps in developing the strategy in the TOWS analysis

Regarding strategic planning and decision-making, scholars have emphasized that the TOWS Matrix offers a structured pathway for transforming situational analysis into concrete strategic actions. The following perspectives illustrate the main steps involved in developing strategy through TOWS analysis.

Ferrell and Hartline (2020) proposed that the first step in developing strategy through the TOWS Matrix is to conduct a comprehensive assessment of internal strengths and weaknesses together with external opportunities and threats. This step emphasizes the importance of obtaining a holistic understanding of both organizational capabilities and environmental status. The second step is to construct the four strategic combinations (SO, WO, ST, and WT) in order to generate alternative development options, allowing organizations to explore proactive, corrective, defensive, and adaptive strategic paths. The final step involves evaluating these strategic alternatives and selecting the most appropriate option based on organizational objectives, resource capacity, and risk tolerance, thereby ensuring strategic feasibility and alignment.

Dess, McNamara, Eisner, and Lee (2021) argued that strategy development using the TOWS Matrix begins with systematic environmental scanning and organizational diagnosis. This stage helps decision-makers identify critical trends, constraints, and internal performance gaps. This is followed by the systematic matching of internal capabilities with external status to create a set of strategic alternatives that balance opportunity exploitation with risk mitigation. The final step is strategic selection, where decision-makers prioritize strategies that enhance organizational competitiveness, adaptability, and long-term sustainability in dynamic environments.

Ireland, Hoskisson, and Hitt (2021) proposed that TOWS-based strategy development follows a systematic and iterative three-stage logic integrating analysis, choice, and control. This process begins with strategic diagnosis, identifying key internal strengths and weaknesses alongside external opportunities and threats to clarify organizational positioning, resource status, and environmental uncertainty. Building on this diagnosis, strategy formulation emphasizes constructing SO, WO, ST, and WT strategies by matching internal capabilities with external conditions, generating diversified and context-sensitive options that balance growth, adaptation, risk control, and stability. The process concludes with strategy evaluation and selection, assessing feasibility, consistency, and sustainability in relation to organizational mission, long-term goals, governance capacity, and resource constraints, while incorporating feedback mechanisms to support continuous learning and effective execution.

Wheelen, Hunger, Hoffman, and Bamford (2022) emphasized that developing strategy through the TOWS Matrix requires a sequential process of situation analysis, strategy generation, and strategic choice. The first step is to analyze organizational strengths, weaknesses, opportunities, and threats in a structured manner to clarify strategic positioning. The second step is to design alternative strategies through TOWS matching, encouraging creative yet disciplined strategic thinking. The final step is to choose the most feasible and sustainable strategy based on organizational resources, institutional constraints, and external uncertainties, ensuring practical applicability.

De Wit and Meyer (2023) further argued that strategy development using the TOWS Matrix starts with identifying key strategic issues derived from comprehensive environmental and organizational analysis. The next step is to develop alternative strategies through internal–external factor matching, which enables organizations to address strategic tensions and trade-offs. The final step is strategic integration, where the selected strategy is embedded into organizational planning, governance structures, and performance management systems, ensuring consistency between strategic intent and operational execution.

In summary, the above studies demonstrate that developing strategy through the TOWS Matrix is a systematic process encompassing situational diagnosis, internal–external factor matching, strategic option generation, and rational selection. Existing research highlights that the TOWS framework goes beyond descriptive analysis by translating strengths, weaknesses, opportunities, and threats into actionable strategic pathways, including growth-oriented, improvement-oriented, defensive, and risk-avoidance strategies. Moreover, scholars emphasize that the TOWS Matrix supports strategic coherence by aligning organizational capabilities with environmental demands while balancing long-term goals and short-term constraints. In education management, these insights indicate that the TOWS Matrix offers a robust analytical tool for guiding institutional positioning, governance reform, and sustainable development under conditions of policy uncertainty, resource competition, and educational transformation.



Figure 2.3 TOWS Analysis

Evaluation of educational management strategies

Scheerens (2019) argued that the evaluation of educational management strategies refers to a systematic assessment of how strategic planning, organizational processes, and management practices contribute to institutional effectiveness. From this perspective, evaluation means examining the consistency between strategic goals, implementation mechanisms, and educational outcomes. In education

management, strategic evaluation emphasizes effectiveness, efficiency, and coherence as core criteria for judging long-term institutional development.

De Boer, Enders, and Leisyte (2020) explained that the evaluation of educational management strategies refers to an analytical process that assesses governance arrangements, accountability mechanisms, and managerial autonomy within higher education systems. This evaluation means identifying how strategic management approaches influence institutional responsiveness, performance improvement, and system coordination. They emphasized that strategy evaluation is essential for understanding the balance between state regulation and institutional self-governance.

Hitt, Ireland, and Hoskisson (2021) proposed that the evaluation of educational management strategies refers to the assessment of strategic decisions and resource configurations in relation to organizational performance and sustainability. In education management, this evaluation means analyzing whether leadership strategies, resource allocation, and capability development effectively support innovation, competitiveness, and long-term growth. Strategic evaluation thus serves as a bridge between managerial decision-making and institutional outcomes.

Pashiardis and Brauckmann (2022) argued that the evaluation of educational management strategies refers to a multidimensional examination of leadership vision, strategic actions, and contextual adaptation. This evaluation means assessing how management strategies respond to environmental complexity, policy change, and stakeholder expectations. In educational organizations, strategy evaluation highlights adaptability, learning capacity, and strategic alignment as key indicators of management effectiveness.

Kaplan and Norton (2022) emphasized that the evaluation of educational management strategies refers to a performance-oriented framework that links strategic objectives with measurable outcomes. This evaluation means using balanced indicators—such as learning quality, internal processes, stakeholder satisfaction, and institutional development—to assess strategy implementation. In

education management, such evaluation frameworks help transform abstract strategies into operational and assessable practices.

Scott (2023) further argued that the evaluation of educational management strategies refers to a reflective and developmental process that examines how strategies shape institutional culture, innovation capacity, and long-term resilience. This evaluation means focusing not only on short-term performance indicators but also on the sustainability and transformative impact of management strategies. From this perspective, strategic evaluation supports continuous organizational learning and sustainable educational development.

In summary, the evaluation of educational management strategies refers to a systematic and multidimensional process for assessing how effectively strategic goals, governance mechanisms, resource allocation, and implementation practices are aligned within educational institutions, and means examining not only short-term managerial efficiency but also long-term institutional development and sustainability. Existing studies consistently suggest that effective evaluation should integrate outcome performance, process quality, stakeholder participation, and adaptive capacity, emphasizing whether education management strategies can respond to policy change, social demand, and technological transformation. From a higher education perspective, such evaluation means determining the extent to which management strategies support innovation-oriented teaching, organizational learning, and the sustainable cultivation of students' innovation abilities. Taken together, these insights indicate that strategy evaluation serves as a critical bridge between educational policy intentions and institutional practice, providing an essential analytical foundation for improving education management quality and promoting sustainable innovation-driven development.

Concepts and theories of innovation ability

In the context of innovation-driven development and the transformation of higher education, innovation ability has become a core indicator for measuring the quality of talent cultivation in universities. Cultivating college students' innovation ability is not only a key requirement for national development strategies, but also an essential goal of higher education reform. Therefore, clarifying the concept, components, and evaluation of innovation ability provides an important theoretical foundation for understanding how universities can effectively foster students' sustainable innovation competence.

Definition of innovation ability

In the context of innovation-driven development and the transformation of higher education, cultivating college students' innovation ability has become a central objective of university education. Scholars have increasingly explored the conceptual connotation and developmental mechanisms of innovation ability among university students, emphasizing its importance for talent cultivation, technological advancement, and sustainable social development. The main definitions are presented as follows.

Liu and Wang (2020) argued that college students' innovation ability refers to their capacity to generate original ideas and apply them effectively in both academic and practical contexts. This ability means that university students are capable of integrating disciplinary knowledge with creative thinking, analytical reasoning, and problem-solving skills, enabling them to transform theoretical learning into innovative solutions and tangible outcomes. From a higher education perspective, innovation ability reflects students' potential to participate in scientific research, technological development, and entrepreneurial practice, and it also indicates their readiness to respond to complex societal challenges and emerging technological demands.

He and Zhang (2021) stated that college students' innovation ability refers to a comprehensive competence that combines creative cognition, critical thinking, and technological application. This competence means that students are able to identify problems in real-world situations, analyze complex and uncertain challenges, and

design innovative approaches through interdisciplinary learning and knowledge integration. In university education, innovation ability is regarded not only as a key outcome of talent cultivation but also as an important indicator of students' future employability, adaptability, and long-term competitiveness in innovation-driven economies.

Qin and Zhao (2021) proposed that college students' innovation ability refers to a dynamic capability to explore, experiment, and create new knowledge through inquiry-based learning and research practice. This capability means that students can actively engage in scientific exploration, question existing assumptions, challenge conventional ideas, and continuously generate innovative outcomes through iterative learning and experimentation. In higher education, innovation ability is closely associated with students' participation in research projects, innovation competitions, academic forums, and open innovation platforms that encourage independent inquiry and creative exploration.

Tang and Xu (2022) defined college students' innovation ability as an integrated capacity that refers to the effective combination of creativity, innovation awareness, and execution competence. This capacity means that students are not only able to propose novel ideas but also capable of transforming these ideas into feasible products, technological solutions, or entrepreneurial projects through planning, collaboration, and implementation. Universities therefore play a crucial role in cultivating innovation ability by providing practice-oriented curricula, innovation laboratories, incubation platforms, and opportunities for collaboration with industry and research institutions.

Gao and Feng (2023) emphasized that college students' innovation ability refers to their ability to integrate interdisciplinary knowledge and technological resources to solve complex problems in creative and effective ways. This ability means that students can engage in collaborative innovation, apply digital technologies and emerging tools, and participate in project-based and problem-based learning to develop innovative products, services, or solutions. From the perspective of higher education reform, innovation ability represents a core

competence for cultivating future-oriented talents who can adapt to rapid technological change and societal transformation.

Peng and Luo (2024) further argued that college students' innovation ability refers to a multidimensional competence encompassing idea generation, innovation design, and innovation implementation. This competence means that students are capable of transforming abstract concepts into concrete innovations through experimentation, design thinking, iterative improvement, and reflective learning. In universities, innovation ability is closely linked to students' involvement in innovation and entrepreneurship education, scientific research training, interdisciplinary project development, and real-world problem-solving activities, which together form an integrated pathway for sustainable innovation capability development.

In summary, existing studies indicate that college students' innovation ability refers a multidimensional competence integrating creative thinking, critical analysis, interdisciplinary knowledge application, and practical execution, and means the capacity to transform ideas and knowledge into effective solutions through inquiry, experimentation, and collaboration. Scholars widely agree that this ability is cultivated in authentic academic and real-world contexts, particularly through research participation and project-based learning. As a core outcome of higher education, college students' innovation ability reflects their adaptability to technological change, problem-solving capacity in complex environments, and long-term competitiveness in innovation-driven and knowledge-based economies.

Components of the innovation ability

Innovation ability is widely recognized as a core competence for college students in innovation-driven and knowledge-based economies. Rather than a single skill or outcome, existing literature conceptualizes innovation ability as a composite capability formed through multiple interrelated elements. Clarifying its components is therefore essential for understanding how college students' innovation ability develops and how it can be effectively cultivated in higher education. Accordingly, the following review synthesizes key studies that conceptualize innovation ability in terms of its constituent components.

Amabile (1996) conceptualized innovation ability as a multi-component construct composed of domain-relevant knowledge and skills, creativity-relevant cognitive processes, and intrinsic motivation. In the context of higher education, this framework suggests that college students' innovation ability includes not only mastery of disciplinary knowledge but also the capacity for flexible thinking, problem redefinition, and original idea generation. Intrinsic motivation is viewed as a critical internal component that sustains students' long-term engagement in innovative activities. From this perspective, innovation ability is understood as an integrated capability formed through the interaction of cognitive, motivational, and skill-based components rather than a single creative outcome.

Bandura (1997) emphasized self-efficacy as a central psychological component of human agency and innovative behavior. Applied to college students, innovation ability is partly composed of students' beliefs in their capacity to generate novel ideas, cope with uncertainty, and persist in complex and challenging tasks. Innovation self-efficacy enables students to take intellectual risks and maintain effort in the face of failure, which is essential for innovative practice. This perspective highlights that innovation ability includes stable psychological traits that support confidence, self-regulation, and sustained creative action.

Zhou (2012) examined creativity and innovation development in educational contexts and argued that students' innovation ability consists of both internal creative potential and the ability to transform ideas into practical outcomes. He identified creative thinking, problem identification, and idea implementation as core components of innovation competence. In higher education, this implies that innovation ability involves not only divergent idea generation but also analytical evaluation, iterative refinement, and application-oriented skills. Zhou's work underscores the structural and process-oriented nature of innovation ability.

Hu and Adey (2012) developed a model of scientific creativity and argued that students' innovation ability consists of creative thinking skills, domain-specific knowledge, and task engagement. Their model emphasizes that innovation ability emerges from the coordinated development of cognitive abilities, knowledge

foundations, and motivational involvement in learning tasks. In the context of higher education, this suggests that college students' innovation ability is a composite capability integrating intellectual processes, disciplinary understanding, and active participation in innovation-related learning experiences.

Zhao (2018) focused on innovation education in higher education and proposed that college students' innovation ability is composed of innovation awareness, critical thinking, and practical problem-solving ability. Innovation awareness reflects students' sensitivity to problems and opportunities for improvement, while critical thinking enables them to question assumptions and evaluate alternative solutions. Practical problem-solving ability represents the application-oriented component of innovation ability, allowing students to translate knowledge into innovative outcomes. Together, these elements form an operational and education-oriented definition of innovation ability.

Fang and Chen (2020) analyzed college students' innovation ability from a developmental perspective and argued that it comprises individual innovative qualities, learning-based innovation skills, and the capacity to engage with external innovation resources. They emphasized that innovation ability includes both internal competencies and socially embedded application abilities, such as collaboration, resource integration, and experiential learning. This view highlights innovation ability as a holistic construct shaped by the interaction between personal development, educational experiences, and social engagement.

In summary, based on the perspectives of the aforementioned scholars, the constituent elements of educational management have gradually evolved from a narrow focus on single administrative functions into a multidimensional, structured, and systematic framework that emphasizes synergy and integration across multiple levels to enhance overall management effectiveness. Drawing on relevant theories, this study conceptualizes educational management as a coherent system composed of several interrelated and mutually reinforcing structural dimensions, thereby providing a comprehensive analytical lens for institutional operation and governance optimization.

Meanwhile, this study conceptualizes innovation ability as a relatively independent and hierarchical competency system encompassing three core dimensions: (1) innovative thinking, intrinsic motivation, decision-making ability, and resilience; (2) interdisciplinary integration, practical ability, collaborative communication, and problem-solving ability; and (3) practical application ability, continuous learning ability, and social connection and responsibility awareness. By clearly distinguishing the structural composition of educational management from the competency-based dimensions of innovation ability at the conceptual level, this study establishes a logically coherent and hierarchically differentiated analytical framework, laying a solid theoretical foundation for examining how management mechanisms systematically support the development of sustainable innovation ability in higher education.

Factors affecting innovation ability

Research examines factors influencing innovation ability in higher education. Scholars argue it arises from interaction between individual traits and environment. The following studies show how collaboration, instruction, and evaluation affect students' innovation development.

Sawyer (2020) argued that innovation ability is significantly affected by collaborative learning processes and social interaction. He emphasized that creativity and innovation are not purely individual achievements but emerge through dialogue, teamwork, and shared problem-solving. In higher education, students' innovation ability is shaped by whether institutions provide opportunities for collaborative projects, interdisciplinary teamwork, and peer knowledge exchange. Learning environments that encourage communication, negotiation, and collective reflection are more likely to foster sustained innovation development.

Rogers (2021) highlighted that innovation ability is influenced by individuals' openness to new ideas and their position within innovation diffusion networks. He argued that exposure to new technologies, practices, and perspectives accelerates individuals' adoption of innovative behaviors. In university contexts, students' innovation ability is affected by their access to innovation communities, research

networks, and knowledge-sharing platforms. Institutional connectivity therefore becomes a key factor shaping innovation capacity.

Schneider and Preckel (2022) emphasized that instructional quality and cognitive challenge are critical factors affecting innovation ability. They noted that learning tasks requiring higher-order thinking, problem formulation, and reflective judgment promote students' creative and innovative competence. Their research suggests that innovation ability is weakened when teaching remains examination-oriented or overly standardized. Conversely, cognitively demanding and inquiry-driven instruction enhances students' innovation awareness and problem-solving capability.

Audretsch (2022) argued that innovation ability is strongly shaped by the surrounding entrepreneurial and innovation ecosystem. He emphasized that access to start-up incubators, innovation hubs, and industry collaboration platforms enables students to transform ideas into practical innovations. For college students, participation in entrepreneurship education, technology transfer activities, and applied research projects provides essential experiential learning status that strengthen innovation ability.

Li and Sun (2024) further proposed that evaluation and incentive mechanisms play a decisive role in influencing innovation ability development. They argued that assessment systems focusing solely on academic scores and standardized outcomes may suppress creativity and risk-taking. In contrast, diversified evaluation approaches that recognize innovation processes, project outcomes, and experimentation encourage students to engage more actively in innovation activities. Their findings indicate that innovation ability flourishes when evaluation systems align with innovation-oriented educational goals.

In summary, existing studies consistently demonstrate that college students' innovation ability is shaped by a multilayered system of interrelated factors, including individual cognitive and motivational characteristics, collaborative learning and social interaction, instructional design and cognitive challenge, institutional and entrepreneurial ecosystems, as well as evaluation and incentive mechanisms. Rather

than emerging from isolated training or short-term interventions, innovation ability develops through sustained engagement within supportive and well-structured educational environments. These perspectives indicate that enhancing college students' innovation ability requires systematic education management strategies that integrate curriculum reform, pedagogical innovation, institutional support, ecosystem construction, and evaluation reform. Such a holistic and coordinated approach provides a solid theoretical foundation for designing sustainable, innovation-oriented talent cultivation systems in higher education.

Innovation ability evaluation

In the context of higher education reform and innovation-driven development, evaluating college students' innovation ability has become an important basis for improving innovation education quality and optimizing talent cultivation models. Recent studies have explored multidimensional evaluation frameworks and assessment methods to measure students' innovation competence.

Sun and Chen (2020) proposed that innovation ability evaluation should be constructed on a multidimensional framework encompassing creative thinking, problem identification, solution design, and innovation implementation. They emphasized that effective evaluation should combine outcome-based assessment with process-oriented assessment, such as project performance, research participation, and innovation practice. Their study highlighted that innovation ability cannot be accurately captured through one-time testing, but instead should be assessed through continuous observation of students' learning behaviors, innovation engagement, and practical achievements over time.

Yuan and Huang (2021) argued that innovation ability evaluation refers to a systematic measurement of students' innovation awareness, creative thinking, and practical innovation performance. They suggested that universities should adopt diversified evaluation methods, including innovation portfolios, project reports, expert reviews, and peer assessment, to comprehensively reflect students' innovation development and learning progress. Their research emphasized that

evaluation should focus not only on final innovation outcomes but also on students' learning processes, reflective ability, and innovation growth trajectories.

Ma and Zhou (2022) developed an innovation ability evaluation model for college students based on competency theory. They proposed that innovation competence should be assessed through dimensions such as interdisciplinary knowledge integration, creative design capability, technological application, and teamwork skills. Their research highlighted the importance of formative evaluation and continuous feedback mechanisms in promoting students' sustainable innovation development, and pointed out that innovation ability evaluation should be deeply embedded into teaching and learning processes rather than treated as an isolated assessment activity.

Liu and Shen (2023) emphasized that innovation ability evaluation should integrate academic indicators with practical innovation achievements. They suggested that assessment systems should include indicators such as innovation project implementation, patent application, scientific research involvement, innovation competition performance, and entrepreneurial practice. Their findings demonstrated that diversified and practice-oriented evaluation approaches can more accurately reflect students' real innovation level and effectively stimulate active participation in innovation activities.

Wen and Gao (2024) further proposed that innovation ability evaluation should be supported by digital technologies and data-driven assessment tools. They highlighted that learning analytics, e-portfolios, and performance-based assessment platforms can provide dynamic, longitudinal, and objective evidence of students' innovation growth. Their study emphasized that technology-enabled evaluation systems improve the reliability and validity of innovation ability assessment while also offering real-time feedback to support students' self-regulation and educators' instructional decision-making.

In summary, the existing literature demonstrates that college students' innovation ability evaluation is a multidimensional, dynamic, and systematic process involving creative thinking, problem-solving competence, practical innovation

performance, and continuous learning development. As discussed above, scholars consistently emphasize that effective evaluation should integrate process-oriented and outcome-based assessment, combine academic and practical indicators, and be supported by digital and data-driven tools. These perspectives provide an important theoretical foundation for constructing a scientific, fair, and sustainable innovation ability evaluation system in higher education, while also highlighting the importance of interdisciplinary collaboration, stakeholder participation, transparent evaluation criteria, and continuous feedback mechanisms to improve assessment validity. Such approaches support evidence-based educational decision-making and promote the long-term enhancement of students' innovation capability development.

Concepts and theories of sustainable development

Definition of sustainable development

In the context of higher education reform and innovation-driven development, sustainable development has gradually become a key concept in the cultivation of college students' innovation ability. It no longer only concerns environmental or economic sustainability, but increasingly emphasizes the long-term, continuous, and stable development of students' creative competence and innovation potential within educational systems.

Li and Wang (2020) argued that sustainable development refers to a long-term educational philosophy that promotes the continuous improvement of students' innovation awareness, creative thinking, and practical problem-solving ability. In their view, sustainable development means establishing stable innovation education mechanisms, interdisciplinary learning platforms, and long-term institutional support systems. Through systematic curriculum design, innovation practice programs, and mentoring guidance, universities can ensure that students maintain sustained innovation motivation and adaptability in a rapidly changing social and technological environment.

Chen and Zhao (2021) stated that sustainable development refers to the coordinated development of students' innovation competence, lifelong learning ability, and social responsibility. They emphasized that sustainable development means cultivating students' capacity for continuous knowledge renewal, independent exploration, and creative application. By integrating innovation education into general education, professional education, and entrepreneurship education, universities can help students build a solid foundation for long-term innovation growth and career development.

Liu and He (2022) proposed that sustainable development refers to a dynamic and evolving process of innovation ability accumulation among college students. According to their framework, sustainable development means embedding innovation education into curriculum design, research-based learning, and project-driven practice. They highlighted that students' innovation competence should be developed through continuous participation in scientific research projects, innovation competitions, and interdisciplinary collaboration, thereby forming a sustainable pathway for creativity development.

Zhou and Deng (2023) argued that sustainable development refers to the long-term formation of students' innovation literacy, interdisciplinary integration competence, and technological adaptability. They pointed out that sustainable development means constructing a stable innovation ecosystem that connects universities, industries, and research institutions. Through industry-university-research collaboration platforms and real-world innovation projects, students are provided with continuous opportunities to apply creative ideas and technological knowledge in practical contexts.

Sun and Gu (2024) emphasized that sustainable development refers to the systematic cultivation of students' innovation ability supported by institutional policies and educational governance. In their view, sustainable development means establishing sustainable innovation platforms, mentoring systems, and evaluation mechanisms. They argued that only by embedding innovation education into

university governance structures and long-term development strategies can students' innovation competence be continuously enhanced and effectively sustained.

Feng and Xu (2024) further proposed that sustainable development refers to the continuous optimization of students' creative thinking patterns, innovation behaviors, and entrepreneurial awareness. They argued that sustainable development means forming a long-term innovation education pathway that integrates formal education, extracurricular innovation activities, and social engagement. By creating a diversified and open innovation learning environment, universities can support students' enduring innovation growth and lifelong creative development.

In summary, sustainable development in higher education refers a long-term, cumulative, and self-reinforcing process through which students' innovation awareness, creative thinking, and problem-solving competence are continuously cultivated across different stages of learning. It means institutionalizing innovation education within stable curricular, governance, and support systems that enable ongoing learning, feedback, and capability renewal rather than one-off interventions. Collectively, these perspectives indicate that sustainable development provides a structural and normative framework for ensuring the durability, continuity, and resilience of students' innovation ability in the context of persistent social, technological, and economic transformation.

Components of sustainable development

In higher education, sustainable development has gradually evolved from a macro-level development concept into a core framework for cultivating innovative talents. Scholars generally agree that the sustainable development of college students' innovation ability is a systematic process composed of multiple interrelated components that jointly support long-term innovation growth.

Yang and Xie (2020) proposed that the sustainable development of college students' innovation ability consists of three core components: innovation awareness cultivation, creative thinking training, and long-term innovation practice mechanisms. They emphasized that innovation awareness serves as the cognitive foundation that

stimulates students' curiosity and innovation motivation, creative thinking acts as the internal driving engine that supports idea generation and problem exploration, and innovation practice provides the application pathway for transforming ideas into real achievements. Their study highlighted that only when these three components are developed in a coordinated manner can students' innovation competence achieve sustainable growth.

Zhou and Lin (2021) argued that sustainable innovation development is composed of curriculum system design, innovation platform construction, and mentoring support systems. They pointed out that a structured innovation curriculum provides systematic theoretical guidance and interdisciplinary knowledge, innovation platforms offer real-world experimentation and research opportunities, and mentoring systems deliver long-term personalized support. According to their framework, these components jointly create a stable innovation education ecosystem that enables students to continuously accumulate innovation experience and competence.

Tang and Wu (2022) identified interdisciplinary integration, technological literacy, and collaborative innovation as the three key components of sustainable innovation ability. They emphasized that interdisciplinary knowledge integration broadens students' problem-solving perspectives and enhances creativity, technological literacy strengthens the feasibility and applicability of innovation ideas, and collaborative innovation improves communication and teamwork efficiency. Their research demonstrated that these components together form a sustainable structure for innovation competence development in complex real-world contexts.

He and Qiao (2023) proposed that the sustainable development of innovation ability is composed of internal learning motivation, supportive innovation environments, and continuous evaluation feedback mechanisms. They argued that learning motivation drives students' long-term engagement in innovation activities, while a supportive learning environment provides necessary resources, facilities, and academic support. In addition, continuous evaluation and feedback mechanisms help

students reflect on their innovation performance and adjust learning strategies, ensuring stable and progressive competence development.

Peng and Rao (2024) further suggested that sustainable innovation development consists of innovation culture cultivation, industry-university cooperation platforms, and social innovation practice systems. They emphasized that innovation culture shapes students' creative values and innovation identity, industry-university cooperation provides real-world innovation contexts and technical resources, and social practice strengthens students' adaptability and problem-solving ability. Their study indicated that the integration of these components forms a sustainable pathway for long-term innovation talent cultivation.

In summary, existing studies indicate that the sustainable development of college students' innovation ability is a multidimensional and systematic process composed of innovation awareness, creative thinking, curriculum support, innovation platforms, interdisciplinary integration, learning motivation, mentoring systems, evaluation feedback, and social practice. These components interact with one another and jointly construct a stable innovation education ecosystem, providing a solid foundation for the long-term cultivation of students' innovation competence and sustainable innovation development.

Importance of sustainable development

In the era of the knowledge economy and innovation-driven development, sustainable development has become an essential guiding principle for higher education reform and talent cultivation. Especially in the context of cultivating innovative talents, sustainable development is regarded as a fundamental guarantee for the long-term improvement of college students' innovation competence.

Xu and Ma (2020) emphasized that sustainable development is of great importance for higher education because it ensures the long-term cultivation of innovative talents who can continuously adapt to technological progress and industrial transformation. They argued that without a sustainable development perspective, innovation education may become fragmented and short-term oriented. By contrast, sustainable innovation development enables universities to establish

stable training mechanisms, long-term innovation platforms, and continuous support systems that help students maintain lasting innovation motivation and creative vitality.

Feng and Du (2021) pointed out that sustainable development plays a critical role in improving the overall quality of innovation education in universities. They suggested that sustainable development helps integrate innovation education into curriculum reform, teaching methodologies, and assessment systems in a systematic manner. Their research indicated that sustainable innovation education not only improves students' innovation performance during university study, but also cultivates lifelong learning awareness and long-term creative growth capability.

Qiao and Ren (2022) argued that sustainable development is important for cultivating students' long-term innovation potential rather than merely focusing on short-term innovation achievements. They emphasized that sustainable innovation development enables students to form stable creative thinking habits, strong technological adaptability, and interdisciplinary integration competence. These abilities are essential for graduates to continuously innovate and remain competitive in rapidly changing professional environments.

Deng and Yao (2023) highlighted that sustainable development is a key driving force for building an innovation-oriented higher education system. They proposed that sustainable development promotes the construction of innovation ecosystems that integrate education, scientific research, industry, and entrepreneurship. Such ecosystems provide students with continuous access to innovation resources, real-world innovation scenarios, and professional mentoring, thereby strengthening the connection between university education and social innovation needs.

Zhu and Han (2024) further argued that sustainable development is crucial for aligning university innovation education with national development strategies and global innovation trends. They pointed out that sustainable innovation development ensures that talent cultivation keeps pace with technological revolutions and industrial upgrading. By embedding sustainable development principles into university governance and long-term planning, higher education institutions can

cultivate innovative graduates with strong social responsibility, global vision, and continuous innovation capability.

In summary, existing studies consistently demonstrate that sustainable development is of vital importance for the long-term cultivation of college students' innovation ability. Scholars emphasize that sustainable development enables universities to establish stable innovation education systems, improve education quality, cultivate lifelong learning and innovation competence, and build innovation ecosystems aligned with social and national development needs. These perspectives highlight the indispensable role of sustainable development in promoting enduring innovation growth and high-quality talent cultivation in higher education.

Sustainable development evaluation

Scholars increasingly examine systematic evaluation of sustainable innovation capability. Beyond short-term outputs, research emphasizes multidimensional, process-oriented frameworks that assess long-term resilience, adaptability, and institutional sustainability across diverse organizational and educational contexts.

Bossel (2020) argued that sustainable innovation capability evaluation refers to a systematic assessment of an organization's or system's ability to generate continuous innovation while maintaining long-term economic viability, social responsibility, and environmental sustainability. This evaluation means moving beyond short-term output indicators to focus on structural capacities such as learning mechanisms, adaptive governance, and innovation continuity. From an evaluation perspective, sustainable innovation capability is assessed through integrated indicators reflecting resilience, adaptability, and long-term developmental potential.

Singh, Murty, Gupta, and Dikshit (2020) proposed that sustainable innovation capability evaluation refers to a multidimensional measurement framework that combines innovation performance with sustainability-oriented indicators. This framework means assessing not only technological novelty and efficiency but also social impact, environmental performance, and institutional support status. Their

study emphasizes that sustainable innovation capability evaluation should capture both current innovation outcomes and future innovation potential.

Balkyte and Tvaronavičiene (2021) emphasized that sustainable innovation capability evaluation refers to the assessment of a system's capacity to maintain innovation-driven growth under sustainability constraints. This evaluation means integrating economic competitiveness indicators with innovation inputs, institutional quality, and sustainability governance mechanisms. In this view, sustainable innovation capability evaluation functions as a diagnostic tool for identifying strengths and weaknesses in innovation systems and policy effectiveness.

Elkington and Rowlands (2022) argued that sustainable innovation capability evaluation refers to an assessment approach grounded in the triple-bottom-line framework. This approach means evaluating innovation capability through economic value creation, social contribution, and environmental responsibility simultaneously. Their work highlights that sustainable innovation capability cannot be accurately evaluated through single-dimensional metrics, but requires balanced scorecards and composite indicators that reflect long-term innovation sustainability.

Lozano, Barreiro-Gen, and Zafar (2023) further proposed that sustainable innovation capability evaluation refers to a dynamic and process-oriented assessment system that monitors how innovation capacity evolves over time. This evaluation means emphasizing learning trajectories, institutional embedding, and continuous improvement rather than static benchmarking. In education and public-sector contexts, such evaluation frameworks are increasingly used to assess whether innovation initiatives contribute to sustainable transformation rather than short-term performance gains.

Taken together, existing studies indicate that sustainable innovation capability evaluation refers to a multidimensional, long-term, and dynamic assessment of an organization's or system's capacity to continuously generate innovation aligned with sustainability objectives. Across different perspectives, this evaluation consistently means integrating innovation performance indicators with measures of learning capacity, governance effectiveness, social impact, and environmental responsibility.

These insights suggest that effective evaluation of sustainable innovation capability—particularly in higher education—should move beyond short-term outcomes and adopt systematic, process-oriented, and development-focused assessment frameworks. Such an approach provides a critical theoretical basis for designing education management strategies that support the sustainable cultivation of innovation capability among college students.

The connection between sustainable development and education management

With the acceleration of globalization and the transition toward innovation-driven economies, sustainable development has become a core guiding framework for higher education reform. Education management plays a central role in transforming sustainability principles into institutional strategies, governance systems, and talent cultivation models. Increasingly, scholars emphasize that education management functions as the operational engine that enables universities to achieve sustainable development goals.

Gu and Pei (2020) argued that sustainable development and education management are structurally interconnected because education management provides the institutional mechanisms through which sustainability policies can be implemented. They emphasized that education management should embed sustainability into strategic planning, curriculum governance, and innovation training systems. Their research showed that universities with long-term governance models are better positioned to cultivate innovative talents who can adapt to future societal and technological changes.

Mo and Zhang (2021) pointed out that education management serves as the organizational foundation of sustainable development in higher education. They argued that sustainable development requires education managers to adopt a long-term vision, establish continuous improvement systems, and optimize resource allocation. Their study demonstrated that scientific education management enables universities to balance immediate performance indicators with long-term development objectives.

Qin and Yue (2022) proposed that the connection between sustainable development and education management lies in policy coordination and institutional governance. They emphasized that education management should construct sustainable mechanisms for curriculum reform, faculty development, and student innovation training. In this framework, education management functions as a strategic tool for ensuring the sustainable development of teaching quality and innovation capacity.

Nie and Fang (2023) highlighted that sustainable development provides the value orientation for education management reform. They argued that modern education management should focus on building sustainable education ecosystems that integrate teaching, research, industry, and social service. Through collaborative governance and platform-based management models, universities can cultivate students' sustainable innovation ability and social adaptability.

Tang and He (2024) further argued that the relationship between sustainable development and education management is reflected in governance modernization. They proposed that education management should shift from traditional administrative control toward strategic, digital, and service-oriented governance models. This transformation enhances institutional resilience, innovation efficiency, and long-term competitiveness, thereby supporting the sustainable development of higher education systems.

In summary, existing studies consistently demonstrate that sustainable development and education management are deeply interconnected. Sustainable development provides the strategic direction and value foundation for higher education, while education management serves as the institutional guarantee and operational mechanism for achieving sustainability goals. Through scientific governance, long-term planning, and systemic reform, education management plays a decisive role in promoting sustainable educational quality and cultivating innovative talents for long-term social development.

SDG4

With the implementation of the United Nations 2030 Agenda for Sustainable Development, Sustainable Development Goal 4 (SDG4) has become an important global framework guiding educational reform and innovation. Beyond ensuring equitable access and quality education, SDG4 increasingly emphasizes sustainability awareness, innovation capability, and lifelong learning. In higher education, this shift highlights the need to cultivate innovative talent capable of addressing complex social, economic, and environmental challenges. Accordingly, scholars have explored how sustainability education, competency-based learning, and innovation-oriented educational management contribute to the development of college students' innovation ability within the SDG4 framework.

SDG4 (Quality Education): Connotation and Development Background

Sustainable Development Goal 4 (SDG4), a core part of the United Nations 2030 Agenda, aims to ensure inclusive, equitable quality education and promote lifelong learning for all. With the rapid growth of the knowledge economy, technological innovation, and sustainable development needs, education has become a key driver of social progress, economic growth, and innovation capability. In higher education, SDG4 emphasizes not only equity and quality but also innovation capability, sustainability awareness, and global competence. Reviewing its conceptual connotations and development background therefore provides an important theoretical basis for research on educational management strategies to enhance college students' sustainable innovation capabilities.

United Nations (2015) formally introduced SDG4 in the 2030 Agenda for Sustainable Development, emphasizing the transformative role of education in promoting social inclusion, economic development, and environmental sustainability. The framework moved beyond traditional concerns with educational access to highlight quality education, equitable opportunities, and the acquisition of knowledge, skills, and values necessary for sustainable development. It also underscored the importance of lifelong learning systems capable of supporting continuous personal and professional development.

Marginson (2016) highlighted the growing global significance of higher education in achieving sustainable development objectives. He argued that universities play a central role in cultivating advanced knowledge, fostering innovation capability, and facilitating social mobility. From this perspective, higher education institutions are not only knowledge transmission centers but also innovation hubs that contribute to economic transformation, technological advancement, and international collaboration aligned with SDG4 principles.

UNESCO (2017) further elaborated the educational implications of SDG4 by emphasizing Education for Sustainable Development (ESD) as a key pathway for implementation. According to UNESCO, quality education should foster critical thinking, problem-solving ability, global citizenship awareness, and sustainability values. This perspective highlights the integration of sustainability concepts into curricula, pedagogy, and institutional governance, reinforcing the role of education in shaping responsible and innovative citizens.

Leicht, Heiss, and Byun (2018) emphasized that ESD provides an important conceptual and practical foundation for achieving SDG4, particularly Target 4.7, which focuses on sustainability knowledge and global citizenship education. They argued that educational systems should cultivate interdisciplinary thinking, ethical awareness, and innovation capacity to address complex global challenges. Higher education institutions were identified as key actors in promoting sustainability-oriented research, curriculum reform, and innovation practice.

Tikly (2019) interpreted SDG4 within a broader social justice framework, suggesting that quality education should be understood in relation to cultural relevance, equity, and capability development. He emphasized that education systems must equip learners with the skills and competencies required for sustainable development, including adaptability, creativity, and collaborative problem-solving ability. This perspective highlights the need for systemic educational reform rather than isolated policy adjustments.

Unterhalter (2019) focused on the governance and policy dimensions of SDG4 implementation, arguing that educational equity, gender inclusion, and institutional coordination are essential components of sustainable educational development. She noted that achieving SDG4 requires strong policy alignment, effective institutional management, and sustained investment in educational innovation. This governance-oriented perspective underscores the importance of educational management strategies in translating global goals into practical institutional actions.

In summary, existing studies indicate that SDG4 has evolved from a global commitment to expanding educational access toward a comprehensive framework emphasizing quality, equity, sustainability, and innovation capability development. Scholars generally highlight the pivotal role of higher education institutions in cultivating advanced knowledge, promoting social mobility, and supporting sustainable development through innovation and collaboration. At the same time, Education for Sustainable Development (ESD), social justice considerations, and effective governance mechanisms are widely recognized as key pathways for implementing SDG4. Overall, the literature underscores that achieving SDG4 requires not only improved educational access but also systemic reforms integrating quality enhancement, innovation cultivation, sustainability values, and coordinated educational management practices.

Components of the SDG4

As a central goal of the United Nations 2030 Agenda, SDG4 emphasizes inclusive, equitable, and quality education while promoting lifelong learning opportunities. Its framework consists of multiple interconnected components that guide global educational reform and sustainable development.

McGrath and Powell (2016) emphasized that SDG4 encompasses multiple interrelated components, including equitable access to education, quality improvement, skills development, and lifelong learning opportunities. They argued that these elements collectively reflect a holistic approach to education that supports both individual development and sustainable socio-economic progress.

Auld and Morris (2019) highlighted that the structural composition of SDG4 integrates formal, non-formal, and informal education systems. According to their analysis, this comprehensive framework recognizes diverse learning pathways and stresses the importance of flexible educational provision to meet evolving societal and labor market demands.

Benavot (2017) noted that SDG4 incorporates specific targets related to literacy, numeracy, vocational skills, and global citizenship education. He argued that these components collectively aim to enhance human capability, promote social inclusion, and strengthen the role of education in sustainable development agendas.

King (2016) suggested that the targets under SDG4 emphasize not only access and participation but also learning outcomes, teaching quality, and institutional capacity building. He emphasized that strengthening educational infrastructure and teacher development constitutes a critical dimension of achieving SDG4 objectives.

Schleicher (2018) argued that SDG4 includes measurable indicators related to learning achievement, equity, and educational system performance. He stressed that data-driven monitoring and international benchmarking are essential components for evaluating progress toward inclusive and high-quality education worldwide.

Overall, the components of SDG4 collectively emphasize not only educational access but also quality enhancement, skills development, equity promotion, and effective governance. These elements work together to support sustainable social development, strengthen human capital formation, and improve global educational systems, providing an important framework for advancing innovation capacity and lifelong learning in higher education contexts.

SDG4 and the cultivation of innovation ability of college students

Sustainable Development Goal 4 (SDG4) emphasizes inclusive, equitable quality education and lifelong learning, while increasingly highlighting the cultivation of innovation capability and sustainability awareness in higher education. Scholars have therefore examined how SDG4-related educational concepts contribute to developing college students' innovation abilities.

Barth et al. (2007) argued that integrating sustainability principles into higher education fosters transformative learning processes that enhance creativity, reflective thinking, and innovation awareness. Their research indicated that sustainability-oriented curricula can encourage students to engage actively with real-world problems, thereby strengthening long-term innovation capability and professional adaptability.

Wiek, Withycombe, and Redman (2011) proposed a sustainability competency framework including systems thinking, anticipatory competence, strategic competence, and interpersonal competence. These competencies are closely related to innovation ability because they support interdisciplinary collaboration, forward-looking problem solving, and adaptive learning in complex sustainability contexts.

UNESCO (2017) emphasized that implementing SDG4 requires higher education institutions to cultivate critical thinking, creativity, and problem-solving ability through Education for Sustainable Development (ESD). Integrating sustainability concepts into curricula and pedagogy helps students develop innovative perspectives and the capacity to address global sustainability challenges.

Leicht, Heiss, and Byun (2018) further highlighted that ESD provides both conceptual and practical foundations for fostering innovation competence. Interdisciplinary curricula, experiential learning, and sustainability-oriented research engagement were identified as effective approaches for strengthening students' systems thinking, ethical awareness, and creative problem-solving skills.

OECD (2018) emphasized that quality education aligned with SDG4 should prioritize key competencies such as creativity, collaboration, and innovative thinking. The organization highlighted interdisciplinary learning, digital literacy, and flexible teaching models as important mechanisms for preparing students for innovation-driven economies.

World Bank (2019) suggested that higher education contributes to sustainable development by cultivating innovation skills, entrepreneurial awareness, and technological adaptability among college students. Strengthening innovation-oriented

educational management, industry–education collaboration, and practical learning environments can enhance graduate employ ability and support sustainable economic transformation.

In summary, the literature shows a gradual evolution from early sustainability education research to the SDG4 framework emphasizing innovation capability development in higher education. Scholars generally agree that integrating sustainability concepts, interdisciplinary learning, competency-based education, and practical innovation experiences can effectively enhance college students' innovation ability. Aligning educational management strategies with SDG4 objectives therefore provides important theoretical guidance for cultivating innovative talent and promoting sustainable development in higher education.

Concepts and theories of college students

Definition of college students

In higher education research, the concept of college students is understood not only as an administrative identity but also as a developmental and social role. Scholars define college students from perspectives of learning status, personal growth, and future social responsibility.

Liao (2020) argued that the term college students refers to individuals who are formally registered in higher education institutions and participate in structured academic programs. In his view, this educational identity means that students are engaged in systematic knowledge acquisition, skill development, and intellectual training. He emphasized that college students represent a transitional population between adolescence and adulthood, during which personal values, learning habits, and professional aspirations are gradually formed.

Zeng (2021) proposed that college students refers to young adults who pursue higher-level education in universities and colleges for the purpose of enhancing academic competence and professional capability. According to his interpretation, this status means that students are expected to develop independent learning ability, critical thinking, and problem-solving skills. He further noted that

college students play an active role in knowledge construction rather than passively receiving information.

Pei (2022) stated that college students refers to a social group receiving advanced education and specialized training within higher education systems. In his framework, being a college student means preparing for future professional development and social participation through academic learning, practical training, and innovation activities. He highlighted that university education lays the foundation for students' long-term career development and social adaptation.

Qian (2023) defined college students as individuals who engage in higher education to cultivate academic literacy, practical competence, and innovation awareness. In her view, this identity refers to a crucial stage of cognitive and psychological development, and this stage means that students gradually form stable values, career goals, and social responsibility. She emphasized that the university period has a lasting influence on students' personal growth.

Han (2024) argued that college students refers to learners who undertake higher education in order to enhance their comprehensive quality and innovation potential. According to his definition, this educational role means that college students are regarded as future contributors to scientific, technological, and social development. He pointed out that their academic performance and innovation capacity are closely related to national competitiveness and sustainable development.

In summary, college students are defined as a distinct educational and social group at a critical transitional stage between adolescence and adulthood, formally enrolled in higher education institutions and engaged in systematic academic learning and professional training. Their identity refers to learners who participate in structured higher education while gradually developing autonomy, critical thinking, and problem-solving ability. This stage represents a key developmental period in which foundational capacities, value orientations, and long-term career aspirations for future professional and social roles are progressively formed and consolidated.

Importance of college students

In the context of social development and higher education reform, college students are widely recognized as a crucial group for national progress, technological innovation, and social sustainability. As the main recipients of higher education, college students play an important role in knowledge creation, talent development, and future social transformation.

Liu (2020) emphasized that college students are of critical importance as they constitute the core reserve force of future professionals, innovators, and skilled talent. He argued that the quality of college students' education directly influences national competitiveness, economic vitality, and innovation capacity. According to his study, college students function as a crucial bridge between academic knowledge and real-world application, transforming theoretical learning into technological advancement and industrial upgrading, thereby becoming an essential driving force of modern economic development.

Zhao (2021) pointed out that college students play a vital role in promoting social modernization and cultural development. He argued that universities are not merely institutions for knowledge transmission but also important incubators of social values and civic consciousness, with college students serving as the primary carriers of these values. Through higher education, students cultivate critical thinking, social responsibility, ethical awareness, and global perspectives, which are fundamental to building an inclusive, innovative, and sustainable modern society.

Wu (2022) highlighted that college students represent an important engine for scientific research and technological innovation. He noted that a large number of research projects, innovation competitions, and entrepreneurial activities rely heavily on student participation. According to his research, college students contribute fresh ideas, creative thinking, and interdisciplinary perspectives, injecting continuous vitality into scientific research systems and accelerating the transformation of knowledge into innovation outcomes.

Peng (2023) argued that college students hold strategic significance for national development and long-term sustainability. He emphasized that cultivating high-quality college students helps establish a strong and resilient talent base to support future economic transformation, technological upgrading, and social governance. In his view, students' comprehensive quality, innovation ability, and adaptability play a decisive role in determining a country's long-term development potential and its ability to cope with complex global challenges.

Tang (2024) further pointed out that college students constitute the main force of future social development and technological progress. He argued that higher education plays a decisive role in shaping students' values, competencies, and career orientations. As future leaders, professionals, and innovators, college students will assume important responsibilities in promoting social equity, advancing technological progress, and achieving sustainable development goals.

In summary, the existing literature demonstrates a strong consensus that college students are of fundamental importance to national development, social progress, and technological innovation. As future professionals, innovators, and social leaders, college students form the core driving force of knowledge-based economies and innovation-oriented societies. Their educational quality, innovation capacity, and comprehensive development are closely linked to a country's long-term competitiveness, social vitality, and sustainable development trajectory.

Characteristics of college students

In the context of higher education and social transformation, college students represent a dynamic group with distinctive psychological, cognitive, and social characteristics. Understanding these characteristics is essential for designing effective education management strategies and promoting students' comprehensive development.

Wang (2020) argued that college students are characterized by advanced cognitive development and strong learning capacity. He pointed out that university students are at a critical stage of intellectual maturity, during which higher-order cognitive abilities such as abstract thinking, analytical reasoning, and complex

problem-solving are rapidly strengthened. These cognitive characteristics enable students to engage effectively in advanced academic tasks, independent inquiry, and interdisciplinary learning, providing a solid intellectual foundation for innovation-oriented education.

Li (2021) emphasized that college students demonstrate an increasing level of self-awareness and identity formation. According to his study, students gradually clarify their personal values, career aspirations, and sense of social responsibility during their university years. This process of self-exploration and identity construction plays a key role in shaping students' long-term life goals, professional orientation, and motivation for self-directed learning and innovation.

Zhou (2022) highlighted that college students possess high levels of creativity and innovation potential. He noted that continuous exposure to diverse knowledge systems, emerging technologies, and open academic environments stimulates students' curiosity and encourages them to challenge conventional perspectives. These qualities form an important psychological and cognitive basis for innovative thinking, entrepreneurial activity, and problem-driven learning.

He (2023) pointed out that college students exhibit strong adaptability and digital competence. Growing up in an era of rapid technological advancement, most university students are proficient in using digital tools, online learning platforms, and information-processing technologies. Their ability to quickly adapt to changing learning environments and technological contexts enhances both academic efficiency and participation in digital and social innovation activities.

Xu (2024) further argued that college students are characterized by increasing social engagement and global awareness. With the expansion of international education, digital connectivity, and cross-cultural exchange, students develop broader perspectives on global issues, intercultural communication, and social responsibility. This global consciousness enables them to participate more actively in public affairs, collaborative innovation, and international cooperation, while promoting inclusive development across diverse societies.

In summary, college students are characterized by strong cognitive abilities, increasing self-awareness, considerable innovation potential, digital adaptability, and a growing global perspective. These characteristics reflect both their intellectual development and their evolving roles as future professionals, innovators, and contributors to society. At this stage, they are increasingly capable of complex learning, interdisciplinary thinking, and creative problem-solving. Therefore, higher education institutions should cultivate these qualities through supportive learning environments, innovation-oriented curricula, and diverse developmental opportunities, helping to enhance students' sustainable innovation capacity and contribute to long-term social and economic development.

Related Research

Researches on innovative education

In the era of rapid technological advancement and knowledge-based economic development, innovative education has become a key pathway for cultivating high-level talents with creativity, critical thinking, and practical problem-solving abilities. It emphasizes the transformation of traditional teaching models and promotes the deep integration of knowledge, technology, and real-world application.

Zheng (2020) described innovative education as an educational philosophy that focuses on cultivating students' creative thinking, independent learning ability, and problem-solving competence. He argued that innovative education encourages students to actively participate in inquiry-based learning, project-based learning, and collaborative exploration. Through real-world problem scenarios and open-ended learning tasks, students are guided to generate original ideas and develop innovative solutions, thereby forming strong innovation awareness and practical competence.

Ren (2021) emphasized that innovative education is characterized by flexible curriculum structures and interdisciplinary integration. According to his research, innovative education breaks down rigid disciplinary boundaries and promotes cross-disciplinary learning among science, technology, engineering, humanities, and social sciences. This integrated learning model helps students build systematic knowledge

frameworks, broaden their thinking perspectives, and enhance their ability to apply knowledge creatively in complex contexts.

Cao (2022) pointed out that innovative education relies heavily on the construction of smart learning environments and the application of digital technologies. He argued that artificial intelligence, big data, and online learning platforms enable personalized learning pathways and adaptive teaching strategies. These technologies provide students with rich learning resources and interactive learning experiences, which support individualized development and stimulate students' creativity and exploration motivation.

Ma (2023) highlighted that innovative education places strong emphasis on student-centered teaching and active participation. He noted that teachers in innovative education act as mentors, facilitators, and learning designers rather than traditional knowledge transmitters. By guiding students to design learning projects, conduct independent research, and engage in reflective learning, innovative education helps students develop autonomy, responsibility, and lifelong learning habits.

Shen (2024) further argued that innovative education aims to cultivate students' social responsibility and entrepreneurial awareness. He emphasized that innovation should not be separated from social development and industrial needs. Through innovation competitions, entrepreneurial training programs, and university-industry cooperation projects, students are encouraged to transform creative ideas into practical products and social value, thereby enhancing their comprehensive innovation capability.

In summary, innovative education is widely recognized as a core educational model for cultivating creative and high-quality talents in the context of innovation-driven development. It emphasizes interdisciplinary integration, digital empowerment, student-centered learning, and social engagement. Through innovative education, universities can effectively enhance students' creativity, practical competence, and entrepreneurial spirit, thereby promoting the sustainable

development of students' innovation ability and supporting long-term social and economic progress.

Researches on innovative atmosphere and guarantee mechanism

In the era of innovation-driven development, creating an innovative atmosphere and establishing a sound guarantee mechanism have become the basic status for universities to cultivate high-level innovative talents. The combination of a supportive campus culture and a systematic institutional guarantee has laid the foundation for the sustainable development of innovation education.

Zhou (2020) holds that the innovative atmosphere in universities refers to a campus culture that encourages exploration, critical thinking, and creative experimentation. He emphasizes that universities should foster an open academic environment where students can freely express new ideas, challenge existing knowledge, and engage in interdisciplinary collaboration. According to his research, a strong innovative atmosphere can significantly enhance students' intrinsic motivation to conduct research, start businesses, and engage in technological innovation, thereby improving the overall quality of innovation education.

Tang (2021) pointed out that the guarantee mechanism for innovative education refers to a comprehensive institutional system, including policy support, organizational coordination, and stable financial input. He believes that universities should establish dedicated innovation funds, research support projects, and incentive policies to ensure the continuous development of innovative activities. These mechanisms provide long-term resource support for students and teachers and reduce the risks of innovative exploration.

Qin (2022) emphasized that the innovative atmosphere and guarantee mechanisms should develop in coordination. He pointed out that merely having a positive innovative culture without corresponding institutional guarantees is insufficient. Universities must incorporate innovative development into their strategic planning, clarify management responsibilities, and establish standardized assessment systems to ensure the effective implementation of innovative education policies.

Luo (2023) emphasized the significance of innovation platforms as a core component of the safeguarding mechanism. He argued that universities should establish maker spaces, innovation laboratories, business incubators, and interdisciplinary research centers. These platforms offer students access to advanced equipment, technical guidance, and project support, enabling them to transform their creative ideas into tangible outcomes.

Xie (2024) further pointed out that leadership support and teacher participation are the key driving forces for an innovative atmosphere and guarantee mechanism. He emphasized that university leaders should make innovative development a strategic priority, while teachers should integrate innovative education into course design and teaching practice. Through strong leadership commitment and active teacher participation, universities can build a sustainable innovation ecosystem.

In conclusion, scholars generally believe that an innovative atmosphere and a sound guarantee mechanism are the important foundations for universities to promote innovative education. A positive campus culture encourages innovation and exploration, while a systematic institutional support ensures stable resources, effective management and long-term development. Through the coordinated construction of cultural environment, policy system, innovation platform and leadership support, universities can create sustainable status for cultivating high-level innovative talents and promoting innovation-driven development.

Researches on innovative education system and student evaluation

In the context of innovation-driven development and higher education transformation, the construction of an innovative education system and a scientific student evaluation mechanism has become an important foundation for cultivating high-level innovative talents. A systematic education framework provides structural support for innovation learning, while a comprehensive evaluation system ensures the effective measurement and continuous improvement of students' innovation abilities.

Wei (2020) argued that an innovative education system refers to a comprehensive educational framework that integrates curriculum reform, teaching model innovation, and practical training. He emphasized that universities should redesign traditional discipline-based curricula by introducing interdisciplinary programs, research-based learning, and project-oriented teaching. According to his study, an innovative education system should focus on cultivating students' critical thinking, creativity, and problem-solving ability through flexible learning pathways and experiential learning opportunities.

Dong (2021) pointed out that student evaluation in innovative education should shift from traditional exam-oriented assessment to a competency-based and process-oriented evaluation model. He argued that innovation ability is reflected not only in academic achievement but also in students' research performance, creative projects, teamwork, and entrepreneurial practice. Therefore, student evaluation systems should adopt diversified assessment methods, including project reports, innovation portfolios, peer evaluation, and teacher observation.

Peng (2022) emphasized that an innovative education system should be closely integrated with industry and social practice. He highlighted the importance of school-enterprise cooperation, innovation internships, and entrepreneurship training programs in cultivating students' practical innovation competence. In this system, student evaluation should include feedback from enterprise mentors and project supervisors, ensuring that students' innovation ability aligns with real-world standards and industrial needs.

Yu (2023) argued that digital technologies play a crucial role in optimizing both innovative education systems and student evaluation mechanisms. He noted that learning management systems, artificial intelligence, and big data analytics enable personalized learning design and data-driven assessment. Through digital platforms, teachers can track students' learning progress, innovation behavior, and collaborative performance more accurately and efficiently.

Ren (2024) further pointed out that the construction of an innovative education system and student evaluation mechanism should follow the principle of

continuous improvement. He emphasized that universities should regularly update curriculum content, teaching strategies, and evaluation criteria based on feedback from students, teachers, and industry partners. This dynamic adjustment mechanism helps ensure the long-term effectiveness and sustainability of innovation education.

In summary, Chapter 2 establishes the theoretical and conceptual foundation of this study by clarifying the key variables and their interrelationships within the proposed framework. Through a systematic literature review, this chapter demonstrates that educational management has evolved into a multidimensional and structured system that influences students' innovation development through coordinated institutional mechanisms. In this research, sustainable innovation ability is defined as the dependent variable and conceptualized as a hierarchical competence system including innovative thinking, intrinsic motivation, decision-making ability, resilience, interdisciplinary integration, practical problem-solving ability, continuous learning capacity, and social adaptability. These dimensions collectively represent students' capacity for long-term innovative development in dynamic educational and social contexts.

The independent variables consist of three interrelated dimensions of educational management: individual-level factors, educational and learning environment factors, and social or external support factors. These dimensions function as structural conditions that shape the cultivation process of innovation ability. Moreover, this chapter reviews strategic management theories and analytical tools—including SWOT analysis, PEST analysis, and the TOWS Matrix—which provide methodological support for diagnosing internal and external conditions and formulating systematic educational management strategies. The integration of vision, mission, goals, measures, and implementation guidelines further ensures that strategic formulation aligns with institutional governance and sustainable development objectives.

In summary, Chapter 2 clarifies the independent and dependent variables derived from the conceptual framework, elaborates on their conceptual definitions and theoretical foundations, and systematically explains the logical relationships

among them within a structured analytical paradigm. By integrating relevant educational management, innovation theory, and strategic management theories, this chapter constructs a coherent and multidimensional analytical structure that effectively links institutional conditions, environmental influences, and individual development factors with measurable innovation outcomes. Furthermore, it critically synthesizes prior research findings to justify variable selection and theoretical positioning, ensuring conceptual clarity and academic validity. It also establishes a clear and sequential analytical pathway for subsequent empirical investigation, strategy formulation through structured analytical tools such as SWOT and PEST, and the evaluation of feasibility, effectiveness, and contextual adaptability in the following chapters. In doing so, the chapter strengthens the internal consistency of the overall research design, enhances the explanatory power and practical relevance of the proposed strategies, and ensures theoretical rigor, methodological continuity, and logical coherence throughout the entire study.

Chapter 3

Research Methodology

In order to study educational management strategies for enhancing sustainable innovation ability of college students.

The purpose of this research is to study the following aspects:

1. To study the current and desired status of education management for enhancing sustainable innovation ability of college students in Shaanxi Province.
2. To develop educational management strategies for enhancing sustainable innovation ability of college students in Shaanxi Province.
3. To evaluate the feasibility and suitability of educational management strategies for enhancing sustainable innovation ability of college students in Shaanxi Province.

In order to solve the problems mentioned in Chapter 1 and achieve the above research objectives, the researchers adopted the following research procedures, as follows:

1. The population and the sample Group
2. Research Instruments
3. Data Collection
4. Data Analysis

phase 1: Studying the current and desired status of education management for enhancing sustainable innovation ability of college students in Shaanxi Province.

The Population

According to information released by the Shaanxi Provincial Department of Education, by 2024 there are 111 higher education institutions in Shaanxi Province, including 55 undergraduate institutions (including 10 independent colleges), 2 undergraduate vocational institutions, 40 vocational (junior college) institutions, and

14 adult higher education institutions. In addition, 22 research institutions are authorized to offer postgraduate education. The total population of students enrolled in higher education in Shaanxi Province is 1,926,879.

The Sample Group

1. Students

Considering the actual research status and regional distribution of higher education institutions in Shaanxi Province, ten universities were selected from Northern Shaanxi, Southern Shaanxi, and the Guanzhong region as research sites. To ensure representativeness across regions and institutions, stratified random sampling was employed, with students stratified by region and university before selection. Based on Cochran's (1977) formula, for a population of 1,926,879 students, with a 95% confidence level and a 0.05 margin of error, the required sample size is approximately 384 participants. This shows that even with a population exceeding 1.9 million, the sufficient sample size remains about 384, as further increases have negligible effect. Therefore, a sample of 384 students obtained through stratified random sampling ensures the reliability and representativeness of the findings.

Table 3.1 Sample size table of this survey

NO.	Education Institutions	Population	Sample Group	City
1	Yan 'an University	24300	50	YanAn
2	Shaanxi University Of Technology	22856	46	HanZhong
3	Xijing University	18600	38	Xi'an
4	Eurasia University	18342	36	Xi'an
5	Haojing College, Shaanxi University of Science and Technology	9246	20	Xi'an
6	Shaanxi International Business College	23644	48	Xi'an
7	Shaanxi Fashion Engineering University	12635	25	Xi'an
8	Xi 'an Automotive Vocational University	17625	36	Xi'an
9	Shaanxi Vocational and Technical College of Finance and Economics	18600	39	Xi'anYang
10	Xianyang Polytechnic Institute	22380	46	Xi'anYang
Total		188228	384	

2. Experts

A total of 10 experts participated in the interview study aimed at examining the current status, desired status and influencing factors related to the sustainable innovation ability of college students in Shaanxi Province. These experts were selected by purposive sampling, and the specific criteria are as follows: 1) Having an associate professor or higher title; 2) Engaging in teaching or management work in colleges and universities in Shaanxi Province for more than 15 years; 3) Long-term

participation in college students' innovation education, talent cultivation or education management related work, and having relevant research or practical experience.

Research instrument

1. Questionnaire

A questionnaire on the current and desired status of education management for enhancing sustainable innovation ability of college students in Shaanxi Province. The researcher adopted a two-part questionnaire.

Part I: This section collects demographic information of participants, including gender, grade and major background.

Part II: This study examined current and desired status of sustainable innovation ability of college students through a questionnaire survey, covering three core dimensions: individual characteristics, educational and learning environments, and social and external factors.

This tool aims to study current and desired status of sustainable innovation ability of college students. Respondents are required to determine the degree of each statement that reflects effectiveness. Each statement is measured using a 5-point Likert scale (1932): 5 = Strongly Agree, 4 = Agree, 3 = Moderately Agree, 2 = Disagree, 1 = Strongly Disagree, as shown in Table 3.2.

Table 3.2 Measurement scale for the studying current and desired status of sustainable innovation ability of college students

Perception level	Score
Strongly Agree	5
Agree	4
moderate	3
Disagree	2
Strongly Disagree	1

High scores on the scale indicate a positive level of the current and desired status of sustainable innovation ability of college students. The sustainable development of innovation ability education management for college students is measured by ranking the average scores into five perceived levels. The average score is calculated based on Best's (1977) evaluation criteria and divided into five grades.

Therefore, the range and average value of the measurement scores for the sustainable development of college students' innovation ability education management were divided, and the scale was divided into five perceived levels to put forward suggestions for the sustainable development of college students' innovation ability education management.

2. Interview Form

Based on the results of the questionnaire survey on the current and desired status of sustainable innovation ability of college students in Shaanxi Province, a structured interview guide was developed. The interview questions were organized around three dimensions: personal traits, educational and learning environment, and social and external factors, in order to further explore experts' perspectives on existing challenges and expected improvements in enhancing sustainable innovation ability. Structured interviews were conducted with 10 experts responsible for educational management from 10 universities in Shaanxi Province.

Quality of Research Instrument

The instrument was developed from Phase (1) as a questionnaire. The quality of the questionnaires was assessed by content validity and reliability. For the content validity, it was checked by 5 experts and analyzed by Item-Objective Congruence (IOC).

Reliability of Questionnaire

The results of a reliability analysis of research instruments, specifically focusing on variable reliability correlation. In the case handling summary, it is noted that all 384 cases were effective, with no exclusions, representing 100% of the data set. This suggests that the entire sample was used for the analysis. In the reliability statistics section, the Cronbach's Alpha coefficient is reported as 0.97, both for the

unstandardized and standardized items. This indicates a very high level of internal consistency among the variables in the instrument. The analysis was conducted on 30 items, meaning that all of these items contributed to the calculation of Cronbach's Alpha. With a value of 0.965, the instrument is deemed highly reliable for assessing the variables in question.

Content Validity of Questionnaire

The content validity of the research questionnaire was relatively examined by 5 experts to check the correctness and appropriateness of the language, the coverage of the content, and the content relevance of the research dimensions. According to the experts' suggestions on the results of the item-objective congruence (IOC), the instrumental items were passively checked, verified, and finally determined. The itemized presentation of the IOC was relatively expected to be used in the research within the range of "0.60 - 1.00".

Data Collection

The content validity of the research questionnaire was relatively examined by five experts to check the correctness and appropriateness of the language, the coverage of the content, and the content relevance of the research dimensions. According to the experts' suggestions on the item-object consistency (IOC) results, the instrumental items were passively inspected, verified, and finally determined. Subsequently, the researches proceeded to collect research data, which was done as follows:

- 1) Researchers have applied to the School of Education for permission to continue their research and conducted the study from January 5th to February 5th, 2025, in accordance with the guidance procedures and research plan.

- 2) The sample subjects were directly informed of the content scope and research objectives, and received the official permission letter sent by the university to the administrator, allowing them to conduct the survey and collect data from teachers from February 5th to March 5th, 2025, in accordance with the approval letter issued by the relevant authorities.

3) After the administrator's permissions were processed and confirmed, the researchers and the instructors or university coordinators agreed to distribute the questionnaires both online and offline. The questionnaires were accompanied by research guidelines, standards, participation information forms, and summaries of each research project for the response sections. The questionnaires were sent out through WeChat, the Internet, email, researchers, and other channels from March 5th to March 30th, 2025.

4) The questionnaire was completed within four weeks. The data collection period was one month, from February 1st to March 1st, 2025.

Data Analysis

Researchers utilized data analysis software such as SPSS to analyze the collected data. The analysis process is summarized as follows:

Step 1: Conduct frequency and percentage analysis of the personal information of the questionnaire respondents, classified by gender, grade, and professional background, etc.

Before conducting inferential statistical analysis, the interpretation criteria for mean scores and the Priority Needs Index Modified (PNI modified) were established based on established measurement principles to ensure consistency in data interpretation. For the interpretation criteria to classify the mean score, the researcher used the measurement criteria according to the concept of Best (Best, 1997). Mean scores were 1.00-1.49, 1.50-2.49, 2.50-3.49, 3.50-4.49, 4.5-5.00's level.

The average value interpretation, based on Rensis Likert (1932), is outlined as follows:

4.50 – 5.00: Expressed the highest level.

3.50 – 4.49: Expressed a high level.

2.50 – 3.49: Expressed a medium level.

1.50 – 2.49: Expressed a low level.

1.00 – 1.49: Expressed a lowest level

For the calculation of the current status and desired status, the Priority Needs Index Modified (PNI Modified) is used, with the following calculation formula:

$$\text{PNI modified} = (I-D) / D$$

I (Important) means the actual/current state of being.

D (Degree of success) means the status that should be.

$$\text{PNI modified} = (I-D) / D$$

Step 2: Use mean and standard deviation, the modified Priority Needs Index (PNI modified), independent samples t-test, and one-way ANOVA to analyze the current status, expected status, and influencing factors of the improvement of sustainable innovation ability of college students in Shaanxi Province, covering three areas: 1) Personal traits 2) Educational and learning environment 3) Social and external factors.

Step 3: Use content analysis to analyze the current situation, desired status, and influencing factors of the improvement of sustainable innovation ability, and formulate strategies through SWOT analysis, PEST analysis, and TOWS matrix.

Phase 2: Developing educational management strategies for enhancing sustainable innovation ability of college students in Shaanxi Province.

Target Group

There were 10 experts in focus group for developing strategies for enhancing the sustainable innovation ability of college students in Shaanxi Province.

Target group for interviews or focus group discussion; Participants were selected using purposive sampling based on the following criteria: (1) holding the rank of associate professor or above; (2) having at least 10 years of work experience in higher education institutions in Shaanxi Province; and (3) being familiar with innovation education and student development in higher education, with experience in related research projects.

Table 3.3 List of focus group interviewee

NO	University Name	Population	Sample Group
1	Yan 'an University	3	1
2	Shaanxi University Of Technology	3	1
3	Xijing University	3	1
4	Eurasia University	3	1
5	Haojing College, Shaanxi University of Science and Technology	3	1
6	Shaanxi International Business College	3	1
7	Shaanxi Fashion Engineering University	3	1
8	Xi 'an Automotive Vocational University	3	1
9	Shaanxi Vocational and Technical College of Finance and Economics	3	1
10	Shaanxi Polytechnic university	3	1
Total		30	10

Research Instrument

1. The draft of Educational Management Strategies

Based on data collected from questionnaires and interviews, a comprehensive and systematic SWOT analysis was conducted. The four dimensions—strengths, weaknesses, opportunities, and threats—were carefully and systematically examined to assess how internal strengths and weaknesses affect the current status of college students' sustainable innovation capability in Shaanxi Province, and how external opportunities and threats influence the gap between existing status and desired development goals within complex educational contexts. Based on these integrated analyses, targeted and context-sensitive education management strategies were formulated to effectively leverage strengths, address

weaknesses, capitalize on opportunities, and mitigate potential threats in a coordinated manner. By integrating findings from the questionnaire survey, expert interviews, and the results of the SWOT, PEST, and TOWS matrix analyses, a structured, logically coherent, and evidence-based preliminary framework for education management strategies aimed at enhancing college students' sustainable innovation capability in Shaanxi Province was systematically developed.

2. Focus group discussion

Steps for constructing a focus group discussion

Step 1: The draft of the proposed educational management strategies was submitted to the thesis supervisor for review. Revisions were made based on feedback, and the final version was confirmed by the Experts in focus group discussion.

Step 2: An official invitation letter for the focus group experts was requested from the university and sent to the selected participants.

Step 3: Online focus group discussion were conducted with the consenting experts, and the content provided by each participant was systematically organized.

Data Collection

Qualitative data were collected to address Research Objective 2, which focused on the development of educational management strategies for enhancing the sustainable innovation capability of college students. Data collection was conducted in accordance with the research instruments and established procedures. The specific steps were as follows:

Step 1: Formal approval was obtained from the Graduate School of Bansomdejchaopraya Rajabhat University to conduct focus group discussions involving 10 experts.

Step 2: Key information was documented throughout the focus group discussions, and the collected materials were systematically organized and consolidated to support subsequent qualitative analysis.

Data Analysis

Step 1: A focus group discussion outline was developed to guide expert dialogue. During the focus group sessions, expert feedback and supplementary suggestions were collected to further refine the draft educational management strategies.

Step 2: Based on this process, the final version of the Educational Management Strategies for enhancing the sustainable innovation capability of college students was proposed.

Phase 3: Evaluating the feasibility and adaptability of educational management strategies for enhancing sustainable innovation ability of college students in Shaanxi Province.

Target Group

Five experts participated in the evaluation of the feasibility and adaptability of strategies for enhancing the sustainable innovation ability of college students in Shaanxi Province. These experts were selected from colleges and universities in Shaanxi Province. The selection of experts adopted purposive sampling, with the following specific criteria: 1) Holding positions related to education and teaching or student management in colleges and universities; 2) Having more than 10 years of experience in college education management or teaching, and holding the title of associate professor or above; 3) Having relatively rich teaching, management or research experience in the fields of college student innovation education, talent cultivation or education management.

Table 3.4 Target group for strategy evaluation

NO	University Name	Population	Sample Group
1	Weinan Normal University	3	1
2	Xi'an University of Science and Technology Of Technology	3	1
3	Xi'an University of Finance and Economics	3	1
4	Northwest University	3	1
5	Xianyang Normal University	3	1
Total		15	5

Research Instrument

To achieve Goal 3, research tools were designed. Five educational experts from universities in Shaanxi Province were invited to evaluate the feasibility and adaptability of the educational management strategies aimed at enhancing the sustainable innovation ability of college students.

Evaluation Form

This instrument collects data for Objective 3 and evaluates the suitability and feasibility of educational management strategies to improve sustainable innovation ability of college students. Five experts from Xi'an Jiaotong University and xi'an university of electronic science and technology were invited to evaluate the suitability and feasibility of the strategy. The evaluation form provide into two parts:

Part 1: the personal information of experts classified by work position, work experience, educational background, and academic title.

Part 2: The evaluation form about the educational management strategies to improve innovation ability of college students. The criteria for data interpretation based on a five-point's scale (1932), The data interpretation is as follows:

5 refers to the suitability and feasibility of the strategies at the highest level

4 refers to the suitability and feasibility of the strategies at a high level

3 refers to the suitability and feasibility of the strategies at a medium level

2 refers to the suitability and feasibility of the strategies at a low level

1 refers to the suitability and feasibility of the strategies at the lowest level

The data interpretation for average value is based on Rensis Likert (1932). The data interpretation is as follows:

4.50 - 5.00 expresses the highest level

3.50 - 4.49 expresses high level

2.50 - 3.49 expression moderate level

1.50 - 2.49 expresses low level

1.00 - 1.49 expresses the lowest level

Data Collection

The method of data collection for Aim 3: to evaluate the suitability and feasibility of educational management strategies to improve the sustainable innovation ability of college students.

The result from second stage are used to evaluate the educational management strategies to improve the students' sustainable innovation ability. the steps are as follows:

Step 1: The researcher requested a letter from the Graduate School of Bansomdejchaopraya Rajabhat University to collect evaluation from five experts from Xi'an University of Finance and Economics and Xi'an university of electronic science and technology to formulate the educational management strategy for improving sustainable innovation ability.

Step 2: The researcher distributed the evaluation forms to the five experts, chose an appropriate time and place to contact the experts, instructed them to score the assessment forms, and ensured that the a evaluation forms were collected 100%.

Step 3: The researcher Invited experts to fill out the evaluation form.

Step 4: The researcher summarized and analyzed the results of the evaluation form.

Data Analysis

Objective 3 of this study adopted a qualitative research approach. Five experts evaluated the feasibility, adaptability, and applicability of the educational management strategies for enhancing sustainable innovation abilities of college students. The evaluation results provided important references for improving the proposed strategies and refining their practical implementation in real educational contexts. The data analysis utilized the mean and standard deviation to ensure analytical reliability and consistency, while also enhancing the credibility, validity, and interpretability of the research findings.

Summary

This study adopts a mixed-methods research design that integrates quantitative and qualitative approaches and is conducted in three interrelated stages.

Phase 1: Studying the current and desired status of education management for enhancing sustainable innovation ability of college students in Shaanxi Province.

This initial stage focuses on examining the current and desired status level of sustainable innovation ability of college students and the existing educational management support mechanisms. Key challenges and constraints related to governance arrangements, curriculum implementation, learning environments, and innovation support are identified, and the essential status for enhancing sustainable innovation capability are clarified. The findings of this stage provide the necessary empirical foundation and problem-oriented evidence for subsequent stages.

Phase 2: Developing educational management strategies for enhancing sustainable innovation ability of college students in Shaanxi Province.

Building on the results of Phase 1, this phase integrates quantitative survey data and qualitative evidence to formulate targeted educational management strategies from a management perspective. The proposed strategies aim to address the identified gaps by optimizing governance mechanisms, teaching and learning

support, and innovation-supportive environments, thereby promoting the systematic and sustainable development of students' innovation capability.

Phase 3: Evaluating the feasibility and adaptability of educational management strategies for enhancing sustainable innovation ability of college students in Shaanxi Province.

In the final stage, expert review and comprehensive analysis are employed to assess the feasibility and appropriateness of the proposed educational management strategies for enhancing college students' sustainable innovation capability. This stage seeks to examine the practical applicability and effectiveness of the strategies in real higher education contexts, providing scientific evidence for their broader implementation and continuous improvement.

This 3 phase research framework ensures that the proposed strategies are evidence-based and rigorously evaluated for their practical impact, thereby offering a comprehensive and implementable educational management framework for fostering sustainable innovation ability of college students, while strengthening theoretical integration, improving contextual relevance, supporting continuous assessment processes, and enhancing institutional effectiveness in higher education innovation practices.

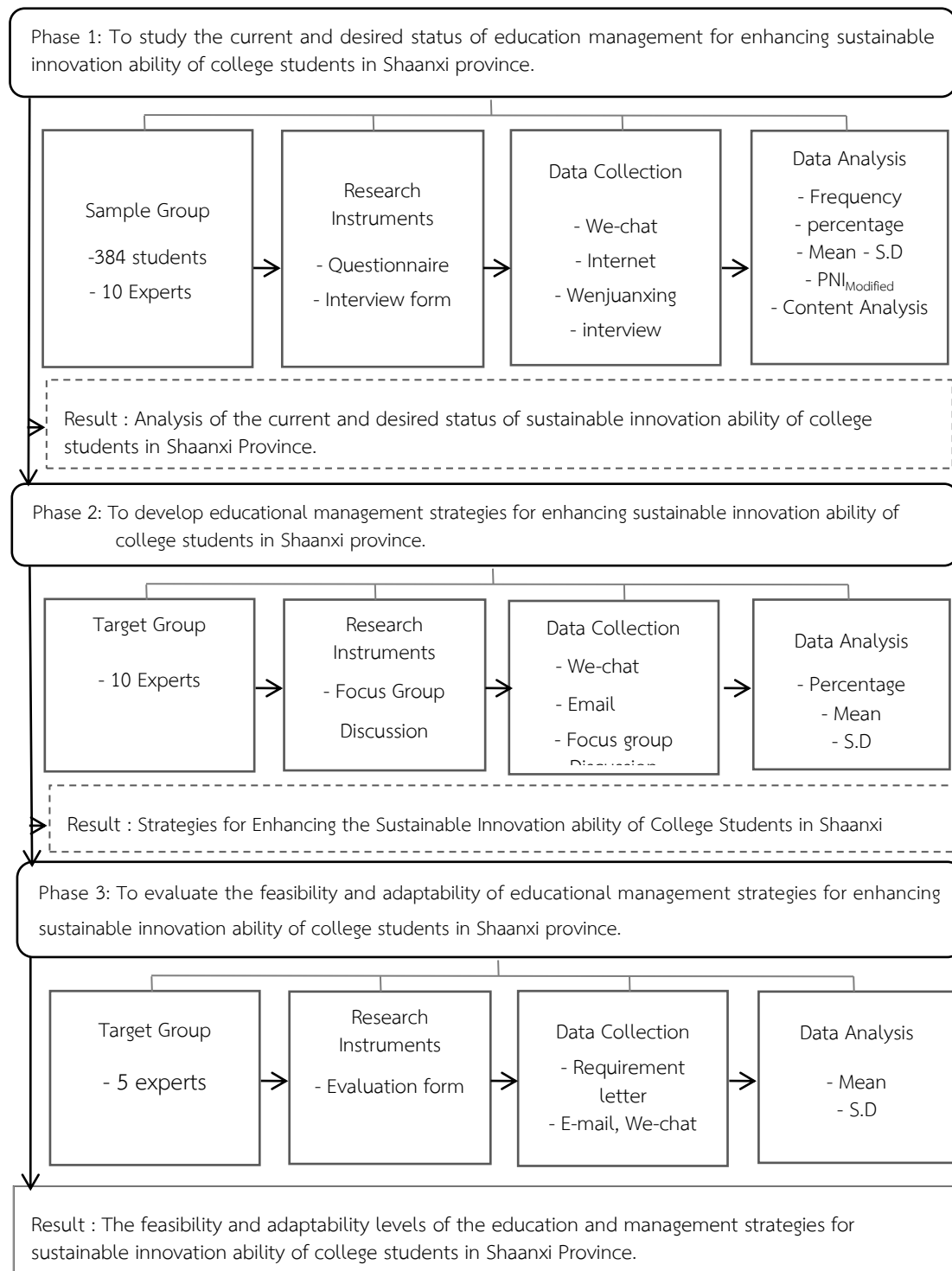


Figure 3.1 Research method

Chapter 4

Results of Analysis

The research on development of educational management strategies for enhancing sustainable innovation ability of college students in Shaanxi Province aims to achieve the following objectives: 1) To study the current and desired status of education management for enhancing sustainable innovation ability of college students in Shaanxi Province. 2) To develop educational management strategies for enhancing sustainable innovation ability of college students in Shaanxi Province. 3) To evaluate the feasibility and adaptability of educational management strategies for enhancing sustainable innovation ability of college students in Shaanxi Province. The sample and target group consisted of 384 college students for the questionnaire survey, 10 teachers and educational administrators for interviews, 10 experts for focus group discussions, and 5 experts for evaluations. Stratified random sampling and questionnaire survey methods were adopted to study the current status and desired status of sustainable innovation ability of college students in different regions of Shaanxi Province, as well as the supporting factors for promoting sustainable development. The relevant research data were divided into the following three parts:

1. Results of the current and desired status of education management for enhancing sustainable innovation ability of college students in Shaanxi Province.

- 1.1 Analysis of demographic information of participants, including gender, grade, and major, was conducted to understand the basic demographic and academic characteristics of the respondents and to provide a foundational basis for subsequent analysis of differences in sustainable innovation abilities.

- 1.2 Analyze the questionnaire information on the current and desired status of educational management for enhancing sustainable innovation ability of college students

1.2.1 Overall Analysis of Personal Traits, Educational and Learning Environment, and Social and External Factors

1.2.2 Analysis of Personal traits

1.2.3 Analysis of Education and learning environment

1.2.4 Analysis of Social and external factors

1.3 Analysis of the results of interview

1.3.1 Analysis Results from the First Round of Expert Interviews.

1.3.2 Analysis Results from the Second Round of Expert Interviews.

2. Results of the development of educational management strategies for enhancing sustainable innovation ability of college students in Shaanxi Province.

2.1 Based on the analysis results of educational management for enhancing sustainable innovation ability of college students, corresponding educational management strategies are formulated to support the systematic cultivation and sustainable innovation ability of college students.

2.1.1 SWOT and TOWS Matrix of Personal traits.

2.1.2 SWOT and TOWS Matrix of Education and learning environment.

2.1.3 SWOT and TOWS Matrix of Social and external factors.

2.1.4 SWOT and TOWS Matrix of total: Personal traits, Education and learning environment, Social and external factors.

2.1.5 SWOT and PEST Analysis of total: Personal traits, Education and learning environment, Social and external factors.

2.1.6 Results of the comprehensive analysis using SWOT Analysis PEST Analysis, and the TOWS Matrix are presented.

2.2 Analysis of focus group discussion.

2.2.1 Analysis of status information statistics of Interviewee (Expert).

2.2.2 The Three Developed Strategies derived from the focus group discussion.

2.3 Summary of development strategies.

3. Results of evaluating the feasibility and adaptability of educational management strategies for enhancing sustainable innovation ability of college students in Shaanxi Province.

3.1 An assessment and in-depth analysis of the feasibility and adaptability of sustainable development strategies for the education and management of college students' innovation abilities are conducted to evaluate their practical applicability and effectiveness in different educational contexts.

The details of the data analysis are presented below.

Phase 1. Results of the current and desired status of education management for enhancing sustainable innovation ability of college students in Shaanxi Province.

1.1 Analysis of personal information of college students, including gender, grade, and professional background, was conducted to describe the basic characteristics of the research sample and to ensure the representativeness and rationality of the survey data. The details are as follows:

Table 4.1 Analysis of demographic information of participants

Personal information		Number of People	Percentage
Gender	Male	127	33.07
	Female	257	66.93
	Total	384	100
Grade	First grade	123	32.03
	Second grade	194	50.52
	Third grade	35	9.11
	Fourth grade	31	8.07
	Postgraduate or above	1	0.26
	Total	384	100

Table 4.1 (Continued)

Personal information		Number of People	Percentage
Professional background	Engineering	113	29.43
	Literature	21	5.47
	Science	89	23.18
	Business	79	20.57
	Art	8	2.08
	Other	74	19.27
	Total	384	100

According to Table 4.1, this study involved a total of 384 valid participants. Among the respondents, 127 were male students, accounting for 33.07%, and 257 were female students, accounting for 66.93%. Among them, there were 123 first-year students, accounting for 32.03%, 194 second-year students, accounting for 50.52%, 35 third-year students, accounting for 9.11%, 31 fourth-year students, accounting for 8.07%, and 1 postgraduate student or above, accounting for 0.26%. In terms of professional background, there were 113 engineering students, accounting for 29.43%, 21 literature students, accounting for 5.47%, 89 science students, accounting for 23.18%, 79 business students, accounting for 20.57%, 8 art students, accounting for 2.08%, and 74 students from other fields, accounting for 19.27%. The overall distribution of the population involved in this questionnaire survey was relatively even.

1.2 Analysis of the questionnaire information on the current status and desired status of education management for enhancing sustainable innovation ability of college students in Shaanxi Province.

1.2.1 Overall Analysis of Personal Traits, Educational and Learning Environment, and Social and External Factors.

Based on the questionnaire survey, this study analyzed the data on the personal traits, educational and learning environment, and social and external

factors of the sustainable development of innovation ability education management for college students, and obtained the mean and standard deviation. At the same time, exploratory factor analysis was used to test the reliability and validity of each variable. Through factor analysis, the data variables in the questionnaire were found to be correlated, indicating acceptable construct consistency and providing empirical support for subsequent model refinement and interpretation.

Table 4.2 Analysis of the current and desired status of education management for enhancing sustainable innovation ability of college students

(N=384)

Dimension	Current status(D)		Desired status(I)		PNI _{modified} (I-D)/D	Rank
	$\bar{X}$	S.D.	$\bar{X}$	S.D.		
1. Personal Traits	2.26	0.86	3.15	0.76	0.394	3
2. Educational and Learning Environment	2.19	0.92	3.07	0.83	0.402	2
3. Social and External Factors	2.13	0.87	3.02	0.79	0.418	1
Total	2.19	0.88	3.08	0.79	0.405	

According to the data in Table 4.2, the current status of sustainable development of innovation ability education and management for college students, as reflected by the average score of the three aspects of the total score, is at a moderately low level ($\bar{X}=2.19$, S.D.=0.88). All aspects are at a moderately low level, with the average values from high to low being: personal traits ($\bar{X}=2.26$, S.D.=0.86), educational and learning environment ($\bar{X}=2.19$, S.D.=0.92), and social and external factors ($\bar{X}=2.13$, S.D.=0.87). This indicates that the innovation ability of college students still needs to be developed. The desired condition of sustainable development of innovation ability education and management for college students, as perceived by the surveyed students, is generally at a moderate level ($\bar{X}=3.08$, S.D.=0.79). The average values from high to low are: personal traits ($\bar{X}=3.15$,

S.D.=0.76), educational and learning environment ($\bar{X}$ =3.07, S.D.=0.83), and social and external factors ($\bar{X}$ =3.02, S.D.=0.79). There is a gap between the current condition and the desired condition of sustainable development of innovation ability education and management for college students. This indicates that the innovation ability of college students still needs to be developed. This can be seen from the total PNI value (PNI =0.405), with the values from high to low being: social and external factors (PNI= 0.418), educational and learning environment (PNI=0.402), and personal traits (PNI= 0.394). This indicates that the innovation ability of college students needs improvement in all three aspects mentioned above.

1.2.2 Analysis of current status and desired status of Personal Traits

This research mainly used Mean, Standard Deviations and PNI_{modified} to analyze the condition of each variable.

Table 4.3 Analysis of the current and desired status of education management for enhancing sustainable innovation ability of college students in terms of personal traits

Personal Traits	(n=384)					
	Current status(D)		Desired status(I)		PNI_{modified} (I-D)/D	Rank
	$\bar{X}$	S.D.	$\bar{X}$	S.D.		
1. When faced with innovative tasks, you will actively seek solutions	2.22	0.87	3.11	0.78	0.401	4
2. You often think about problems from different perspectives and put forward new viewpoints	2.24	0.83	3.14	0.72	0.402	3
3. When solving problems, you tend to prefer independent thinking	2.29	0.86	3.18	0.79	0.389	7
4. You can stay calm and manage stress and emotions effectively	2.30	0.89	3.23	0.81	0.404	2

Table 4.3 (Continued)

(n=384)

Personal Traits	Current status(D)		Desired status(I)		PNI _{modified} (I-D)/D	Rank
	$\bar{X}$	S.D.	$\bar{X}$	S.D.		
5. When faced with unexpected problems, you can quickly adjust your approach to deal with them	2.24	0.83	3.12	0.72	0.393	6
6. When faced with multiple choices, you can make decisions quickly and take action	2.34	0.87	3.23	0.78	0.380	10
7. You will take the initiative to shoulder important responsibilities and tasks within the team	2.26	0.87	3.13	0.74	0.385	8
8. In team collaboration, you can effectively express your opinions and viewpoints	2.18	0.84	3.07	0.77	0.408	1
9. You can manage your time well and maintain high work efficiency	2.29	0.84	3.17	0.76	0.384	9
10. You have a great interest in learning innovative content	2.24	0.85	3.09	0.75	0.394	5
Total	2.26	0.86	3.15	0.76	0.394	

According to the data in Table 4.3, the current status of the surveyed students' personal traits promoting the sustainable development of innovation ability education management for college students is at a medium to low level on average ($\bar{X}=2.26$, S.D.=0.86) across the 10 aspects. All aspects are at a medium to low level. The average values of each aspect, from high to low, are as follows: You can make quick decisions and take action when faced with multiple choices ($\bar{X}=2.34$, S.D.=0.87), You can remain calm and effectively manage stress and emotions

($\bar{X}$ =2.30, S.D.=0.89), You can arrange your time reasonably and maintain high work efficiency ($\bar{X}$ =2.29, S.D.=0.84), When solving problems, you tend to think independently ($\bar{X}$ =2.29, S.D.=0.86), You will take on important responsibilities and tasks in the team proactively ($\bar{X}$ =2.26, S.D.=0.87), You often think about problems from different perspectives and put forward new ideas ($\bar{X}$ =2.24, S.D.=0.83), When facing unexpected problems, you can quickly adjust your methods to deal with them ($\bar{X}$ =2.24, S.D.=0.83), You have a strong interest in learning innovative content ($\bar{X}$ =2.24, S.D.=0.85), When facing innovative tasks, you will actively seek solutions ($\bar{X}$ =2.22, S.D.=0.87), In team cooperation, you can effectively express your opinions and viewpoints ($\bar{X}$ =2.18, S.D.=0.84). This Regarding the sustainable development of innovation ability education management for college students, the desired condition of the surveyed students' personal traits was generally at a medium level (mean=3.15, standard deviation=0.76). The mean values from high to low for each level were as follows: when faced with multiple choices, you can make decisions quickly and take action ($\bar{X}$ =3.23, S.D.=0.78), you can remain calm and effectively manage stress and emotions ($\bar{X}$ =3.23, S.D.=0.81), when solving problems, you tend to think independently ($\bar{X}$ =3.18, S.D.=0.79), you can arrange your time reasonably and maintain high work efficiency ($\bar{X}$ =3.17, S.D.=0.76), you often think about problems from different perspectives and put forward new viewpoints ($\bar{X}$ =3.14, S.D.=0.72), you will take on important responsibilities and tasks in the team proactively ($\bar{X}$ =3.13, S.D.=0.74), when encountering unexpected problems, you can quickly adjust strategies to deal with them ($\bar{X}$ =3.12, S.D.=0.72), when facing innovative tasks, you will actively seek solutions ($\bar{X}$ =3.11, S.D.=0.78), you have a strong interest in learning innovative content ($\bar{X}$ =3.09, S.D.=0.75), in team cooperation, you can effectively express your opinions and viewpoints ($\bar{X}$ =3.07, S.D.=0.77). There is a gap between the current condition and the expected condition of the sustainable development of college students' innovation ability education management in terms of personal traits. This indicates that the innovation ability of college students still needs to be developed in terms of personal traits. This can be reflected in the overall PNI value (PNI=0.394), from high to low: in team

collaboration, you can effectively express your opinions and viewpoints (PNI=0.408), you can remain calm and effectively manage stress and emotions (PNI=0.404), you often think about problems from different perspectives and put forward new viewpoints (PNI=0.402), when facing innovative tasks, you will actively seek solutions (PNI=0.401), you have a strong interest in learning innovative content (PNI=0.394), when encountering unexpected problems, you can quickly adjust methods to deal with them (PNI =0.393), when solving problems, you tend to think independently (PNI=0.389), you will take on important responsibilities and tasks in the team proactively (PNI=0.385), you can arrange your time reasonably and maintain high work efficiency (PNI=0.384), when faced with multiple choices, you can make decisions quickly and take action (PNI=0.385). It can be said that in terms of personal traits, the innovation ability of college students needs to be improved in the above 10 aspects.

In summary, the results indicate that the current level of personal traits related to the sustainable development of college students' innovation abilities remains relatively low and does not fully meet the expected standards. The gaps between the current and desired status across all dimensions suggest that college students still face notable deficiencies in key innovation-related personal traits, particularly in communication within teams, emotional regulation, multi-perspective thinking, and proactive problem-solving. The PNI analysis further confirms that all ten aspects require improvement, highlighting the necessity of strengthening educational management measures aimed at cultivating students' self-regulation, cognitive flexibility, collaboration skills, and initiative. These findings provide important empirical support for the formulation of targeted educational management strategies to enhance the sustainable development of innovation abilities among college students.

1.2.3 Analysis of current status and desired status of education and learning environment.

This research mainly used Mean, Standard Deviations and PNI_{modified} to analyze the status of each variable.

Table 4.4 Analysis of current and desired status in terms of education and learning environment

(n=384)

Education and learning Environment	Current status(D)		Desired status(I)		PNI _{modified} (I-D)/D	Rank
	$\bar{X}$	S.D.	$\bar{X}$	S.D.		
1. The curriculum of the school	2.23	0.91	3.08	0.84	0.381	10
2. The school's teaching philosophy and teaching methods	2.23	0.95	3.13	0.85	0.404	6
3. The learning atmosphere in school	2.17	0.92	3.12	0.83	0.438	1
4. Adequate support for extracurricular activities	2.13	0.89	3.01	0.81	0.413	4
5. Offer specialized innovation education courses	2.16	0.94	3.08	0.87	0.426	2
6. Teachers have sufficient ability and resources to guide students in innovation	2.06	0.88	2.93	0.77	0.422	3
7. There are sufficient opportunities to participate in innovative experiments and practical projects	2.23	0.90	3.09	0.78	0.386	9
8. Have the opportunity to participate in cross-disciplinary cooperation and innovation activities	2.29	0.96	3.18	0.86	0.389	8
9. The talent cultivation system of the school	2.16	0.92	3.02	0.82	0.398	7
10. The school's evaluation system	2.19	0.93	3.08	0.83	0.406	5
Total	2.19	0.92	3.07	0.83	0.402	

According to the data in Table 4.4, the current condition of the respondents in terms of educational and learning environment is at a moderately low level ($\bar{X}=2.19$, S.D.=0.92). Each aspect is at a moderately low level, with the average values of each level from high to low being: having the opportunity to participate in interdisciplinary cooperation and innovation activities ($\bar{X}=2.29$, S.D.=0.96), having sufficient opportunities to participate in innovative experiments and practical projects ($\bar{X}=2.23$, S.D.=0.90), the school's curriculum content ($\bar{X}=2.23$, S.D.=0.91), the school's teaching philosophy and teaching methods ($\bar{X}=2.23$, S.D.=0.95), the school's evaluation system ($\bar{X}=2.19$, S.D.=0.93), the school's learning atmosphere ($\bar{X}=2.17$, S.D.=0.92), the school's talent cultivation system ($\bar{X}=2.16$, S.D.=0.92), specialized innovation education courses ($\bar{X}=2.16$, S.D.=0.94), adequate extracurricular activity support ($\bar{X}=2.13$, S.D.=0.89), and teachers having sufficient ability and resources to guide students in innovation ($\bar{X}=2.06$, S.D.=0.88). Regarding the desired condition of the educational and learning environment, it is generally at a moderate level ($\bar{X}=3.07$, S.D.=0.83). The average values from high to low for each level are as follows: having the opportunity to participate in interdisciplinary cooperation and innovation activities ($\bar{X}=3.18$, S.D.=0.86), the school's teaching philosophy and teaching methods ($\bar{X}=3.13$, S.D.=0.85), the school's learning atmosphere ($\bar{X}=3.12$, S.D.=0.83), having sufficient opportunities to participate in innovative experiments and practical projects ($\bar{X}=3.09$, S.D.=0.78), the school's evaluation system ($\bar{X}=3.08$, S.D.=0.83), the school's course content ($\bar{X}=3.08$, S.D.=0.84), offering specialized innovation education courses ($\bar{X}=3.08$, S.D.=0.87), the school's talent cultivation system ($\bar{X}=3.02$, S.D.=0.82), adequate extracurricular activity support ($\bar{X}=3.01$, S.D.=0.81), and teachers having sufficient ability and resources to guide students in innovation ($\bar{X}=2.93$, S.D.=0.77). The gap between the current condition and expectations in the educational and learning environment indicates the need for improvement. This can be seen from the overall PNI value (PNI=0.402), with the PNI values for each aspect from high to low being: the school's learning atmosphere (PNI=0.438), specialized innovation education courses (PNI=0.426), teachers having sufficient ability and resources to guide students in innovation (PNI=0.422), adequate

extracurricular activity support (PNI=0.413), the school's evaluation system (PNI=0.406), the school's teaching philosophy and teaching methods (PNI=0.404), the school's talent cultivation system (PNI=0.398), having the opportunity to participate in interdisciplinary cooperation and innovation activities (PNI=0.389), having sufficient opportunities to participate in innovative experiments and practical projects (PNI=0.386), and the school's course content (PNI=0.381). It can be described that all 10 areas in the educational and learning environment need improvement.

In summary, the findings indicate that the current educational and learning environment for cultivating college students' sustainable innovation abilities remains at a relatively low level and does not fully meet students' expectations. The noticeable gaps between the current and desired status across all dimensions suggest systematic deficiencies in the educational and management environment. In particular, aspects related to the learning atmosphere, innovation-oriented courses, teacher guidance capacity, and extracurricular support demonstrate the most urgent needs for improvement. These results highlight the necessity for universities to optimize their educational philosophy, curriculum design, support mechanisms, and resource allocation in order to create a more supportive and sustainable environment for the development of college students' innovation abilities.

1.2.4 Analysis of current and desired status of Social and External Factors

This research mainly employed descriptive statistical methods, including the mean and standard deviation, as well as the modified Priority Needs Index (PNI modified), to systematically analyze the status and relative importance of each variable and to identify gaps between the current status and desired status.

Table 4.5 Analysis of the current and desired status in terms of social and external factors

(n=384)

Social and External Factors	Current		Desired		PNI _{modified} (I-D)/D	Rank
	status(D)		status(I)			
	$\bar{X}$	S.D.	$\bar{X}$	S.D.		
1. A favorable socio-economic environment for innovation	2.13	0.89	3.08	0.81	0.446	1
2. Government policies support innovative talent development	2.10	0.87	2.95	0.78	0.411	9
3. Technology-driven innovation and application	2.10	0.87	2.99	0.79	0.424	3
4. An innovation-friendly local culture	2.13	0.89	3.05	0.83	0.432	2
5. Local industries offer strong innovation opportunities	2.13	0.88	3.02	0.78	0.418	4
6. Cross-disciplinary cooperation drives innovation	2.15	0.89	3.04	0.81	0.414	6
7. Society can provide the resources needed for innovation, such as funds and technological platforms.	2.16	0.87	3.06	0.77	0.417	5
8. Social recognition drives continuous innovation	2.12	0.85	2.97	0.75	0.401	10
9. The society has relevant introduction policies to attract innovative talents.	2.11	0.85	2.98	0.76	0.412	8
10. Globalization offers you more opportunities for innovation.	2.13	0.88	3.01	0.78	0.413	7
Total	2.13	0.87	3.02	0.79	0.418	

According to the data in Table 4.5, the 10 aspects of social and external factors influencing the innovation ability of college students are currently at a medium to low level ($\bar{X}=2.13$, S.D.=0.87). All aspects are at a medium to low level, with the means from high to low being: society can provide resources needed for innovation (such as funds, technical platforms, etc.) ($\bar{X}=2.16$, S.D.=0.87), there are abundant cross-field cooperation opportunities in society that can promote innovation development ($\bar{X}=2.15$, S.D.=0.89), local industries offer rich innovation opportunities to promote the application of new technologies and ideas ($\bar{X}=2.13$, S.D.=0.88), globalization provides more innovation opportunities ($\bar{X}=2.13$, S.D.=0.88), the current social and economic environment provides sufficient opportunities for innovative talents ($\bar{X}=2.13$, S.D.=0.89), the local cultural atmosphere encourages innovation and entrepreneurship ($\bar{X}=2.13$, S.D.=0.89), social recognition of innovation achievements can motivate you to continue innovating ($\bar{X}=2.12$, S.D.=0.85), society has relevant policies to attract innovative talents ($\bar{X}=2.11$, S.D.=0.85), the current level of scientific and technological development promotes innovation and the application of new technologies ($\bar{X}=2.10$, S.D.=0.87), and the government provides support policies for innovation to promote the development of innovative talents ($\bar{X}=2.10$, S.D.=0.87). In terms of social and external factors, the desired condition for enhancing the innovation ability of college students is generally at a medium level ($\bar{X}=3.02$, S.D.=0.79). The means from high to low are: the current social and economic environment provides sufficient opportunities for innovative talents ($\bar{X}=3.08$, S.D.=0.81), society can provide resources needed for innovation (such as funds, technical platforms, etc.) ($\bar{X}=3.06$, S.D.=0.77), the local cultural atmosphere encourages innovation and entrepreneurship ($\bar{X}=3.05$, S.D.=0.83), there are abundant cross-field cooperation opportunities in society that can promote innovation development ($\bar{X}=3.04$, S.D.=0.81), local industries offer rich innovation opportunities to promote the application of new technologies and ideas ($\bar{X}=3.02$, S.D.=0.78), globalization provides more innovation opportunities ($\bar{X}=3.01$, S.D.=0.78), the current level of scientific and technological development promotes innovation and the application of new technologies ($\bar{X}=2.99$, S.D.=0.79), society has relevant policies to

attract innovative talents ($\bar{X}=2.98$, S.D.=0.76), social recognition of innovation achievements can motivate you to continue innovating ($\bar{X}=2.97$, S.D.=0.75), and the government provides support policies for innovation to promote the development of innovative talents ($\bar{X}=2.95$, S.D.=0.78). The gap between the current condition and the desired condition indicates that the social and external factors for the sustainable development of innovation ability education and management for college students still need to be further improved. This

From the total PNI value (PNI=0.418), it can be seen that the ranking of various aspects from high to low is as follows: The current social and economic environment provides sufficient opportunities for innovative talents (PNI=0.446), the local cultural atmosphere encourages innovation and entrepreneurship (PNI=0.432), the current level of scientific and technological development promotes innovation and the application of new technologies (PNI=0.424), the local industry provides rich innovation opportunities to promote the application of new technologies and new ideas (PNI=0.418), society can provide the resources needed for innovation (such as funds, technology platforms, etc.) (PNI=0.417), there are abundant cross-field cooperation opportunities in society that can promote innovation and development (PNI=0.414), globalization provides more opportunities for innovation (PNI=0.413), society has relevant policies for introducing innovative talents (PNI=0.412), the government provides supportive policies in innovation to promote the development of innovative talents (PNI=0.411), and social recognition of innovation achievements can motivate you to continue innovating (PNI=0.401). It can be described as follows: Among the 120 aspects mentioned, all aspects related to society and external factors need improvement.

In summary, the findings indicate that the current social and external environment supporting the sustainable development of college students' innovation abilities remains insufficient and does not fully meet students' expectations. The noticeable gaps between the current and desired status across all dimensions suggest that external support systems for innovation, including policy support, cultural atmosphere, resource provision, and industry linkages, have not yet

fully played an effective facilitating role. The relatively high PNI values further indicate that improvements are particularly needed in optimizing the socio-economic environment, strengthening innovation-oriented cultural support, enhancing technological development status, and expanding opportunities for industry–education integration. These results highlight the importance of coordinated efforts among government, industry, and society to create a more supportive external environment for the sustainable development of college students' innovation abilities.

1.3 Analysis of the results of interview

1.3.1 Analysis Results from the First Round of Expert Interviews.

Based on the interview outline designed by the researchers, this study selected 10 experts from outstanding universities to investigate the supporting factors for the sustainable development of college students' innovation ability education management through interviews. The selection criteria for these 10 experts are as follows: 1) they have at least five years of school experience; 2. They are familiar with the specific condition of school development planning, teaching management and students.

The details of the interview are as follows:

The research team conducted 10 online face-to-face interviews. Each interview was one-on-one and no one else could hear the conversation to ensure that the respondents would not be distracted by other factors. The interview content is analyzed in Table 4.6.

Table 4.6 The interview content

Questions	Influencing Factors	Interview1	Interview2	Interview3	Interview4	Interview5	Interview6	Interview7	Interview8	Interview9	Interview10	Frequency	Percentage
1	1. Carry out innovation task-oriented training	√	√		√	√	√		√	√	√	8	80.0%
	2. Multidimensional Thinking Training Camp		√	√	√	√	√	√	√		√	8	80.0%
	3. Independent thinking module design		√	√	√		√	√	√	√		7	70.0%
	4. Emotion and Stress Management Course	√		√	√	√	√	√	√	√	√	9	90.0%
	5. Scenario simulation training	√	√	√	√			√	√	√	√	8	80.0%
	6. Decision-making and Execution Training Camp	√	√		√	√	√	√	√	√	√	9	90.0%
	7. Responsibility and Commitment Experience Project		√	√	√	√	√	√	√	√	√	9	90.0%
	8. Workshop on Expression and Communication	√	√	√	√	√	√	√	√	√		9	90.0%
	9. Time Management and Efficiency Enhancement Training			√	√	√	√	√	√	√	√	8	80.0%

Table 4.6 (Continued)

Questio	Influencing Factors	Interview1	Interview2	Interview3	Interview4	Interview5	Interview6	Interview7	Interview8	Interview9	Interview10	Frequency	Percentage
	10. Innovation Interest Stimulation Course	√	√	√	√	√	√	√	√	√		9	90.0%
	11. Design thinking course			√	√	√	√	√	√	√	√	8	80.0%
	12. Self-awareness and career planning guidance	√	√	√	√	√	√	√		√	√	9	90.0%
	13. Innovative Growth Archive System	√	√	√	√	√	√	√	√		√	9	90.0%
	14. The tutorial system combined with a feedback mechanism	√	√	√	√	√	√	√	√	√		9	90.0%
	15. Failure tolerance and review mechanism			√	√	√	√	√	√	√	√	8	80.0%
	16. Cross-grade Innovation Sharing Session	√	√	√	√	√	√	√	√			8	80.0%
	17. Innovation ability assessment and feedback system	√	√	√	√	√		√	√	√	√	9	90.0%
	18. Personalized Growth Plan Document	√	√			√	√	√	√	√	√	8	80.0%
2	1. Embedded Innovation Course Development			√	√	√	√	√	√	√	√	8	80.0%
	2. Interdisciplinary joint courses	√	√	√	√	√	√	√		√	√	9	90.0%
	3. Reform of Project-Based Teaching Mode	√	√	√	√	√	√	√	√	√		9	90.0%

Table 4.6 (Continued)

Questio	Influencing Factors	Interview1	Interview2	Interview3	Interview4	Interview5	Interview6	Interview7	Interview8	Interview9	Interview10	Frequency	Percentage
4.	Construction of an Online and Offline Hybrid Teaching Platform			√	√	√	√	√	√	√	√	8	80.0%
5.	Teacher Enterprise Practice Training Program	√	√	√	√	√	√	√	√	√		9	90.0%
6.	Innovative curriculum evaluation reform	√	√		√	√	√	√	√	√	√	9	90.0%
7.	Expansion of the Intra-campus Innovation Experiment Platform	√	√	√		√	√	√	√	√	√	9	90.0%
8.	Resource input for supporting innovation activities		√	√	√	√	√	√	√	√		8	80.0%
9.	Incentive Mechanism for Interdisciplinary Cooperative Innovation			√	√	√	√	√	√	√	√	9	90.0%
10.	The joint innovation guidance system for teachers and students	√	√	√	√	√	√	√	√			8	80.0%
11.	Regularized display channels for innovation achievements	√			√	√	√	√	√	√		7	70.0%

Table 4.6 (Continued)

Questio	Influencing Factors	Interview1	Interview2	Interview3	Interview4	Interview5	Interview6	Interview7	Interview8	Interview9	Interview10	Frequency	Percentage
	12. The evaluation system reflects the capacity for innovation.	√	√	√		√	√	√	√	√	√	9	90.0%
	13. Collaborative course construction between schools and enterprises	√	√	√	√	√	√	√	√	√		9	90.0%
	14. Embedding enterprise projects in the classroom			√	√	√	√	√	√	√	√	8	80.0%
	15. Special Funding System for Innovative Education		√	√	√	√	√	√	√	√	√	9	90.0%
	16. Innovative Teaching Workshop and Training Camp	√	√	√	√	√	√	√	√			8	80.0%
	17. Teaching experiment data feedback mechanism	√	√	√				√	√	√	√	7	70.0%
	18. Inter-school Resource Sharing Alliance		√	√	√	√	√	√	√	√	√	9	90.0%
3	1. Establish a university–local innovation platform	√	√	√	√	√	√	√	√	√		9	90.0%
	2. Local industry project open participation mechanism	√	√	√	√		√	√	√	√	√	9	90.0%
	3. Social Resources Open Access Program			√	√	√	√	√	√	√	√	8	80.0%
	4. Establish a university-industry innovation fund for the local area			√	√	√	√	√	√	√	√	8	80.0%

Table 4.6 (Continued)

Questio	Influencing Factors	Interview1	Interview2	Interview3	Interview4	Interview5	Interview6	Interview7	Interview8	Interview9	Interview10	Frequency	Percentage
	5. Interpretation and Alignment of Innovation Policies	√	√	√	√	√	√	√	√	√		9	90.0%
	6. Innovation and entrepreneurship-driven talent introduction mechanism	√			√	√	√	√	√	√	√	8	80.0%
	7. Plan for Cultural Atmosphere Development		√	√	√	√	√	√	√	√	√	9	90.0%
	8. Construction of cross-border collaboration platforms	√	√	√	√	√	√	√	√	√		9	90.0%
	9. The mechanism for transforming and incubating innovation outcomes has been improved	√	√	√				√	√	√	√	7	70.0%
	10. Local Role Model Lecture Hall Program	√			√	√	√	√	√	√	√	8	80.0%
	11. Regional Innovation Forum and Competition System		√	√	√	√	√	√	√	√	√	9	90.0%
	12. Social publicity and guidance mechanism	√		√	√	√	√	√	√	√		8	80.0%
	13. Globalization cooperation and exchange project expansion		√	√	√	√	√	√	√		√	8	80.0%
	14. International Innovation Competition Participation Support Mechanism	√	√	√	√		√	√	√	√	√	9	90.0%

Table 4.6 (Continued)

Questio	Influencing Factors	Interview1	Interview2	Interview3	Interview4	Interview5	Interview6	Interview7	Interview8	Interview9	Interview10	Frequency	Percentage
	15. Public innovation resource platform is open.	√	√	√	√	√		√	√	√	√	9	90.0%
	16. Construction of local entrepreneurship internship bases	√	√		√	√	√	√	√	√		8	80.0%
	17. Evaluation and feedback mechanism within the region		√	√	√	√	√	√	√	√	√	9	90.0%
	18. Social capital joint support system	√		√	√	√	√	√	√	√	√	9	90.0%
4	1. Establish a University-Community Integration Innovation Base	√		√	√	√	√	√	√	√	√	9	90.0%
	2. Bring Real Enterprise Projects into the Classroom	√	√	√	√	√		√		√	√	8	80.0%
	3. Develop a Dual-Mentor System		√	√	√	√	√	√	√	√	√	9	90.0%
	4. Create a Social Resource Matching Platform	√	√	√	√	√	√	√	√	√	√	9	90.0%
	5. Establish a University-Industry Joint Innovation Fund	√	√	√	√	√	√		√	√	√	9	90.0%
	6. Design Interdisciplinary Modular Courses	√	√	√	√		√	√	√	√	√	9	90.0%
	7. Launch a Campus-Enterprise-Government "Innovation Internship" Camp	√	√	√		√	√	√	√	√	√	9	90.0%

Table 4.6 (Continued)

Questio	Influencing Factors	Interview1	Interview2	Interview3	Interview4	Interview5	Interview6	Interview7	Interview8	Interview9	Interview10	Frequency	Percentage
	8. Establish a One-stop Incubation Service for Student Projects	√	√	√	√	√	√	√	√	√	√	8	80.0%
	9. Develop a Student Innovation Credit Bank	√	√	√	√		√	√	√	√	√	9	90.0%
	10. Fully Open Co-working and Maker Spaces		√	√	√	√	√	√	√	√	√	9	90.0%
	11. Form an Inter-school Resource Co-construction Alliance	√		√	√	√	√	√	√	√	√	9	90.0%
	12. Implement a Local Innovation Role Model Sharing Program	√	√		√	√	√	√	√	√	√	9	90.0%
	13. Develop a Data-driven Teaching Feedback System	√	√	√	√	√	√	√	√	√	√	8	80.0%
	14. Teacher Enterprise Practice Rotation Training Program.	√	√	√	√	√	√	√		√	√	9	90.0%
	15. Local Innovation Festivals and Regional Competition System	√	√		√	√	√	√	√	√	√	9	90.0%
	16. Open Access to Public Experimental and Data Resources	√	√	√	√	√	√	√	√	√	√	8	80.0%

Table 4.6 (Continued)

Questio	Influencing Factors	Interview1	Interview2	Interview3	Interview4	Interview5	Interview6	Interview7	Interview8	Interview9	Interview10	Frequency	Percentage
5	1. Vision for Sustainable Innovation: Long-term direction focusing on students as innovation agents	√	√	√	√	√	√	√	√	√	√	8	80.0%
	2. Strategic Mission: The core commitments to ability generation, teaching reconstruction, and resource sharing	√	√	√	√		√	√	√	√	√	9	90.0%
	3. Strategic Goals: Specific targets for systemic literacy, integrated teaching, and shared practice platforms	√	√	√		√	√	√	√	√	√	9	90.0%
	4. Strategic Measures: Targeted interventions across personal, environmental, and social dimensions	√	√	√	√	√	√	√	√	√	√	8	80.0%
	5. Guidelines for Implementation: Practical procedures for executing strategies within educational institutions	√	√	√	√	√	√	√	√	√		9	90.0%
	6. Innovation Awareness Awakening: Strategies to stimulate curiosity and intrinsic innovative potential	√	√	√	√	√	√	√	√	√		9	90.0%
	7. Multidimensional Thinking Development: Cultivating systems thinking and diverse problem-solving perspectives	√	√	√	√	√	√	√	√	√	√	8	80.0%

Table 4.6 (Continued)

Questio	Influencing Factors	Interview1	Interview2	Interview3	Interview4	Interview5	Interview6	Interview7	Interview8	Interview9	Interview10	Frequency	Percentage
	8. Psychological Resilience & Stress Management: Enhancing the ability to manage pressure and recover from failures	√	√	√	√	√	√	√		√	√	9	90.0%
	9. Decision-making & Execution Ability: Training for rapid action and effective project implementation	√	√	√		√	√	√	√	√	√	9	90.0%
	10. Independent Thinking & Self-directed Learning: Designing modules that foster autonomy and original ideas	√	√	√	√	√	√	√	√	√	√	8	80.0%
	11. Task-based & Project-driven Pedagogy: Transforming classrooms through real-world problem-solving	√	√	√	√	√	√	√	√	√	√	8	80.0%
	12. Task-based & Project-driven Pedagogy: Real-world problem-solving	√	√	√	√	√	√	√	√	√	√	8	80.0%
	13. Hybrid Innovation Platforms: Integrating online and offline resources for flexible learning	√	√	√	√	√	√	√	√	√	√	9	90.0%
	14. Dual-Mentor ship System: Combining academic guidance with professional industry expertise	√	√	√	√	√	√	√	√	√	√	9	90.0%

Table 4.6 (Continued)

Questio	Influencing Factors	Interview1	Interview2	Interview3	Interview4	Interview5	Interview6	Interview7	Interview8	Interview9	Interview10	Frequency	Percentage
	15. Practical Ecosystem & Maker Spaces: Providing open co-working spaces and innovation laboratories	√	√	√	√	√	√	√	√	√	√	8	80.0%
	16. Industry-University-Community Collaboration: Connecting institutional resources with local economic demands	√	√	√	√	√	√	√	√	√	√	9	90.0%
	17. Competency-based Evaluation System: Implementing innovation credit banks and achievement-oriented assessments	√	√	√	√	√	√	√	√	√	√	9	90.0%
	18. Policy & Special Funding Support: Ensuring sustainability through financial mechanisms and institutional guarantees	√	√	√	√	√	√	√	√	√	√	8	80.0%

According to Table 4.6, these 10 tables summarize various strategies and suggestions collected from interviews with ten participants, forming an integrated analytical basis for understanding the sustainable development of innovation ability education management for college students. These strategies focus on enhancing the sustainable development of innovation ability education management for college students. The respondents provided feedback on several key areas, including individual growth and core competence shaping, innovation teaching system and curriculum reform, construction of practical platforms and resource support, external collaboration and policy environment optimization, as well as construction of innovation culture and value guidance. The five strategic areas constitute a panoramic ecological map for cultivating college students' innovation ability, covering the entire chain from individual quality, teaching mechanisms, and social support to policy coordination and cultural construction, thereby promoting sustainable educational management development and systematic empowerment of student growth.

Based on the interview data you provided Table 4.11, the following analysis is presented from the perspective of educational management for cultivating sustainable innovation ability of college students. The discussion can be grouped into five main aspects: pedagogical innovation, platform and resource support, faculty guidance mechanisms, collaborative innovation systems, and institutional policy support.

1. Pedagogical Innovation

The interview results indicate strong support for task-based and project-driven pedagogy (80%) and the competency-based evaluation system (90%), suggesting that experts widely recognize practice-oriented teaching and outcome-based assessment as important pathways for enhancing students' innovation ability. Project-based learning strengthens real-world problem-solving skills and fosters innovative thinking, while competency-based evaluation systems, such as innovation credit banks and achievement-oriented assessments, help incorporate innovation activities into formal educational frameworks. These developments reflect a gradual shift in higher

education from traditional knowledge transmission toward competence cultivation and innovation-oriented learning.

2. Innovation Platforms and Resource Support

The high recognition of hybrid innovation platforms (90%) and practical ecosystems and maker spaces (80%) indicates that innovation education increasingly relies on diversified learning environments and accessible resources. Blended online–offline platforms improve learning flexibility and expand access to innovation-related resources, while maker spaces and laboratories provide essential environments for experimentation, collaboration, and creative practice. The integration of digital technologies with physical innovation spaces contributes to the development of more comprehensive innovation ecosystems within universities.

3. Faculty Support and Mentorship Mechanisms

The dual-mentorship system (90%) received strong support, highlighting the importance of combining academic supervision with professional industry expertise. This approach facilitates closer connections between theoretical instruction and practical application, enhances the quality of innovation guidance, and enables students to better understand industry demands and innovation processes. Such mentorship structures also help strengthen professional development opportunities for faculty members engaged in innovation education.

4. Collaborative Innovation Mechanisms

The strong endorsement of industry–university–community collaboration (90%) reflects the increasing emphasis on cooperative innovation education models. Collaboration among universities, industries, and local communities expands opportunities for applied innovation practice, supports technology transfer, and aligns educational activities with regional economic and social development needs. These partnerships also contribute to broader innovation networks that enhance students' exposure to real-world innovation contexts.

5. Institutional and Policy Support

Recognition of policy and special funding support (80%) indicates that institutional guarantees remain crucial for sustaining innovation education initiatives.

Financial investment supports the continuity of innovation projects and infrastructure development, while policy frameworks provide strategic direction, encourage educational reform, and facilitate resource coordination. These factors contribute to the stability and long-term viability of innovation education systems.

Overall, the interview findings suggest that the cultivation of college students' sustainable innovation ability is increasingly supported by diversified pedagogical approaches, integrated innovation platforms, strengthened mentorship systems, expanded collaborative partnerships, and improved institutional support. The consistently high levels of expert agreement (80%–90%) indicate broad recognition of the need for a multidimensional and systematic innovation education framework. Future efforts should focus on enhancing coordination among teaching reform, resource development, faculty capacity building, cross-sector collaboration, and policy support to promote the sustained development of students' innovation ability.

1.3.2 Analysis Results from the Second Round of Expert Interviews

Table 4.7 Analysis interview content

Strengths (S)
1. The regional universities possess a profound academic heritage and a solid student foundation, providing strong intellectual support and human capital for the cultivation of innovation abilities
2. Students demonstrate strong adaptability and a high level of self-motivation, enabling them to respond effectively to changing learning environments and innovation-oriented challenges
3. some universities have initially established internal innovation support mechanisms, providing basic institutional and organizational support for innovation-related activities

Table 4.7 (Continued)

Weaknesses (W)
1. There are structural shortfalls in practical opportunities and resource allocation, limiting students' access to hands-on innovation experiences
2. Students exhibit insufficient initiative and a lack of diversity in innovative thinking, which constrains creative exploration and problem-solving
3. Educational incentive and evaluation mechanisms are not well aligned, reducing their effectiveness in encouraging innovation
Opportunities (O)
1. A series of policies on innovation and entrepreneurship at both the national and local levels have been rolled out intensively, injecting institutional dividends into innovation education in colleges and universities
2. The development of new quality productivity creates opportunities for technology-driven transformation and innovation-oriented teaching reform.
3. Regional integration and the university–city collaboration model are continuously deepening, providing stronger support for resource sharing, industry–education integration, and innovation-driven development
Threats (T)
1. The intensification of talent competition has led to a significant “talent suction” effect in developed regions, increasing risk of talent outflow from local universities.
2. Society's understanding and acceptance of innovative educational achievements remain limited, which constrains the transformation and broader application of innovation outcomes
3. External uncertainties and risks, including policy fluctuations and economic instability, may disrupt the pace and continuity of innovation promotion in universities

According to Table 4.7, the SWOT analysis based on the interview content highlights several key points for enhancing the innovation ability of college students. Overall, regional universities demonstrate relatively strong internal foundations for innovation development. Their accumulated academic heritage, relatively stable student resources, and gradually improving institutional support mechanisms provide important intellectual capital and organizational status for cultivating students' innovation abilities. At the individual level, students generally show good adaptability and self-motivation, enabling them to respond positively to evolving learning environments and innovation-oriented educational demands. These internal strengths create a relatively favorable starting point for advancing innovation education.

However, several internal constraints remain evident. Structural deficiencies in practical opportunities, imbalances in resource allocation, and insufficient exposure to authentic innovation scenarios limit students' hands-on experience and applied innovation competence. Meanwhile, some students exhibit relatively weak initiative in innovative exploration and limited diversity in creative thinking, which may constrain deeper engagement in innovation activities. In addition, existing educational incentive and evaluation systems are not always well aligned with innovation-oriented goals, reducing their effectiveness in motivating students and teachers to actively participate in innovation practices. These issues indicate the need for further optimization in educational management, curriculum design, and evaluation mechanisms.

From an external perspective, significant opportunities are emerging. A series of national and local innovation and entrepreneurship policies have provided strong institutional support for universities to promote innovation education. The development of new quality productivity, driven by digitalization, technological advancement, and industrial upgrading, creates favorable status for integrating technology into education and promoting innovation-oriented teaching reform. Furthermore, the continuous deepening of regional integration and university-city collaboration offers expanded possibilities for resource sharing, industry-education

integration, collaborative research, and innovation-driven regional development. These factors collectively provide a supportive macro-environment for enhancing students' innovation abilities.

At the same time, external challenges and uncertainties also exist. Intensified competition for high-level talent has produced a noticeable “talent suction” effect in economically developed regions, increasing the risk of talent outflow from regional universities and potentially weakening local innovation capacity. In addition, societal recognition and acceptance of innovation education achievements remain somewhat limited, which may hinder the transformation, application, and broader dissemination of innovation outcomes. Policy fluctuations, economic uncertainties, and other external risks may also affect the continuity, stability, and long-term effectiveness of innovation education initiatives.

In summary, the sustainable development of college students' innovation ability in regional universities requires a balanced approach that simultaneously leverages internal strengths, addresses structural weaknesses, capitalizes on emerging policy and technological opportunities, and mitigates external risks. Strengthening institutional coordination, improving practical teaching status, optimizing incentive and evaluation mechanisms, expanding collaborative innovation networks, and fostering a more supportive cultural and policy environment will be crucial for promoting the long-term, stable, and high-quality development of innovation education.

Phase 2. Results of the development of educational management strategies for enhancing sustainable innovation ability of college students in Shaanxi Province.

2.1 Based on the analysis of the current and desired status of sustainable management in college students' innovation ability education, development strategies should be formulated.

2.1.1 Results of SWOT and TOWS Matric Analysis of personal traits aspect.

Table 4.8 SWOT analysis: personal traits aspect

S	W
S1: Strong decision-making and execution ability in complex situations S2: Effective time management and consistently high overall work efficiency levels S3: Proactive sense of responsibility and strong initiative in complex collaborative team tasks	W1: Insufficient initiative in expressing ideas within team collaboration W2: Stress and emotional regulation abilities require further improvement W3: Inconsistent ability to think from multiple perspectives and generate innovative ideas
O	T
O1: National policies support "mass entrepreneurship and innovation" education O2: Expansion of the school-enterprise cooperation platform O3: The popularization of digital tools	T1: Unbalanced regional economic development T2: Employment pressure forces conservative choices T3: The external outstanding talents have great appeal

According to the SWOT analysis of college students' personal traits for innovation ability presented in Table 4.8, several important characteristics can be identified. In terms of strengths, college students demonstrate relatively strong internal foundations for innovation ability, as reflected in their ability to make decisions and execute actions efficiently in complex situations, manage time effectively with high work efficiency, and proactively assume responsibility and initiative in team tasks. These strengths indicate that students generally possess sound self-management capacity, action orientation, and a sense of responsibility, which provide a solid basis for participation in innovative activities. However, the analysis also reveals notable weaknesses at the individual level, mainly manifested in insufficient initiative in expressing ideas during team collaboration, inadequate stress

and emotional regulation abilities, and instability in thinking from multiple perspectives and generating innovative ideas. These limitations suggest that although students are capable of task execution, their innovation-related communication skills, emotional resilience, and sustained creative thinking still require further enhancement. From an external perspective, several opportunities create favorable status for improving students' innovation ability, including strong national policy support for "mass entrepreneurship and innovation" education, the expansion of school-enterprise cooperation platforms, and the increasing popularization of digital tools, which together provide supportive institutional and technological environments for innovation practice. At the same time, students also face significant external threats, such as unbalanced regional economic development, employment pressure that encourages conservative career choices, and intensified competition resulting from the strong attraction of outstanding external talents. If these challenges are not properly addressed, they may weaken students' motivation to engage in innovative exploration despite the presence of internal strengths and external opportunities.

In summary, the SWOT analysis indicates that college students possess a relatively solid foundation of personal traits that support the development of innovation ability, particularly in terms of execution, self-management, and responsibility awareness. However, existing weaknesses related to communication initiative, emotional regulation, and sustained innovative thinking may constrain the full realization of this potential if not adequately addressed. Meanwhile, although the external environment offers valuable opportunities through supportive policies, cooperative platforms, and digital technologies, it also presents considerable challenges stemming from regional disparities and competitive pressures. Therefore, educational management should adopt targeted and systematic strategies that focus on strengthening students' practical engagement, enhancing innovation-related communication and emotional resilience, and creating supportive learning environments that effectively connect internal capacities with external opportunities.

Such an approach is essential for mitigating potential threats and promoting the sustainable cultivation of college students' innovation ability.

Based on the TOWS matrix provided in Table 4.6, the following is an analysis of the suggested strategies for personal traits:

1) SO Strategies (Strengths-Opportunities)

S1 and O1: By aligning students' strong decision-making and execution ability in complex situations with national policy support for "mass entrepreneurship and innovation" education, universities can create structured innovation practice pathways that emphasize action-oriented learning. Through policy-backed programs such as innovation training projects, entrepreneurship competitions, and startup incubation initiatives, students can be guided to rapidly identify opportunities, make informed decisions, and implement innovative solutions in real or simulated contexts. This strategy not only maximizes the effectiveness of supportive policies but also transforms students' individual execution strengths into tangible innovation outcomes, thereby enhancing their overall innovation ability.

S2 and O3: By integrating students' effective time management and high work efficiency with the widespread adoption of digital tools, universities can further amplify students' innovation productivity. The use of digital technologies such as artificial intelligence applications, project management platforms, and online learning systems enables students to optimize task scheduling, streamline collaboration processes, and improve information processing efficiency. This alignment allows students to leverage technological support to manage complex innovation tasks more effectively, sustain high levels of performance, and enhance the overall quality and efficiency of innovation activities.

S3 and O2: By combining students' proactive sense of responsibility and initiative in team tasks with the expansion of school-enterprise cooperation platforms, universities can create authentic collaborative innovation environments that emphasize role engagement and task ownership. Through participation in joint university-enterprise projects, internships, and practice-based innovation programs, students are encouraged to take on key responsibilities, coordinate team efforts, and

actively contribute to project implementation. This strategy not only enhances students' teamwork and leadership capabilities but also facilitates the transformation of individual initiative into collective innovation outcomes within real-world contexts.

2) ST Strategies (Strengths-Threats)

S1 and T1: By leveraging students' strong decision-making and execution ability in complex situations, universities can help mitigate the negative impact of unbalanced regional economic development on innovation opportunities. When faced with unequal access to innovation resources across regions, students can be guided to make rational choices, prioritize feasible innovation paths, and actively implement alternative solutions such as online collaboration, virtual projects, and cross-regional innovation initiatives. This strategy enables students to maintain innovation engagement despite external structural constraints, transforming individual execution strengths into adaptive responses to regional disparities.

S2 and T2: By leveraging students' effective time management and high work efficiency, universities can help students respond proactively to employment pressure that often forces conservative career choices. Efficient allocation of time allows students to balance innovation activities with academic and employment preparation, reducing the perceived risk of engaging in innovative exploration. At the same time, high work efficiency enables students to participate in innovation projects without compromising core academic or career objectives. This strategy helps alleviate opportunity-cost concerns and encourages students to maintain innovation engagement even under intense employment pressure.

S3 and T3: By leveraging students' proactive sense of responsibility and initiative in team tasks, universities can effectively help mitigate the strong attraction of outstanding external talents in competitive environments. In collaborative innovation projects, students who actively assume responsibilities and consistently demonstrate initiative are more likely to form stable team roles, develop irreplaceable collaborative value, and significantly enhance their sense of belonging and long-term engagement. This strategy further strengthens internal team cohesion and collective innovation capacity, enabling students to compete through sustained

contribution and teamwork rather than individual comparison alone, thereby reducing the potential deterrent effect of increasingly intense external talent competition pressures.

3) WT Strategies (Weaknesses-Threats)

W1 and T1: Given students' insufficient initiative in expressing ideas during team collaboration and the constraints posed by unbalanced regional economic development, universities should adopt targeted measures to prevent the amplification of these disadvantages. In regions with relatively limited innovation resources, passive communication may further reduce students' access to collaborative opportunities and innovation platforms. Therefore, structured teamwork mechanisms, such as role-based task allocation, guided discussion sessions, and communication skills training, should be introduced to encourage active idea expression. By enhancing students' participation and visibility within teams, this strategy helps mitigate the negative effects of regional disparities and prevents individual weaknesses from being exacerbated by external structural constraints.

W2 and T2: Given students' insufficient stress management and emotional regulation abilities, combined with employment pressure that often forces conservative career choices, there is a risk that students may avoid innovative exploration due to heightened anxiety and fear of failure. To address this issue, universities should incorporate psychological support mechanisms, resilience training, and career guidance into innovation education. By helping students develop coping strategies for stress and uncertainty, this approach reduces the psychological burden associated with innovation-related risks and enables students to make more balanced decisions under employment pressure. As a result, students are more likely to sustain engagement in innovation activities rather than defaulting to overly cautious choices.

W3 and T3: When students exhibit an inconsistent ability to think from multiple perspectives and generate innovative ideas, the strong attraction of outstanding external talents may further weaken their confidence and willingness to

engage in innovation. To prevent this disadvantage from being amplified by external competition, universities should provide structured innovation training that emphasizes divergent thinking, iterative idea development, and reflective learning. Through continuous practice, systematic feedback, and meaningful peer collaboration, students can gradually stabilize their creative thinking processes and develop distinctive, contextually relevant innovation strengths. This strategy helps students build internal confidence and sustained innovative capacity, thereby reducing the potential discouraging impact of increasingly intense external talent competition pressures.

4) WO Strategies (Weaknesses-Opportunities)

W1 and O1: In view of students' insufficient initiative in expressing ideas within team collaboration, national policy support for "mass entrepreneurship and innovation" education provides an important opportunity for targeted improvement. Universities can make full use of policy-backed innovation programs, entrepreneurship courses, and funded practice projects to embed structured communication and participation requirements into innovation activities. By designing task-based discussions, presentation-oriented assessments, and role-specific responsibilities, this strategy encourages students to actively articulate ideas and engage in collaborative innovation. Leveraging policy support in this way helps transform an individual communication weakness into a developmental focus within institutionalized innovation education.

W2 and O3: Given that students' stress management and emotional regulation abilities require further improvement, the widespread use of digital tools offers new opportunities for targeted intervention. Universities can utilize online psychological support platforms, digital well-being applications, and AI-assisted counseling systems to help students monitor emotional states, manage stress, and access timely guidance. In addition, digital learning environments allow flexible participation in innovation activities, reducing time pressure and psychological burden. By integrating emotional regulation training with digital tools, this strategy helps students better cope with uncertainty and pressure in innovation processes.

W3 and O2: In response to students' inconsistent ability to think from multiple perspectives and generate innovative ideas, the expansion of school–enterprise cooperation platforms provides a valuable opportunity for improvement. Through participation in enterprise-led projects, industry internships, and cross-disciplinary collaborative tasks, students are exposed to diverse problem contexts and practical constraints. This real-world engagement encourages students to consider problems from multiple stakeholder perspectives and apply innovative thinking in complex situations. As a result, school–enterprise collaboration helps stabilize and enhance students' creative thinking capacity and supports the development of practical innovation ability.

Overall, based on questionnaire data, PNI analysis, and the SWOT framework, this study systematically examines the innovation ability of college students from the perspective of personal traits and developmental characteristics. The findings indicate that college students generally possess significant internal strengths, including strong decision-making and execution ability, effective time management, high work efficiency, and a clear sense of responsibility in team tasks, which together provide a solid and practical foundation for sustained innovation practice. However, weaknesses such as insufficient initiative in idea expression during collaboration, limited stress tolerance and emotional regulation capacity, and instability in multi-perspective thinking and innovative idea generation may constrain the full realization and transformation of their innovation potential.

The external environment presents both opportunities-such as supportive national policies for “mass entrepreneurship and innovation,” continuous expansion of school–enterprise cooperation platforms, and the widespread popularization of digital tools and intelligent technologies-and challenges, including unbalanced regional economic development, increasing employment pressure leading to more conservative career choices, and intensified competition from outstanding external talents in the innovation ecosystem. By comprehensively integrating SO, ST, WO, and WT strategies, this study proposes targeted and operable pathways that align internal strengths with external opportunities, systematically address existing weaknesses, and

proactively mitigate potential environmental threats. Through the structured, coordinated, and long-term implementation of these strategies, college students can gradually establish a more stable, coherent, and sustainable system of personal traits and innovation competencies, strengthen their adaptability in dynamic environments, and enhance their capacity for continuous self-improvement and reflective growth, thereby promoting the high-quality and long-term development of innovation ability from a comprehensive educational management perspective.

2.1.2 Results of SWOT and TOWS Matric Analysis of Education and learning environment aspect.

Table 4.9 SWOT analysis: education and learning environment aspect

S	W
S1: Well-structured curriculum that effectively supports sustainable innovation development	W1: The learning atmosphere for innovation within the institution requires further enhancement
S2: Abundant opportunities for participation in innovative experiments and practical projects	W2: The provision of specialized innovation-oriented courses remains insufficient
S3: Accessible opportunities for cross-disciplinary collaboration and innovation activities	W3: Teachers' capacity and available resources for guiding students in innovation need strengthening
O	T
O1: The country is vigorously promoting the reform of innovation and entrepreneurship education	T1: The eastern region has a strong appeal in terms of educational resources, but there is a serious outflow of talent
O2: Under the background of the "Western Development Initiative", policy inclination is obvious	T2: Society's understanding of innovation ability is still not comprehensive
O3: Digital educational technology is constantly becoming more widespread	T3: There is a lack of in-depth collaborative mechanisms among universities

According to the SWOT analysis of the education and learning environment for innovation ability presented in Table 4.9, universities generally demonstrate a relatively solid yet uneven foundation for innovation cultivation. In terms of strengths, higher education institutions benefit from well-structured curricula that support innovation development, abundant opportunities for participation in innovative experiments and practical projects, and accessible platforms for cross-disciplinary collaboration. These advantages reflect a strong academic atmosphere, a solid resource base, and the effective implementation of innovation and entrepreneurship policies, which are largely consistent with the desired objectives of innovation-oriented education. However, several weaknesses remain evident. The learning atmosphere for innovation within institutions requires further enhancement, the supply of specialized innovation-oriented courses is still insufficient, and teachers' capacity and available resources for guiding students in innovation activities need strengthening. These shortcomings indicate a gap between current educational practices and the requirements of practice-oriented and student-centered innovation cultivation. From an external perspective, the education and learning environment is influenced by both opportunities and threats. On the one hand, the state's vigorous promotion of innovation and entrepreneurship education reform, the clear policy inclination under the "Western Development Initiative," and the widespread application of digital education technologies provide favorable institutional and technological status for improving innovation education. On the other hand, the strong attraction of educational resources in eastern regions, resulting in talent outflow, incomplete societal understanding of innovation ability, and the lack of in-depth collaborative mechanisms among universities pose significant challenges that may constrain the effectiveness of innovation education.

In summary, the SWOT analysis indicates that the current education and learning environment offers important foundational support for the cultivation of college students' innovation ability, while also facing internal structural weaknesses and external environmental constraints. To achieve a more balanced and sustainable innovation education system, it is necessary to further optimize curriculum design,

strengthen teachers' guidance capacity, and enhance the innovation-oriented learning atmosphere, while simultaneously leveraging policy support and digital technologies and promoting inter-university collaboration. Addressing these issues is essential for narrowing the gap between existing practices and desired outcomes and for improving the overall effectiveness of innovation ability cultivation in higher education. Based on the TOWS Matrix provided for the education and learning environment aspect, here's an analysis using the strategies outlined:

1) SO Strategies (Strengths-Opportunities)

S1 and O1: Building on a well-structured curriculum that supports innovation development, universities should actively align teaching design with the national reform of innovation and entrepreneurship education. Against the background of the country's vigorous promotion of innovation and entrepreneurship education and the construction of high-quality courses, universities can systematically integrate innovation-oriented content into existing curricula, optimize course structures, and strengthen curriculum coherence. By embedding policy requirements into teaching practice, this approach helps transform policy guidance into stable curricular mechanisms, thereby enhancing the effectiveness of innovation education.

S2 and O2: Relying on abundant opportunities for participation in innovative experiments and practical projects, and taking advantage of the clear policy inclination under the "Western Development Initiative," universities can further expand practice-oriented innovation platforms. By increasing support for experimental teaching, project-based learning, and applied research activities that serve regional development needs, students can be encouraged to engage in real-world innovation practices. This strategy contributes to improving students' practical innovation ability while converting regional policy support into sustainable educational outcomes.

S3 and O3: Leveraging accessible opportunities for cross-disciplinary collaboration and innovation activities together with the widespread application of digital educational technologies, universities can promote integrated and diversified innovation education models. Through the use of digital platforms, online

collaborative tools, and virtual laboratories, disciplinary and spatial barriers can be reduced, enabling students from different academic backgrounds to participate in collaborative innovation. This digital empowerment of interdisciplinary cooperation helps foster a more open, flexible, and efficient innovation learning environment.

2) ST Strategies (Strengths-Threats)

S1 and T1: Based on a well-structured curriculum that supports innovation development, universities can enhance their regional educational competitiveness to mitigate the strong attraction of educational resources in eastern regions and the resulting talent outflow. By continuously improving curriculum quality, emphasizing distinctive and forward-looking course design, and integrating regional development needs into teaching content, universities can increase their institutional attractiveness and provide students with competitive learning and development pathways, thereby alleviating talent drain to some extent.

S2 and T2: Leveraging abundant opportunities for participation in innovative experiments and practical projects, universities can help address society's incomplete understanding of innovation ability. By strengthening practice-oriented innovation activities and linking project outcomes with social services and industry needs, students' innovation capabilities can be demonstrated in a more tangible and diversified manner. This approach not only enhances students' practical innovation skills but also promotes a more comprehensive and objective social perception of innovation ability.

S3 and T3: To promote the sharing of high-level resources among universities and solve the problem of insufficient inter-university collaboration, Shaanxi Province should take advantage of the existing resource strengths of key universities to build an "Innovative Education Collaboration Platform for Universities within the Province", and coordinate high-quality courses, online teaching, practical bases, and teaching staff resources to facilitate the joint construction and sharing of resources. By means of cross-university joint courses, joint mentorship systems, and joint project-based learning, the efficiency of educational resource utilization can be enhanced, and the overall ability to cultivate innovative talents can be strengthened. This collaborative

mechanism can also promote policy coordination, academic exchange, and regional innovation ecosystem development.

3) WT Strategies (Weaknesses-Threats)

W1 and T1: Given that the learning atmosphere for innovation within institutions still requires further enhancement, universities may be more vulnerable to the strong attraction of educational resources in eastern regions, which intensifies talent outflow. To mitigate this threat, it is necessary to cultivate a more inclusive and innovation-oriented campus culture by strengthening institutional support, improving incentive mechanisms for innovative activities, and creating visible innovation communities. Enhancing the internal innovation atmosphere can help retain students and faculty by increasing their sense of belonging and development prospects within the region.

W2 and T2: The insufficient provision of specialized innovation-oriented courses, combined with society's incomplete understanding of innovation ability, may limit the recognition and effectiveness of innovation education outcomes. Universities should therefore clarify innovation competence standards and embed innovation objectives more explicitly into curricula through modular and practice-based course design. By aligning course content with social and industry expectations, students' innovation capabilities can be more clearly demonstrated, thereby improving social recognition and reducing external misjudgment of innovation education value.

W3 and T3: Teachers' limited capacity and insufficient resources for guiding student innovation, together with the lack of in-depth collaborative mechanisms among universities, further constrain the effectiveness of innovation education. Addressing this issue requires strengthening inter-university cooperation in faculty development, resource sharing, and joint innovation platforms. Through collaborative training programs, shared laboratories, and co-supervised projects, universities can enhance teachers' innovation guidance abilities while gradually establishing more sustainable and systematic collaborative mechanisms, improving knowledge exchange efficiency and promoting long-term institutional innovation capacity.

4) WO Strategies (Weaknesses-Opportunities)

W1 and O2: Although the learning atmosphere for innovation within institutions still requires further enhancement and sustained strategic attention, the national promotion of innovation and entrepreneurship education reform provides a valuable and timely opportunity for continuous improvement. Universities can actively take advantage of policy guidance and institutional incentives to foster a more dynamic, inclusive, and innovation-oriented campus culture by organizing diverse innovation competitions, comprehensive entrepreneurship training programs, interdisciplinary workshops, and project-based experiential learning activities. Through the systematic and well-coordinated integration of national reform requirements into daily teaching practices and campus governance structures, the overall innovation climate can be gradually and sustainably strengthened across different academic disciplines and student groups.

W2 and O3: The insufficient provision of specialized innovation-oriented courses can be effectively addressed by strategically leveraging the policy inclination under the “Western Development Initiative.” With increased policy support, stable financial guarantees, and targeted funding allocations, universities can systematically optimize curriculum structures by introducing more innovation-focused, interdisciplinary, and practice-oriented courses aligned with regional economic transformation and development needs. This comprehensive approach not only helps compensate for current curricular gaps and structural imbalances but also promotes the localized and context-sensitive development of innovation education systems, fostering sustainable talent cultivation mechanisms and significantly enhancing long-term regional innovation capacity and competitiveness.

W3 and O1: Teachers’ limited capacity and insufficient resources for guiding student innovation can be effectively improved through the widespread application of digital educational technologies. By utilizing online teaching platforms, virtual laboratories, and AI-assisted instructional tools, universities can expand access to high-quality teaching resources and professional training for faculty members. Digital empowerment enables teachers to enhance their innovation guidance capabilities

while reducing resource constraints, thereby supporting more effective innovation education practices, improving instructional flexibility, fostering collaborative learning, and strengthening the sustainability of innovation-oriented teaching development.

In summary, the WO strategies highlight the importance of leveraging external policy and technological opportunities to address internal weaknesses in the educational and learning environment. On the one hand, the continuous promotion of innovation and entrepreneurship education reform at the national level, together with the policy inclination under the “Western Development Initiative,” provides strong institutional support for universities to improve the innovation learning atmosphere, optimize curriculum structures, and reallocate educational resources. On the other hand, the increasing popularization of digital educational technologies offers practical means to enhance teachers’ capacity for innovation guidance and to alleviate constraints related to limited resources. By actively aligning with policy directions, enriching innovation-oriented courses, and strengthening technological empowerment, universities can gradually overcome existing deficiencies and create a more supportive environment for the sustainable development of college students’ innovation ability.

2.1.3 Results of SWOT and TOWS Matric Analysis of Social and external factors aspect.

Table 4.10 SWOT Analysis: Social and external factors aspect.

S	W
S1: Strong social recognition that encourages and sustains continuous innovation S2: Supportive government policies promoting the development of innovative talents S3: Effective talent introduction policies that attract and retain innovative professionals	W1: The socio-economic environment provides insufficient support for innovation activities W2: The local culture is not sufficiently innovation-friendly W3: Technology-driven innovation and its practical application remain underdeveloped
O	T
O1: Digital economy and industrial upgrading drive innovation O2: The "Belt and Road Initiative" strategy expands international resources O3: Local governments promote coordinated school–local development	T1: The phenomenon of high-level talent outflow is prominent T2: There is insufficient recognition of the value of innovative education in society T3: Uncertainty brought about by adjustments in macro policies

According to Table 4.10, the SWOT analysis of the sustainable development of innovation ability education management for college students shows that this system is shaped by the combined influence of internal strengths and weaknesses as well as external opportunities and threats. On the one hand, continuous strengthening of policy-driven forces, the aggregation of regional scientific research and educational resources, and the enhanced interaction between military–civilian integration and high-tech industries provide strong institutional support and practical platforms for innovation education, which are highly consistent with the expected goals of sustainable development. On the other hand, imbalances in regional development and resource allocation, insufficient enterprise support for innovation

education, and relatively low social acceptance of innovation education outcomes reveal clear gaps between current practice and the demands of high-quality, sustainable management. Meanwhile, the expansion of the digital economy and industrial upgrading, the opening of international resources under the “Belt and Road” Initiative, and the promotion of coordinated development between universities and local governments offer important opportunities to strengthen innovation education and align it more closely with economic and social needs. However, prominent high-level talent outflow, inadequate societal recognition of the value of innovation education, and uncertainties brought about by macro policy adjustments pose significant challenges. Overall, while the external environment and policy context provide favorable status, the sustainable development of innovation ability education management ultimately depends on effectively transforming strengths into long-term advantages, addressing structural weaknesses, and proactively responding to emerging risks.

In summary, the SWOT analysis shows that the sustainable development of innovation ability education management for college students is supported by strong policy guidance and resource advantages, but constrained by regional imbalance, limited enterprise involvement, and insufficient social recognition. At the same time, opportunities from the digital economy, industrial upgrading, and coordinated university–local development coexist with challenges such as talent outflow and policy uncertainty. Overall, the results indicate that sustainable improvement depends on effectively leveraging policy and resource advantages while addressing structural weaknesses and external risks.

Based on the TOWS Matrix provided for the Social and external factors aspect, here’s an analysis using the strategies outlined:

1) SO Strategies (Strengths-Opportunities)

S1 and O1: Strong social recognition that encourages and sustains continuous innovation provides an important cultural and value-based foundation for the innovation activities driven by the digital economy and industrial upgrading. As digital technologies, intelligent manufacturing, and emerging industries continue to reshape

economic structures, social recognition of innovation helps legitimize risk-taking, experimentation, and long-term investment in innovation activities. This positive social atmosphere can enhance public acceptance of innovative outcomes, stimulate participation from multiple stakeholders, and accelerate the transformation of technological achievements into practical applications, thereby reinforcing the momentum of innovation-led development.

S2 and O2: Supportive government policies promoting the development of innovative talents can be further leveraged under the framework of the “Belt and Road Initiative,” which expands international cooperation and resource integration. Through policy coordination and international exchange mechanisms, universities and innovation institutions can access broader research networks, advanced technologies, and diverse innovation resources. This alignment not only enhances the global vision and cross-cultural competence of innovative talents but also strengthens the international competitiveness and sustainability of national innovation systems.

S3 and O3: Effective talent introduction policies that attract and retain innovative professionals can be closely combined with local governments’ efforts to promote coordinated school–local development. By integrating universities, local industries, and regional innovation platforms, talent policies can support the formation of stable innovation ecosystems at the regional level. Such coordination facilitates the local transformation of research achievements, improves talent retention, and enhances the long-term capacity of regions to sustain innovation-driven development.

2) ST Strategies (Strengths-Threats)

S1 and T2: Strong social recognition that encourages and sustains continuous innovation can play a mitigating role against the insufficient recognition of the value of innovative education in society. Although innovation education is not yet fully understood or widely valued by all social groups, a generally positive social attitude toward innovation helps create a supportive public discourse that emphasizes creativity, entrepreneurship, and long-term development. By strengthening the connection between innovation education outcomes and tangible social and

economic benefits, this social recognition can gradually improve public understanding and acceptance of innovation education, thereby weakening the negative impact of social cognitive bias.

S2 and T3: Supportive government policies promoting the development of innovative talents provide institutional stability in the face of uncertainty brought about by adjustments in macro policies. While changes in macroeconomic or industrial policies may introduce fluctuations in innovation-related initiatives, consistent talent-oriented policies help maintain continuity in funding, training mechanisms, and institutional support. This policy stability reduces the risks associated with external uncertainty and ensures that innovation education and talent cultivation can proceed in a relatively predictable and sustainable manner.

S3 and T1: Effective talent introduction policies that attract and retain innovative professionals directly address the prominent outflow of high-level talents. By offering competitive incentives, favorable career development pathways, and supportive living and research status, such policies enhance regional attractiveness and reduce talent loss. Moreover, the concentration of high-level talents can generate spillover effects, including mentoring, collaboration, and knowledge diffusion, which further strengthen local innovation ecosystems and counteract the negative effects of talent outflow.

3) WT Strategies (Weaknesses-Threats)

W1 and T1: The insufficient socio-economic support for innovation activities may intensify the phenomenon of high-level talent outflow. When local innovation ecosystems lack adequate financial investment, industrial support, and development opportunities, highly skilled and innovative talents are more likely to seek regions with stronger economic foundations and more mature innovation environments. This mismatch between talent demand and environmental support weakens regional innovation capacity and may create a negative cycle in which talent loss further reduces innovation vitality.

W2 and T2: A local culture that is not sufficiently innovation-friendly can reinforce society's insufficient recognition of the value of innovative education. When

innovation is not widely encouraged or tolerated at the cultural level, innovative education outcomes may be undervalued, and failure or experimentation may be viewed negatively. This cultural constraint limits public understanding of the long-term benefits of innovation education, reduces social support for educational reform, and discourages students and institutions from sustained innovative exploration.

W3 and T3: The underdevelopment of technology-driven innovation and its practical application increases vulnerability to uncertainty brought about by macro policy adjustments. Without strong mechanisms for technological transformation and application, innovation activities are more sensitive to external policy changes and economic fluctuations. Policy shifts may disrupt funding, industrial alignment, or development priorities, making it difficult for institutions to maintain stable innovation practices and achieve long-term sustainability.

4) WO Strategies (Weaknesses-Opportunities)

W1 and O1: Although the socio-economic environment currently provides insufficient support for innovation activities, the rapid development of the digital economy and ongoing industrial upgrading offer important opportunities to alleviate this constraint. Emerging industries, digital platforms, and new business models can lower innovation thresholds and create diversified channels for innovation participation. By aligning innovation education and practice with digital transformation and industrial demand, regions with weaker traditional economic foundations can enhance innovation support capacity and gradually improve the external environment for innovative activities.

W2 and O2: The lack of an innovation-friendly local culture may be partially and progressively addressed through the strategic expansion of international educational and research resources under the “Belt and Road Initiative.” International cooperation programs, bilateral academic exchanges, joint research platforms, and cross-cultural collaborative innovation projects can introduce more open, diverse, inclusive, and forward-looking innovation concepts and practices. Sustained exposure to global innovation ecosystems and successful international cases helps gradually reshape local cultural attitudes toward innovation, strengthen

tolerance for experimentation and trial and error, and enhance social recognition of innovative education and entrepreneurial exploration. In this way, it fosters a more supportive, dynamic, and culturally adaptive environment for innovation development, encouraging broader student and faculty participation, deeper interdisciplinary collaboration, stronger global connectivity, and sustained regional educational innovation progress in the long term.

W3 and O3: The underdevelopment of technology-driven innovation and its practical application can be substantially improved through local governments' active promotion of coordinated school–local integrated development strategies. By systematically strengthening long-term collaboration mechanisms among universities, local industries, research institutions, and emerging technology enterprises, innovation achievements can be more efficiently incubated, evaluated, and transformed into market-oriented and socially relevant practical applications. Targeted policy support at the local level can facilitate innovation platform construction, cross-sector resource integration, financial investment guidance, and smoother technology transfer channels, thereby significantly enhancing the practical value, commercialization potential, and long-term sustainability of technology-driven innovation. At the same time, such coordinated efforts contribute to fostering regional economic vitality, optimizing industrial upgrading pathways, stimulating entrepreneurial activities, and cultivating resilient, mutually reinforcing, and long-term collaborative innovation ecosystems.

In summary, the WO analysis indicates that weaknesses in the socio-economic environment, innovation culture, and technology application can be mitigated by leveraging external development opportunities. The advancement of the digital economy and industrial upgrading provides momentum and structural support for innovation activities, helping compensate for limited traditional resources. Meanwhile, international cooperation under the Belt and Road Initiative introduces diverse innovation concepts that reshape local cultural attitudes toward innovation and enhance recognition of innovative education. In addition, coordinated school–local development promoted by governments creates pathways for strengthening

technology transfer and application. Collectively, these opportunities suggest that aligning innovation education and management with broader economic, policy, and technological trends can transform structural disadvantages into drivers of sustainable innovation development, fostering resilience, adaptability, long-term institutional capacity, cross-sector collaboration, diversified funding mechanisms, inclusive participation, and evidence-based policy adjustments that strengthen sustainable innovation ecosystems.

2.1.4 SWOT and TOWS Matrix of total: Personal traits, Education and learning environment, Social and external factors.

Table 4.11 Results of SWOT and TOWS Matric Analysis of Personal traits, Education and learning environment, Social and external factors aspect

S	W
S1: Strong individual execution ability, a well-structured innovation-oriented education system, and broad positive social recognition for innovation development. S2: High personal efficiency, abundant opportunities for participation in practical innovation activities, and strong support from government talent development policies S3: Strong team initiative, well-established cross-disciplinary collaboration platforms, and effective talent introduction policies that support innovation development.	W1: Limited initiative in idea expression, an insufficiently stimulating innovation learning atmosphere, and inadequate socio-economic support for innovation. W2: Insufficient stress and emotional regulation capacity, limited provision of specialized innovation-oriented courses, and a local culture that is not sufficiently innovation-friendly. W3: Inconsistent multi-perspective and innovative thinking ability, insufficient teacher capacity and resources for innovation guidance, and underdeveloped technology-driven innovation and practical application.

Table 4.11 (Continued)

O	T
O1: Policy support, expansion of "mass entrepreneurship and innovation" platforms, and digital technology empowerment O2: Digitalization of education, integration of industry and education, and policy and financial support O3: The development of the digital economy, the Belt and Road Initiative promoting international exchanges, and the deepening of cooperation between local governments and universities.	T1: Uneven regional development, high employment pressure and a high risk of talent loss T2: The educational assessment indicators are monotonous, the distribution of resources is uneven, and the implementation mechanism is not smooth. T3: Outflow of high-end talents, insufficient recognition of innovative education, and high policy uncertainty.

According to Table 4.11, the SWOT analysis of the sustainable development of innovation ability education and management for college students shows that its strengths lie in the combined advantages of strong individual execution and efficiency, a well-structured innovation-oriented education system, abundant practical innovation opportunities, supportive government talent policies, cross-disciplinary collaboration platforms, and positive social recognition, which together provide a solid foundation for innovation development and are generally consistent with current expectations. However, notable weaknesses remain, including limited initiative in idea expression, insufficient emotional regulation and innovative thinking stability, an inadequately stimulating innovation learning atmosphere, insufficient specialized innovation courses, limited teacher capacity and resources for innovation guidance, as well as insufficient socio-economic support, an innovation-unfriendly local culture, and underdeveloped technology-driven innovation and application. At the same time, external opportunities such as policy support for "mass

entrepreneurship and innovation,” the expansion of innovation platforms, digital technology empowerment, the digitalization of education, deeper integration of industry and education, the development of the digital economy, the advancement of the Belt and Road Initiative, and strengthened cooperation between local governments and universities provide important status for addressing these weaknesses. Nevertheless, threats including uneven regional development, high employment pressure, the risk of talent loss, monotonous educational assessment indicators, uneven resource distribution, insufficient social recognition of innovation education, and increased policy uncertainty may constrain the effectiveness of innovation education if not properly addressed. Overall, the analysis indicates that while the foundation for cultivating college students’ innovation ability is relatively solid, removing structural constraints in educational environments and social support systems is essential for building a student-centered, sustainable innovation education ecosystem and for supporting coordinated regional development and national innovation strategies.

In summary, the SWOT analysis highlights that the sustainable development of innovation ability education for college students depends on the effective integration of individual capabilities, institutional support, and external policy and social environments. While existing strengths and opportunities provide favorable status, persistent weaknesses in educational practice and external support systems, together with structural threats, remain key constraints. Addressing these issues through systematic reform and coordinated governance is essential for transforming potential advantages into long-term innovation capacity and achieving sustainable, high-quality development of innovation education.

Based on the TOWS Matrix provided in the image, here is an analysis of strategies using the four quadrants of the TOWS Matrix (SO, ST, WT, WO):

1) SO Strategies (Strengths-Opportunities):

S1 and O1: Strong individual execution ability, a well-structured innovation-oriented education system, and broad positive social recognition for innovation development provide a solid internal foundation for fully leveraging policy support,

the expansion of “mass entrepreneurship and innovation” platforms, and digital technology empowerment. These strengths enable students and institutions to respond efficiently to policy incentives, actively participate in innovation platforms, and transform digital tools into practical innovation outcomes.

S2 and O2: High personal efficiency, abundant opportunities for participation in practical innovation activities, and strong support from government talent development policies align closely with the digitalization of education, the integration of industry and education, and sustained policy and financial support. This alignment facilitates the deep integration of learning and practice, enhances the effectiveness of innovation training, and promotes the continuous improvement of students’ applied innovation abilities.

S3 and O3: Strong team initiative, well-established cross-disciplinary collaboration platforms, and effective talent introduction policies create favorable status for leveraging the development of the digital economy, international exchanges promoted by the Belt and Road Initiative, and deepened cooperation between local governments and universities. These combined factors help expand innovation networks, enhance cross-border and cross-sector collaboration, and support the formation of a more open and sustainable innovation ecosystem.

2) ST Strategies (Strengths-Threats):

S1 and T1: Strong individual execution ability, a well-structured innovation-oriented education system, and broad positive social recognition for innovation development can partially offset the negative impacts of uneven regional development, high employment pressure, and the risk of talent loss. These strengths help enhance students’ adaptability and competitiveness in diverse regional labor markets, enabling them to better cope with employment uncertainty and reducing the likelihood of innovation talent outflow.

S2 and T2: High personal efficiency, abundant opportunities for participation in practical innovation activities, and strong support from government talent development policies provide important counterbalances to monotonous educational assessment indicators, uneven resource distribution, and inefficient

implementation mechanisms. Through practice-oriented innovation activities and policy support, the limitations of traditional evaluation systems can be mitigated, promoting more diversified pathways for innovation ability development.

S3 and T3: Strong team initiative, well-established cross-disciplinary collaboration platforms, and effective talent introduction policies play a critical role in responding to the outflow of high-end talents, insufficient recognition of innovative education, and high policy uncertainty. These strengths enhance institutional attractiveness and collaborative stability, helping retain innovative talents, strengthen social recognition of innovation education, and buffer the risks brought by policy fluctuations.

3) WT Strategies (Weaknesses-Threats):

W1 and T1: Limited initiative in idea expression, an insufficiently stimulating innovation learning atmosphere, and inadequate socio-economic support for innovation may be further amplified under status of uneven regional development, high employment pressure, and a high risk of talent loss. In regions with weaker economic foundations, these internal and external constraints interact, making it more difficult for students to accumulate innovation experience and increasing the likelihood of innovation-oriented talents flowing to more developed areas.

W2 and T2: Insufficient stress and emotional regulation capacity, combined with the limited provision of specialized innovation-oriented courses and a local culture that is not sufficiently innovation-friendly, is closely linked to monotonous educational assessment indicators, uneven resource allocation, and ineffective implementation mechanisms. Traditional evaluation systems and rigid institutional arrangements tend to undervalue innovation-oriented learning outcomes, thereby reinforcing conservative learning behaviors and further weakening students' motivation and resilience in innovation activities.

W3 and T3: Inconsistent multi-perspective and innovative thinking ability, insufficient teacher capacity and resources for innovation guidance, and underdeveloped technology-driven innovation and practical application are strongly constrained by the outflow of high-end talents, insufficient social recognition of

innovative education, and high policy uncertainty. The loss of high-level faculty and experts reduces mentorship quality and continuity, while policy instability discourages long-term investment in innovation platforms, ultimately hindering the sustainable development of innovation ability education.

4) WO Strategies (Weaknesses-Opportunities):

W1 and O1: Limited initiative in idea expression, an insufficiently stimulating innovation learning atmosphere, and inadequate socio-economic support for innovation can be effectively mitigated through policy support, the expansion of “mass entrepreneurship and innovation” platforms, and digital technology empowerment. These external opportunities provide diversified innovation spaces and institutional incentives, which help stimulate students’ participation, lower innovation thresholds, and compensate for deficiencies in the local innovation environment.

W2 and O2: Insufficient stress and emotional regulation capacity, together with the limited provision of specialized innovation-oriented courses and an innovation-unfriendly local culture, can be addressed by the digitalization of education, the integration of industry and education, and enhanced policy and financial support. Digital learning platforms and practice-oriented curricula expand access to innovation resources, while industry participation and targeted funding improve course relevance and foster a more supportive innovation culture.

W3 and O3: Inconsistent multi-perspective and innovative thinking ability, insufficient teacher capacity and resources for innovation guidance, and underdeveloped technology-driven innovation and practical application may be alleviated by the development of the digital economy, the Belt and Road Initiative–driven international exchanges, and deeper cooperation between local governments and universities. These opportunities introduce advanced technologies, global perspectives, and collaborative networks, thereby strengthening faculty capacity, enhancing innovation guidance, and promoting the transformation of innovative ideas into practical outcomes.

In summary, the WO analysis indicates that existing weaknesses in individual initiative, emotional regulation, innovation-oriented curriculum supply, faculty capacity, and practical innovation transformation can be effectively alleviated by leveraging external opportunities such as strong policy support, educational digitalization, industry–education integration, and the expansion of the digital economy and international cooperation platforms. By embedding digital technologies into innovation education, expanding practice-based and industry-linked learning scenarios, and strengthening multi-level collaboration among governments, universities, and industries, internal constraints can be gradually transformed into developmental momentum. This process not only enhances students’ innovation capabilities and adaptability but also promotes the systematic improvement of the innovation education ecosystem, laying a solid foundation for the sustainable development of innovation ability cultivation.

2.1.5 SWOT and PEST Analysis of total: Personal traits, Education and learning environment, Social and external factors.

SWOT is an analytical method used to examine an organization's internal environment, summarizing its strengths and weaknesses; at the same time, it analyzes the external environment to identify opportunities and threats, and uses this as the basis for strategy formulation. When analyzing the external environment, researchers combined PEST analysis, as shown in Figure 4.1.

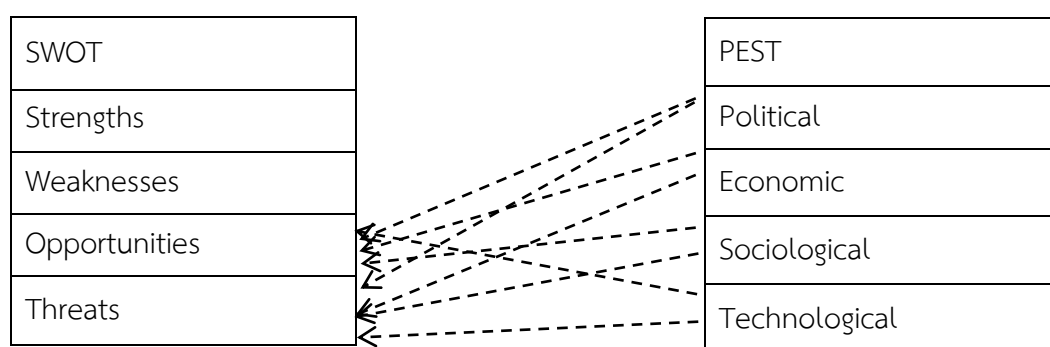


Figure 4.1 SWOT combined PEST

Figure 4.1 illustrates an integrated analytical framework in which SWOT (Strengths, Weaknesses, Opportunities, and Threats) and PEST (Political, Economic, Social, and Technological) analyses are applied simultaneously to provide a more comprehensive understanding of the strategic environment. The figure demonstrates that internal factors identified in the SWOT analysis—namely strengths and weaknesses—are continuously shaped and adjusted by changes in political, economic, social, and technological contexts, while external factors such as opportunities and threats directly originate from the broader PEST environment. Through multiple interaction paths, the diagram highlights that each SWOT dimension may be influenced by more than one PEST factor, reflecting the complexity and interdependence between internal status and external forces. This integrated approach enables a deeper interpretation of how internal capabilities align with external dynamics, thereby offering a more systematic and holistic basis for strategic analysis and decision-making.

In summary, the combined use of SWOT and PEST analysis provides a holistic and dynamic perspective for comprehensive strategic evaluation. By linking internal strengths and weaknesses with external political, economic, social, and technological factors, this integrated framework helps clearly reveal the underlying structural drivers of opportunities and threats. Such an approach not only clarifies how the external environment shapes internal status and developmental trajectories but also supports more informed, adaptive, and forward-looking strategic decision-making across diverse contexts, organizational levels, and long-term development planning processes.

Table 4.12 Results of OT-PEST Analysis for strategies development

P	E
P1: Promoting the implementation of innovative education policies and balanced regional development P2: School–local coordination by local governments P3: Strengthen policy publicity and guidance to enhance students' policy literacy and innovative awareness.	E1: Strengthen the connection between innovation education and key industries in regional economic development. E2: Improve the economic support system of "university-enterprise collaboration - project-driven-achievement transformation" E3: Enhance students' economic awareness and business innovation literacy.
S	T
S1: Build an inclusive, diverse and collaborative innovation culture atmosphere. S2: Deepen the integration of social practice and service-oriented innovation projects. S3: Build a trilateral collaborative education model involving universities, social organizations and families.	T1: The system promotes the in-depth integration of cutting-edge technologies such as AI, big data, and virtual simulation in innovative education. T2: Narrow the gap in technical resources and promote the development of "digital educational equity" T3: Strengthening technical ethics education and information literacy construction

According to Table 4.12, by integrating the SWOT factors with the PEST-based strategic directions, a coherent environmental analysis of the sustainable development of innovation ability education management for college students can be formed as follows.

Strength Points

College students demonstrate strong execution ability, high efficiency, and a solid foundation of innovative awareness, which interact positively with a relatively well-structured innovation-oriented education system. Universities provide cross-disciplinary collaboration platforms and practical innovation opportunities, while society and governments offer increasing recognition and policy support for innovation-driven talent development. At the political and social levels, the promotion of innovative education policies, school–local coordination mechanisms, and inclusive innovation cultures further reinforce these internal strengths. Together, individual initiative, institutional support, and favorable policy and social environments form a strong internal–external synergy for cultivating innovation ability.

Weak Points

Despite these advantages, limitations remain at both individual and systemic levels. Some students lack initiative in expressing ideas, show insufficient emotional regulation and resilience, and have unstable multi-perspective innovative thinking abilities. At the educational level, innovation-oriented courses and teacher guidance resources are uneven, and the learning atmosphere for innovation is not sufficiently stimulating. From an economic and social perspective, inadequate socio-economic support, weak university–enterprise collaboration, and an innovation-unfriendly local culture further constrain the effectiveness of innovation education, resulting in gaps between educational goals and practical outcomes.

Opportunity Points

Externally, the political, economic, social, and technological environments provide significant opportunities. National policies supporting “mass entrepreneurship and innovation,” balanced regional development, and school–local cooperation create a favorable policy framework. Economic strategies emphasizing industry–education integration, project-driven collaboration, and achievement transformation expand practical innovation channels. Socially, deeper integration of social practice and service-oriented innovation projects broadens students’ real-world engagement.

Technologically, the application of AI, big data, and virtual simulation, along with efforts to promote digital educational equity, offers powerful tools to enhance innovation education quality and accessibility.

Obstacle Points

At the same time, several obstacles may hinder sustainable development. Uneven regional development, high employment pressure, and the risk of talent outflow weaken long-term innovation capacity. Traditional educational evaluation systems, uneven resource distribution, and inefficient implementation mechanisms limit policy effectiveness. Moreover, insufficient societal recognition of innovative education, policy uncertainty, and gaps in technological resources and ethics education may reduce students' confidence and continuity in innovation activities. These constraints highlight the need for coordinated reforms across policy design, resource allocation, cultural cultivation, and technological governance to ensure the steady advancement of innovation ability education.

2.1.6 Results of the comprehensive analysis using SWOT Analysis PEST Analysis, and the TOWS Matrix are presented.

By integrating SWOT, TOWS and PEST analyses, a systematic and comprehensive strategic plan can be formulated to promote the sustainable development of innovation ability education management for college students. This strategy focuses on leveraging the inherent strengths of universities, addressing existing weaknesses, seizing external opportunities and effectively responding to potential challenges. It advocates for targeted intervention measures and multi-party strategic collaboration to form a synergy for cultivating talents. The overall strategy emphasizes a virtuous cycle of continuous improvement, flexible adaptation and resource support, and is committed to building an open, diverse and forward-looking innovation education ecosystem, ultimately cultivating college students with global vision and practical abilities as innovative talents.

Based on the results of SWOT, TOWS and PEST analyses, formulate strategies to enhance sustainable innovation ability of college students

1) SWOT Analysis identifies:

a. Strengths: college students demonstrate strong learning capacity, curiosity, and a latent awareness of innovation, which constitute the core internal driving forces for the development of their innovation ability. These personal traits enable students to adapt to new knowledge, technologies, and problem-solving contexts relatively quickly. At the institutional level, some universities have gradually established more complete scientific research platforms, interdisciplinary innovation spaces, and innovation-oriented curricula, leading to continuous optimization of teaching resources and learning environments. Externally, the sustained implementation of national policies such as “mass entrepreneurship and innovation,” together with industrial structure upgrading, has strengthened collaboration between universities and enterprises. This policy-driven and industry-supported environment provides a relatively solid external guarantee for improving college students’ innovation ability.

b. Weaknesses: Despite these advantages, significant internal and systemic weaknesses persist. At the individual level, many students still show insufficient initiative, low self-efficacy, and limited psychological resilience, especially when facing uncertainty, failure, or long-term innovation tasks. At the educational level, there remains a notable mismatch between curriculum content and real industry needs, alongside inadequate practical training opportunities and imperfect innovation evaluation systems. Furthermore, social participation in innovation education is relatively weak. University–enterprise cooperation often stays at a superficial level, lacking stable, long-term, and mechanism-based collaboration. As a result, social and industrial resources are not fully integrated into the educational process, constraining the practical transformation of students’ innovative ideas.

c. Opportunities: The emergence of new productive forces, particularly artificial intelligence, digital technologies, and the digital economy, has opened up unprecedented opportunities for innovation education. These developments support personalized learning pathways and diversified innovation models, allowing students to explore their potential more flexibly. Educational technologies have accelerated

changes in teaching methods, with immersive learning, project-based learning, and interdisciplinary problem-solving becoming increasingly feasible. At the macro level, governments' continued emphasis on higher education reform and enterprises' growing demand for innovative talent provide favorable status for deepening industry–education integration and expanding external support networks for universities.

d. Threats: At the same time, multiple external threats may hinder sustainable development. Traditional examination-oriented evaluation systems still exert strong constraints on students' innovative motivation and risk-taking behaviors. Some students lack effective coping strategies for setbacks, which restricts the long-term cultivation of innovative personality traits. In addition, universities in some regions respond slowly to reforms in teaching systems and evaluation mechanisms, potentially undermining the quality and effectiveness of innovation education. From a broader perspective, the overall social innovation culture is still in a formative stage, enterprises' willingness to deeply participate in talent cultivation remains limited, and uncertainties in policy continuity and resource allocation pose further challenges to establishing a stable and sustainable innovation education management system.

In Summary, the cultivation of innovation ability of college students is shaped by the dynamic interaction between individual traits, institutional status, and the broader socio-economic and technological environment. While strong internal foundations and favorable policy trends create important opportunities, unresolved weaknesses and external threats highlight the urgency of systematic reforms. Only by strengthening students' psychological and innovative capacities, optimizing curriculum–industry alignment, deepening multi-stakeholder collaboration, and improving policy and evaluation mechanisms can a resilient and sustainable innovation education ecosystem be realized.

2) TOWS Matric suggests strategies that leverage strengths and opportunities while addressing weaknesses and threats:

a. SO Strategies: By capitalizing on universities' existing advantages in teaching resources, research platforms, and policy support, innovation education should be closely aligned with the development trends of new quality productive forces and emerging industries. On this basis, students' existing innovative awareness and learning potential can be further activated through the integration of advanced technologies such as artificial intelligence, big data, and digital platforms. Universities should promote the transformation and upgrading of teaching models by constructing project-driven and problem-oriented innovation education platforms. Meanwhile, by strengthening collaboration with enterprises and government departments, an open and diversified social support system can be established, providing students with authentic innovation and entrepreneurship practice scenarios. This approach helps to fully stimulate individual traits and comprehensively enhance students' innovation abilities.

b. ST Strategies: In response to external risks such as an underdeveloped innovation culture and insufficient enterprise engagement, universities should give full play to their strengths in scientific research capacity, talent aggregation, and organizational coordination, and assume a leading role within the regional innovation ecosystem. By fostering a strong campus innovation culture and reinforcing institutional support mechanisms, universities can guide students to transform personal innovation potential into tangible social value. In addition, innovation education platforms centered on technology transfer, innovation competitions, and entrepreneurship incubation should be strengthened, thereby enhancing the practical orientation and social influence of innovation education and reducing the constraints imposed by external market and cultural environments.

c. WT Strategies: Facing both internal deficiencies and external pressures, universities need to construct a systematic improvement path that emphasizes mechanism optimization and capability enhancement. To address issues such as students' weak innovation competence, the misalignment between teaching content and real-world demands, and fragmented social resource integration, reforms should be carried out in educational evaluation systems, faculty

development mechanisms, and interdisciplinary teaching structures. At the same time, stronger policy guidance and institutional guarantees are required to promote closer and more stable cooperation among universities, enterprises, and governments. Through coordinated resource integration and long-term mechanism building, bottlenecks such as unsustainable investment and fragmented support systems can be gradually resolved, laying a solid foundation for the sustainable development of innovation education.

d. WO Strategies: To address weaknesses such as insufficient innovative motivation, limited resilience in the face of setbacks, and the disconnection between curriculum design and practical application, universities should actively seize the opportunities created by educational reform and socio-economic transformation. This includes accelerating the renewal and iterative optimization of innovation-oriented curricula, strengthening psychological resilience training, and providing personalized learning support to enhance students' intrinsic motivation. Simultaneously, the integration of industry and education should be deepened through the introduction of enterprise mentors, real innovation projects, and off-campus practice bases. These measures help compensate for insufficient institutional support and limited social participation, thereby creating more favorable external status for students' innovative growth.

In summary, the TOWS-based strategy framework highlights that the sustainable development of innovation ability education requires differentiated, dynamic, and coordinated strategic responses across multiple levels. By systematically aligning internal status—such as students' personal traits, institutional resources, and teaching capacities—with the evolving external environment shaped by policy, industry transformation, and technological progress, universities can not only amplify existing strengths but also progressively remedy structural weaknesses and mitigate external uncertainties. More importantly, this framework emphasizes strategic complementarity: leveraging strengths to seize opportunities, using strengths to buffer threats, capitalizing on opportunities to compensate for weaknesses, and minimizing risks where weaknesses and threats intersect. Through this integrative and

adaptive approach, universities are better positioned to move beyond fragmented reforms and establish a resilient, student-centered, practice-oriented, and multi-stakeholder innovation education ecosystem that supports continuous capability development and long-term sustainable outcomes.

3) PEST Analysis provides external factors that influence strategic planning:

a. Political: As a major educational center in western China, Shaanxi Province has introduced a series of policies in recent years to support the institutional foundation of innovation education in areas such as "mass entrepreneurship and innovation" education, university transformation, and integration of industry and education. The state and local governments have actively promoted the adjustment of the higher education structure and the improvement of quality through projects such as "Innovation and Entrepreneurship Education Reform Demonstration Universities" and "Provincial College Students' Innovation and Entrepreneurship Training Program", enhancing the policy guarantee for the cultivation of innovative talents in universities. Policy orientation directly affects the construction of the educational and learning environment and, in a subtle way, guides college students to form personal traits that align with the national development strategy, such as a sense of responsibility, mission, and public awareness. If the policy dividends can be effectively connected, it will greatly promote the coordinated efforts of school and social resources and create an institutional environment conducive to the continuous improvement of innovation capabilities.

b. Economic: Shaanxi Province is promoting development strategies such as "Strong Manufacturing Province" and "Digital Shaanxi", providing a broad job market and practical scenarios for high-level applied talents. At the same time, the upgrading of regional industrial structure and technological changes have put forward higher requirements for talent cultivation in colleges and universities, and also forced the transformation of educational content and models. Currently, college students generally face employment pressure and uncertainties brought about by the rapid

changes in industry demands. This reality to some extent affects students' innovative drive and individual psychological characteristics. Therefore, the education system needs to pay attention to changes in the macroeconomic condition, optimize course design and practical paths, and strengthen students' adaptability, entrepreneurial awareness and cross-disciplinary integration capabilities, so that they can better find their positions in the innovative economic system.

c. Social: The perception and value orientation of social culture towards innovation ability directly affect the development of individual innovation tendency among college students. With the enhancement of the public's awareness of innovation, more and more enterprises and institutions are willing to participate in the cultivation of innovative talents in colleges and universities, such as the popularization of cooperation projects like "maker spaces" and "university-enterprise joint laboratories". However, on the other hand, the traditional culture's preference for stable career paths and society's low tolerance for failure still impose certain psychological pressure and behavioral constraints on young individuals. Colleges and universities need to actively guide public opinion, build a cultural atmosphere that encourages attempts and tolerates failures, and at the same time expand the participation channels of external resources such as families, alumni, and industries, so as to optimize the social support structure for innovation education.

d. Technological: New technologies represented by artificial intelligence, virtual reality and big data are profoundly transforming the form of education and the way talents are cultivated. These technologies not only expand teaching tools and methods, but also provide college students with a more realistic, visual and interactive innovative practice environment. For instance, through AI-assisted innovative design, VR experimental simulation, online collaboration platforms and other means, students can conduct cross-disciplinary learning and project-based innovation more efficiently. The rapid development of technology also poses challenges to the allocation of educational resources in colleges and universities, the information literacy of teachers and digital infrastructure. Therefore, educational administrators need to take technology empowerment as one of the

strategic priorities, promote the deep integration of technology and education, and enhance college students' innovation adaptability and practical ability in a technology-driven environment.

By integrating these analyses, a strategic plan can be formulated to enhance the cultivation of innovation capabilities among college students, ensuring the creation of a balanced, supportive and forward-looking environment.

In conclusion, the sustainable development of innovation ability education management for college students was systematically sorted out by using the three analytical frameworks of SWOT, TOWS and PEST, and a targeted and forward-looking strategic system was constructed. The SWOT analysis pointed out that current universities have strong advantages in innovation education, such as resource integration ability, course foundation and policy support, but also exposed key weaknesses such as insufficient individual innovation drive of students, disconnection between courses and practice, and limited social participation. The TOWS analysis further proposed that on the basis of giving full play to existing advantages and policy opportunities, personalized incentive mechanisms, deepening industry-education integration, and reconstructing the learning ecosystem should be actively promoted to facilitate the development of individual traits of college students, optimize the educational and learning environment, and integrate social and external resources, thereby effectively resolving potential threats such as institutional obstacles and social expectation deviations.

Meanwhile, PEST analysis provides a macroscopic basis for the strategy from four dimensions of the external environment: the political dimension emphasizes the important guiding role of policy support in the construction of the innovation mechanism of colleges and universities; the economic dimension focuses on the reverse pressure of regional industrial upgrading on the talent supply structure of colleges and universities; the social dimension focuses on the shaping of students' innovative consciousness by innovative culture, social psychology and enterprise participation; the technological dimension points out the profound transformation effect of emerging technologies on educational models, learning

methods and innovative practice means. Integrating the above multi-dimensional perspectives, this strategy emphasizes the creation of an education ecosystem with a reasonable structure, flexible mechanism, coordinated resources and cultural incentives, to cultivate high-quality innovative talents with independent innovation consciousness, practical ability and social responsibility, and help colleges and universities in Shaanxi move towards a new stage of high-quality education governance.

2.2 Analysis of focus group discussion.

2.2.1 Analysis of status information statistics of Interviewee (Expert).

The focus group discussion on the draft educational management strategies for enhancing the sustainable innovation ability of college students was analyzed using content analysis. The discussion results were summarized and categorized to identify key opinions and common views among experts. In addition, a statistical analysis of the basic information of the respondents (experts) was conducted to provide supporting evidence for the study.

Table 4.13 Personal information of experts

Personal Information		Number	Percentage
Gender	Male	6	60/100
	Female	4	40/100
	Total	10	100/100
Position	Universities' administrator	5	50/100
	Innovation and entrepreneurship expert	5	50/100
	Total	10	100/100

Based on Table 4.13, a total of 10 experts participated in the focus group discussion. In terms of gender distribution, there were 6 male experts (60%) and 4 female experts (40%), indicating a relatively balanced gender composition. Regarding

professional positions, the sample included 5 university administrators (50%) and 5 innovation and entrepreneurship experts (50%). This balanced distribution of roles helps ensure that the discussion incorporated both management-level perspectives and professional expertise in innovation and entrepreneurship, enhancing the representativeness and reliability of the research findings.

2.2.2 The Three Developed Strategies derived from the focus group discussion.

Based on the results of the second part of the questionnaire survey and the content of the third part of the interviews, a comprehensive SWOT analysis of the collected data and interview materials reveals that the innovation ability of college students still needs to be systematically optimized in terms of personal traits, educational and learning environments, as well as broader social and external contextual factors. By integrating and triangulating the findings from both the questionnaire survey and in-depth interviews, this study further proposes a set of structured, evidence-based, and sustainable development strategies for the education and management of college students' innovation ability. These strategies mainly encompass three major dimensions, covering institutional support, individual capability enhancement, and environmental optimization, and include a total of 54 specific, detailed, and operational measures designed for practical implementation and continuous improvement.

Moreover, each proposed measure is aligned with the identified strengths, weaknesses, opportunities, and threats to ensure strategic coherence and feasibility in real-world educational settings. The detailed strategy list and corresponding measures are clearly presented and systematically categorized in Table 4.14, providing a practical reference framework for policymakers, university administrators, and educational practitioners seeking to enhance innovation-oriented management effectiveness.

Table 4.14 List of sustainable development strategies for the management of college students' innovation ability education

NO.	Aspects of strategies	Numbers of Measures
1	Personal traits	18
2	Educational and learning environment	20
3	Social and external environmental aspects	16
Total		54

Based on the content of Table 4.14, a comprehensive set of strategies aimed at enhancing the performance of various dimensions of the organization has been systematically sorted out. These strategies revolve around three core dimensions: individual traits, educational and learning environments, and social and external environmental factors, covering the entire chain from individual capacity building to the optimization of the educational ecosystem and then to external collaborative support. In terms of specific design, each strategy corresponds to clear measures and implementation paths, reflecting a highly structured and goal-oriented management mindset. These strategies not only focus on cultivating core competencies such as students' innovative awareness, adaptability, and decision-making ability, but also emphasize the transformation of the teaching environment, including the construction of interdisciplinary courses, the establishment of practical platforms, and the reform of evaluation mechanisms. At the same time, they also respond to the coordinated interaction at the macro level, such as national policy orientation, regional development advantages, and social resource allocation. Through this systematic integration of strategies and sectoral advancement, this strategic system provides a practical and feasible action blueprint for universities to enhance students' innovation capabilities and promote the sustainable development of educational management.

The strategy focusing on personal trait dimensions aims to enhance college students' thinking ability, behavioral ability, psychological quality and self-awareness, and is dedicated to fundamentally stimulating their intrinsic innovative potential. This dimension employs various means such as multi-dimensional thinking training, design thinking courses, independent project practices, decision-making and execution training, etc., to guide students to develop an open and multi-angle problem awareness and creative thinking paths. At the same time, it combines emotional and pressure management, failure review mechanisms and responsibility-taking experiences to enhance their psychological resilience and stress resistance when facing complex challenges. Through self-awareness counseling, growth file systems and personalized growth plans, it helps students clarify their interest advantages and future directions, and builds a growth mechanism with internal drive and a sense of purpose. Compared with external environmental support, personal traits are the source and foundation of innovation ability, directly influencing whether students possess the core qualities of "daring to think, knowing how to think, being able to do and achieving success". Therefore, this dimension plays a fundamental, driving and continuous role in enhancing the comprehensive innovation ability of college students, and is the primary focus in building a high-quality innovative talent cultivation system.

The improvement of educational and learning environments directly affects the cultivation and enhancement of college students' innovation capabilities. By optimizing course settings, promoting interdisciplinary integration, and introducing project-driven and practical teaching, students can not only master diverse knowledge but also exercise their problem-solving abilities in real-world scenarios. A complete innovation platform and resource support provide students with space for hands-on practice and trial-and-error exploration, stimulating their creative enthusiasm and initiative. Meanwhile, innovative teaching methods and diversified evaluation systems promote the improvement of students' expression abilities and teamwork skills, making them more confident and efficient in the innovation process. Overall, a good educational and learning environment provides a fertile ground for the integration of theory and

practice for college students, which is a key guarantee for stimulating potential, cultivating innovative thinking, and enhancing comprehensive innovation capabilities.

The improvement of social and external factors has provided a broader and more diverse support space for enhancing the innovation ability of college students. Through strengthening the integration of schools and local areas, school-enterprise cooperation, and the opening up of social resources, students can have access to real innovation projects and practical opportunities, thereby enhancing their ability to solve practical problems. The establishment of sound policy support and financial guarantees has lowered the threshold for innovation and entrepreneurship, encouraging students to dare to try and continuously innovate. Meanwhile, a favorable social and cultural atmosphere and the leading role of role models have enhanced college students' sense of identity and belonging to innovation, boosting their confidence and motivation in innovation. More importantly, the expansion of global exchanges and international cooperation has broadened their horizons and promoted the collision of cross-cultural and multi-field innovative thinking, thus promoting the all-round development and internationalization of college students' innovation ability.

External uncertainties and risks, including policy fluctuations, regulatory adjustments, and economic instability, may significantly disrupt the pace and continuity of innovation promotion in universities, weaken long-term planning capacity and strategic consistency, increase operational uncertainty in complex educational reform initiatives, and reduce institutional willingness to invest in innovation-oriented programs, thereby directly affecting the sustainable development, overall effectiveness, and measurable outcomes of innovation education. In the long run, these uncertainties may also hinder cross-sector collaboration, delay the timely implementation of innovation-supportive policies, and exacerbate disparities in financial and technological resource allocation, ultimately constraining the systematic cultivation of high-quality innovative talent and the overall competitiveness of higher education institutions within national and global contexts, while potentially diminishing institutional confidence, slowing reform momentum, and limiting sustained investment in emerging, interdisciplinary, and innovation-driven educational initiatives.

Furthermore, they may weaken international academic cooperation networks, reduce faculty engagement in high-impact innovation projects, constrain student participation in experiential and practice-based learning opportunities, and create additional structural and administrative barriers to stable, resilient, and long-term innovation ecosystem development across regional and international partnerships.

The specific strategies are as follows (Tables 4.15 to 4.17):

Table 4.15 Strategies and measures for strengthening the sustainable development personal traits of college students' innovation ability education and management

Strategies	Measures
Strategies for Enhancing Personal Traits	1. Task-based Innovation Training Camp
	2. Multidimensional Thinking Challenge Competition
	3. Personal project practice support
	4. Emotion and Stress Management Workshop
	5. Simulation drill for unexpected scenarios
	6. Decision-making and Execution Training Camp
	7. Responsibility and Commitment Experience Program
	8. Expression and Communication Skills Enhancement Camp
	9. Time Management and Efficiency Salon
	10. Interdisciplinary Interest Guidance Course
	11. Design Thinking Enlightenment Course
	12. Career and Strengths Planning Guidance
	13. Growth Record and Reflection System
	14. Mentorship follow-up and feedback mechanism
	15. Post-mortem analysis of failures and fault-tolerance systems
	16. Cross-grade Experience Sharing Session
	17. Regular innovation capability assessment
	18. Personalized Growth Plan Document

According to Table 4.15, a total of 18 measures have been proposed regarding the personal trait strategies for strengthening the sustainable development of innovation ability education management for college students:

- 1) Task-based Innovation Training Camp
- 2) Multidimensional Thinking Challenge Competition
- 3) Personal project practice support
- 4) Emotion and Stress Management Workshop
- 5) Simulation drill for unexpected scenarios
- 6) Decision-making and Execution Training Camp
- 7) Responsibility and Commitment Experience Program
- 8) Expression and Communication Skills Enhancement Camp
- 9) Time Management and Efficiency Salon
- 10) Interdisciplinary Interest Guidance Course
- 11) Design Thinking Enlightenment Course
- 12) Career and Strengths Planning Guidance
- 13) Growth Record and Reflection System
- 14) Mentorship follow-up and feedback mechanism
- 15) Post-mortem analysis of failures and fault-tolerance systems
- 16) Cross-grade Experience Sharing Session
- 17) Regular innovation capability assessment
- 18) Personalized Growth Plan Document

These initiatives form a comprehensive personal development strategy for cultivating college students' innovation ability. Centered on task-based training, multidimensional thinking, and project practice, the framework integrates cognitive development, emotional regulation, decision-making, and execution skills. Through interdisciplinary learning, design thinking, mentorship, reflective assessment, and personalized growth planning, the program systematically enhances students' innovative awareness, resilience, communication capacity, and self-management skills, providing sustained internal motivation for the long-term development of innovation capability.

Table 4.16 Strategies and measures for optimizing the sustainable development of education and learning environment for innovation ability of college students

Strategies	Measures
Strategies for Improving the Educational and Learning Environment	1. Innovative modular design of specialized courses
	2. Interdisciplinary Innovation Practice Course across Colleges
	3. Project-based classroom reform
	4. Hybrid innovation platform integrating online and offline elements
	5. Teacher Enterprise Practice Rotation Training Program
	6. Innovative achievements are incorporated into course evaluations
	7. The co-working space is fully open
	8. A funding support mechanism for small-scale projects
	9. Incentive policies for cross-disciplinary teams
	10. A joint innovation guidance mechanism for teachers and students
	11. A regularized platform for showcasing achievements
	12. Student Innovation Credit Bank
	13. The mechanism of jointly building courses by schools and enterprises
	14. Enterprise projects directly enter the classroom
	15. Long-term Special Innovation Funding
	16. Teaching Methods and Practice Workshop
	17. Data-driven teaching feedback system
	18. Inter-school Resource Co-construction Alliance
	19. Innovation mentor rotation system
	20. Student Innovation Clubs and Communities

Based on the content provided in Table 4.16 regarding the strategies for optimizing the sustainable development of educational management and learning environment for enhancing the innovation ability of college students.

- 1) Innovative modular design of specialized courses
- 2) Interdisciplinary Innovation Practice Course across Colleges
- 3) Project-based classroom reform
- 4) Hybrid innovation platform integrating online and offline elements
- 5) Teacher Enterprise Practice Rotation Training Program
- 6) Innovative achievements are incorporated into course evaluations
- 7) The co-working space is fully open
- 8) A funding support mechanism for small-scale projects
- 9) Incentive policies for cross-disciplinary teams
- 10) Incentive policies for cross-disciplinary teams
- 11) A regularized platform for showcasing achievements
- 12) Student Innovation Credit Bank
- 13) The mechanism of jointly building courses by schools and enterprises
- 14) Enterprise projects directly enter the classroom
- 15) Long-term Special Innovation Funding
- 16) Teaching Methods and Practice Workshop
- 17) Data-driven teaching feedback system
- 18) Inter-school Resource Co-construction Alliance
- 19) Innovation mentor rotation system
- 20) Student Innovation Clubs and Communities

These measures constitute a comprehensive strategy for optimizing the educational and learning environment to enhance college students' innovation ability. By promoting modular and interdisciplinary curriculum design, project-based and enterprise-integrated teaching, and hybrid innovation platforms, the framework strengthens the integration of theory and practice. Supported by open collaborative spaces, sustained funding, incentive mechanisms, data-driven feedback, and innovation communities, this system fosters cross-disciplinary collaboration, continuous engagement, and the sustainable development of innovation-oriented teaching and learning in higher education.

Table 4.17 Strategies and measures for the sustainable development of social and external factors in the management of college students' innovation ability education

Strategies	Measures
Strategies for enhancing social and external factors	1. University-Community Integration Innovation Base
	2. The real project cooperation mechanism for local enterprises
	3. Social resource matching platform
	4. University-Industry Joint Fund for Real Estate
	5. Policy Interpretation and Matching Guidance Meeting
	6. Local talent and project incentive policies
	7. Local Innovation Festivals and Competition Events
	8. Joint platform of universities, enterprises and research institutions
	9. One-stop service for student project incubation
	10. Local Innovation Role Model Sharing Program
	11. Regional innovation competition mechanism
	12. Joint media publicity mechanism
	13. International Exchange and Cooperation Support Program
	14. International Competition Participation Funding Policy
	15. Open public experimental and data resources
	16. Campus-Enterprise-Government "Innovation Internship" Camp

Based on the strategies for enhancing the sustainable development of social and external factors in the management of innovation ability education for college students provided in Table 4.17, a total of 16 measures have been proposed:

- 1) University-Community Integration Innovation Base
- 2) The real project cooperation mechanism for local enterprises
- 3) Social resource matching platform
- 4) University-Industry Joint Fund for Real Estate
- 5) Policy Interpretation and Matching Guidance Meeting

- 6) Local talent and project incentive policies
- 7) Local Innovation Festivals and Competition Events
- 8) joint platform of universities, enterprises and research institutions
- 9) One-stop service for student project incubation
- 10) Local Innovation Role Model Sharing Program
- 11) Regional innovation competition mechanism
- 12) Joint media publicity mechanism
- 13) International Exchange and Cooperation Support Program
- 14) International Competition Participation Funding Policy
- 15) Open public experimental and data resources
- 16) Campus-Enterprise-Government "Innovation Internship" Camp

These initiatives establish a comprehensive social and external support framework for enhancing college students' innovation ability. By strengthening university-industry-community collaboration, integrating real enterprise projects, and improving access to policy guidance, funding, and public resources, the framework expands students' practical innovation opportunities. Supported by innovation platforms, role model programs, regional and international competitions, and incubation services, this system fosters real-world engagement, global perspectives, and the sustainable development of innovation ecosystems in higher education.

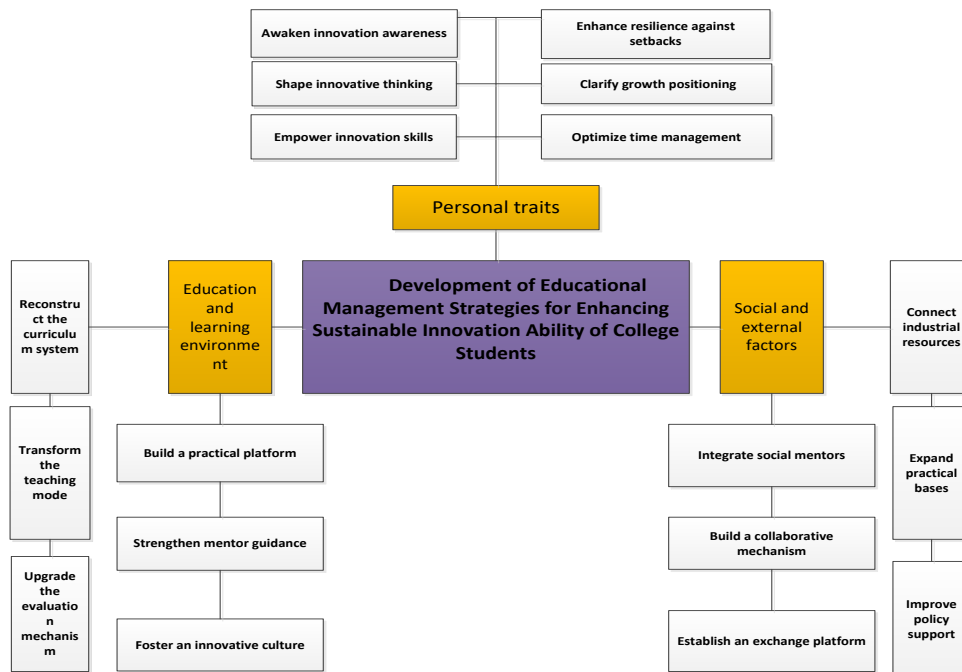


Figure 4.2 Strategy system framework for enhancing

Sustainable innovation ability of college students

This diagram provides an overall framework for the educational management strategies aimed at enhancing the sustainable innovation capabilities of college students. It systematically presents the paths for cultivating innovation capabilities from three aspects: personal traits, educational and learning environment, and social and external factors. Among them, personal traits emphasize intrinsic qualities such as innovative consciousness, thinking ability, skill level, and resilience and time management, which serve as the fundamental driving force for innovation development. The educational and learning environment focuses on optimizing the curriculum system, transforming teaching models, improving evaluation mechanisms, and building practical platforms and mentor guidance, which are the core levers of educational management reform in colleges and universities. Social and external factors, on the other hand, construct a collaborative education ecosystem by integrating industrial resources, social mentors, practical bases, and policy support. The three aspects interact with each other, forming a systematic strategy system that

combines the cultivation of internal capabilities, support from the educational environment, and guarantee from external resources, thereby promoting the continuous development of college students' innovation capabilities.

2.3 Summary of development strategies.

Based on the provided information regarding the sustainable development strategy for the management of innovation ability education for college students, the following is a structured outline for formulating a comprehensive strategy based on the results of SWOT analysis, offering clearer analytical direction and practical guidance for strategic educational management decision-making.

2.3.1 Vision

The vision for enhancing the sustainable innovation capability of college students in Shaanxi Province is to build an open, inclusive, and future-oriented higher education innovation ecosystem through systematic optimization of educational management, deepening educational reforms, and strengthening collaboration among universities, industry, and research sectors. Within this vision, universities should not only strengthen professional knowledge and innovative methodologies but also emphasize the development of critical thinking, interdisciplinary integration, and social responsibility, enabling students to continuously generate innovative outcomes in complex and rapidly changing social and technological contexts. Furthermore, through policy support, resource integration, and regional collaborative innovation platforms, higher education institutions can better serve regional economic and social development while facilitating the transformation of scientific and technological achievements into practical applications. Ultimately, this vision aims to cultivate innovative talents with global perspectives, lifelong learning capabilities, and a strong sense of social responsibility, providing sustained intellectual and human resource support for regional high-quality development and educational modernization.

2.3.2 Mission

1) To be oriented towards ability generation, a comprehensive growth system for students' innovative qualities should be established: focusing on the entire development cycle of college students, promote systematic cultivation from the enlightenment of innovative consciousness, training of thinking patterns to the reshaping of ability structures, and form a mechanism for ability improvement that runs through "cognition - practice - feedback". Emphasize the development of core qualities such as critical thinking, independent judgment, cross-border integration, and stress resistance and adaptability, guiding students to become innovative talents with continuous learning ability and problem-solving ability.

2) Taking teaching reconstruction as a fulcrum, a highly integrated and practical educational supply system is to be built: Deepen the collaborative innovation of the curriculum system and teaching mode, and promote the interactive linkage of the "innovation + professional" dual-core curriculum, the "project + classroom" driving model, and the "ability + achievement" oriented evaluation method. Through promoting the construction of interdisciplinary courses, the application of intelligent teaching platforms, and the improvement of teachers' teaching abilities, the renewal of educational content and the transformation of learning methods are achieved, enhancing the precise matching ability of universities in cultivating innovative talents.

3) Based on resource sharing, build a collaborative and open education ecosystem both inside and outside the campus: integrate the resource advantages of universities, research institutions, enterprises and the government, and establish multi-level and multi-scenario practice platforms to support students' in-depth participation, cross-border collaboration and achievement incubation in real-world problems. Promote the implementation of long-term operation mechanisms for maker spaces, innovation laboratories, and university-enterprise co-construction bases, and achieve the co-construction and sharing, as well as two-way openness of on-campus and social resources.

4) Guaranteed by mechanism innovation, a sustainable and multi-participation management support system should be improved: the whole-process governance mechanism from strategic planning, system design, project management to evaluation and incentive should be refined. It is necessary to encourage universities to set up a department for coordinating innovation capabilities, establish student growth records, teacher incentive policies, ability assessment systems and teaching quality feedback mechanisms, so as to enhance the systematicness and sustainability of innovation education.

5) Taking regional services as the driving force, a cooperative community for the integration of universities into local innovation and development is constructed: Based on the innovation-driven development strategy of Shaanxi Province, the educational resources of universities are precisely matched with the economic and social demands of the local area, and a multi-party collaborative education mechanism involving universities, local governments, enterprises and research institutions is established. Through industrial question banks, local internships, technology transfer and policy alignment, a "two-way empowerment" between talent cultivation and regional development is achieved, creating a model area for college students' innovation education in the western region.

2.3.3 Goals

1) Establish a systematic innovation literacy cultivation system to deeply stimulate the potential and self-motivation of college students: Build a comprehensive innovation literacy training framework covering cognitive awakening, thinking training, practical exercise and psychological adjustment, to promote students to form critical thinking, cross-border integration ability, entrepreneurial spirit and teamwork ability, and drive them to transform from passive learning to active exploration and independent innovation, laying a foundation for innovative talents with high adaptability and sustainable development ability.

2) Promote fundamental changes in the educational structure and teaching concepts of colleges and universities, and achieve deep integration of innovative education and professional education: by reshaping the curriculum

system, updating teaching content, innovating teaching methods and assessment and evaluation systems, establish a new teaching ecosystem driven by projects, featuring cross-disciplinary integration and industry-education collaboration. Strengthen the educational concepts oriented towards practice and ability, enhance teachers' innovative teaching capabilities and students' comprehensive qualities, and create a high-quality education system for cultivating compound and innovative talents.

3) Build an open and shared multi-level innovation practice platform and create a real application scenario and collaborative ecosystem: Promote the interconnection and intercommunication of resources among on-campus innovation laboratories, maker spaces and off-campus enterprises and industrial parks, achieving seamless integration of theory and practice. Through diverse forms such as project incubation, technology transformation, and innovation competitions, stimulate students' enthusiasm for innovation and practical experience, forming a "learning - application - creation" closed loop, and enhancing college students' ability to solve complex problems and market competitiveness.

4) Improve the multi-faceted and interactive policy support system and build a stable and efficient guarantee mechanism for innovative education: Formulate and refine a comprehensive policy system covering resource input, incentive evaluation, teacher training, achievement transformation and data feedback to promote the innovation of the management system for innovative education. Strengthen the strategic planning and execution of innovative education in universities, enhance management efficiency, and ensure the scientificity, continuity and sustainability of the path for cultivating innovative talents.

5) Deepen the in-depth integration of universities with local economic and social development, and build a mutually beneficial and win-win regional innovation development community: guided by local industrial demands and regional development strategies, promote the precise alignment of university innovation resources with local economies, and facilitate the transformation of innovation achievements and the localization of talent services. Establish an integrated collaboration mechanism of industry-university-research-application,

expand the social service functions of education, assist regional innovation-driven and high-quality development, and create a demonstration area for enhancing the innovation capabilities of college students.

2.3.4 Measures

1) Strengthening the cultivation of individual innovation literacy and building an internal driving force for sustainable growth: The fundamental source of innovation ability lies in an individual's initiative and comprehensive quality. Universities should take students as the center and systematically carry out all-round cultivation of critical thinking, problem awareness, cross-border learning ability and psychological resilience. By designing diversified innovation tasks, personalized growth paths and review mechanisms, help students form an innovative personality of "daring to think, knowing how to do and being able to persist" in real status, and realize the role transformation from knowledge receivers to value creators.

2) Promote the transformation and upgrading of the teaching system and build a course ecosystem that supports the development of innovation capabilities: Currently, the course systems in colleges and universities generally have problems such as "emphasizing theory over practice" and "emphasizing scores over abilities". We should focus on the needs of innovative talents and promote the reconstruction of course content, the transformation of teaching methods, and the reform of evaluation mechanisms. Through interdisciplinary integrated courses, project-driven teaching, and outcome-oriented assessment, we can break down the barriers between professional knowledge and real-world problems and enhance students' ability to transform knowledge into innovative achievements.

3) Build a multi-faceted integration practice platform and create an integrated environment of "learning - application - creation": Theory cannot independently generate innovation. We should fully integrate resources both inside and outside the school, and construct multi-dimensional practice carriers such as maker spaces, virtual laboratories, and enterprise co-research platforms to smooth the path from learning to application. Through real enterprise projects, social problem challenges, and cross-team collaboration, students can hone their real skills

in "real problems" and achieve a transformation from "passive learning" to "active creation".

4) Establish a coordinated and efficient policy guarantee mechanism to promote the systematic implementation of innovative education: The cultivation of innovation ability is not an isolated task but a systematic project that requires comprehensive support in terms of systems, resources, and management. It is necessary to improve the systems and mechanisms for special funds for innovative education, teacher incentives, student achievement transformation, and fault-tolerant experiments, clarify the responsibility boundaries of universities in terms of organizational structure, process management, and achievement evaluation, and promote the transformation from "project-driven" to "system construction" to ensure the steady and long-term development of innovative education.

5) To achieve deep integration between universities and regions and build an open and interactive innovation-oriented education ecosystem: The improvement of college students' innovation capabilities not only serves individual development but also relates to the enhancement of regional competitiveness. It is necessary to promote the joint construction of an education community by universities, local governments, enterprises, and research institutions. Through measures such as introducing industrial projects into classrooms, opening local enterprises for practical training, and implementing regional policy support, the education chain both inside and outside the campus should be connected to create a virtuous cycle integrating "learning - practice - incubation - transformation", thereby facilitating a "win-win" condition for high-quality regional development and the realization of young people's value.

In summary, the research findings in this chapter indicated that educational management for enhancing sustainable innovation ability in Shaanxi Province still exhibited significant gaps in the educational and learning environment, and social and external factors. educational and learning environment, and social and external factors., despite students possessing notable strengths in operational commitment. Consequently, the researcher synthesized 54 strategic measures

covering personal traits, educational and learning environment, and social and external factors. Expert evaluations confirmed that these strategies possessed a high level of adaptability and feasibility, and were ready for implementation to enhance students' innovation capacity in a tangible and sustainable manner.

2.3.5 Guidelines for implementing strategies in educational institutions

To implement educational management strategies for enhancing the sustainable innovation ability of college students based on personal traits, educational and learning environments, as well as social and external factors, we will systematically categorize these strategies according to their core focus areas, functional priorities, and expected developmental objectives. This structured classification helps clarify the logical relationships among different measures and ensures coordinated implementation across multiple dimensions. It also facilitates more precise resource allocation, responsibility assignment, and phased evaluation of outcomes within universities.

By distinguishing strategies according to their primary targets—whether individual capability enhancement, institutional environment optimization, or external ecosystem collaboration—administrators and educators can adopt differentiated implementation pathways and monitoring mechanisms. Such categorization not only strengthens strategic coherence and operational feasibility but also supports continuous improvement, adaptive adjustment, and long-term sustainability in innovation-oriented educational management practices. The following is the detailed classification of the strategies:

1) Personal traits

Personal traits serve as the internal foundation for the development of college students' innovative capabilities, directly influencing their innovative motivation, thinking patterns, and sustained action ability. Positive personality traits such as curiosity, openness, autonomy, and risk-taking awareness help to stimulate the desire for exploration and creative potential; while good emotional regulation, self-efficacy, and resilience support them in maintaining persistence and reflection

when facing complex problems and failures. Individual differences determine the expression methods of innovative potential. Therefore, respecting individuality and teaching students in accordance with their aptitudes are the key paths to stimulating the innovative vitality of college students.

1) Each semester, a 24-hour "Thinking Marathon" is held, featuring three types of competition questions (logical analysis, innovative conception, and quick decision-making), and inviting cross-disciplinary judges to provide immediate feedback (adopted from the multi-dimensional thinking training camp strategy).

2) Arrange for entrepreneurs or media professionals from outside the school to share their "start-up stories", and have students participate in "pain point co-creation" on the spot (a strategy from the innovation interest stimulation course).

3) One event is held every month, inviting senior students to share their failed innovative projects and how they iteratively improved them, with joint comments from both teachers and students (from the cross-grade innovation sharing meeting strategy).

4) Set up a "Problem-solving Laboratory", where students sign up independently for one difficult problem each month and go through the entire process from research to presentation of solutions (from the design strategy of the independent thinking module).

5) A topic selection competition is held once a week. Student teams need to formulate a plan, assign tasks and submit an execution report within 48 hours (from the training camp of decision-making and execution ability strategy).

6) Please invite experts to design a "storytelling" training course to help participants clearly explain complex issues within three minutes, enhancing their persuasive power and presentation skills (a strategy from the Expression and Communication Workshop).

7) Through sand play activities, group counseling and meditation exercises, students are helped to identify high-pressure states and establish a self-control mechanism of "stress alert - quick adjustment" (a strategy from the course on emotion and stress management).

8) Establish electronic files for each student, recording their innovative projects, competition achievements and mentor evaluations, to facilitate the connection between the credit system and honor certification (from the strategy of the innovative growth file system).

9) Through MBTI and strength tests, students are guided to find their "most suitable position for innovation" (derived from self-awareness and career planning guidance strategies).

10) supervisor has a one-on-one meeting with the student for one hour every month to follow up on the project progress, difficulties and mindset, and form feedback records (from the mentorship system combined with the feedback mechanism strategy).

2) Education and learning environment

The educational and learning environment is a key carrier for cultivating college students' innovative ability. It not only provides a platform for knowledge acquisition but also shapes their thinking patterns and practical abilities in profound and lasting ways. An open and inclusive teaching atmosphere, interdisciplinary integrated course design, and project-based and problem-oriented learning models can effectively stimulate students' innovative thinking and strengthen their ability to solve complex, real-world problems. Meanwhile, good teacher guidance, sufficient resource support, and well-structured evaluation mechanisms help to build a learning ecosystem where students "dare to think, dare to try, and dare to make mistakes", enabling them to continuously attempt, actively reflect, and confidently break through in authentic practical contexts, thus achieving systematic and sustainable growth in their innovative abilities.

1) An "Innovative Thinking" module is added after professional courses. Students need to complete small projects and write innovative suggestions (derived from the development of embedded innovation courses).

2) Invite local enterprises to provide one real case as the final assignment of the course, which will be included in the course grade (from the strategy of embedding enterprise projects into the classroom).

3) Enterprise representatives serve as co-instructors for the courses and participate in the course design and project review process (from the strategy of collaborative course construction between schools and enterprises).

4) Establish a dual support mechanism of MOOC and on-campus discussion rooms to break through geographical limitations and strengthen practical interaction (from the construction strategy of online and offline hybrid teaching platforms)

5) Implement regular evaluations of teaching satisfaction and ability growth, and promptly adjust the course content and methods based on feedback from the teaching experiment data mechanism.

6) The grades of each related course are composed of three parts: examination, project and team performance. The proportion of the project is no less than 40% (from the innovative course evaluation reform strategy).

7) The mentor team is composed of teachers, enterprise mentors and students, tracking the project life cycle (derived from the strategy of the joint innovation guidance system for teachers and students).

8) Teachers should participate in short-term internships or practical training in enterprises at least once a year and bring back cases to the classroom (as per the strategy of the teacher enterprise practice training program).

9) Monthly theme exhibitions or tea parties are held to allow students to share their achievements in public presentations (derived from the strategy of regularized display channels for innovation achievements).

10) Integrate innovation participation records into the semester report and GPA calculation system (a strategy reflecting innovation ability from the evaluation system)

3) Social and external factors

Social and external factors provide the practical soil and real driving force for the development of college students' innovation capabilities. Policy support, enterprise participation, scientific research resources and social demands jointly build a diverse and open innovation ecosystem, which prompts students to apply their

learned knowledge to real scenarios and enhance their ability to perceive and solve problems. External mechanisms such as school-enterprise cooperation, training bases and competition platforms not only broaden students' horizons and resource channels, but also encourage them to transform their creativity into achievements. A good social support system can strengthen college students' innovation awareness, enhance their result-oriented and responsibility awareness, and thus promote the full release of their innovation potential.

1) Jointly build innovation workshops in the park, and operate a student internship and project-based model throughout the year (from the strategy of establishing a school and local integration innovation platform)

2) During winter and summer vacations, 2-week enterprise internship and project attachment opportunities are provided, allowing for real contact with industrial processes (from the local entrepreneurship internship base construction strategy).

3) The government facilitates the release of demand lists by enterprises, and student teams apply for solutions based on the themes (from the strategy of open participation mechanism for local industrial projects).

4) Regularly hold innovation roadshow events and introduce investment institutions to support student projects (from the strategy of the joint support system of social capital)

5) Provincial laboratories and data platforms are open for students to make reservations and use them (as per the public innovation resource platform's open policy).

6) Provide legal, market and capital guidance, and offer a "one-stop" service package for student projects (derived from the improved strategy of the innovation transformation and incubation mechanism).

7) Every year, 5 to 10 students are selected to go abroad for exchange programs or joint research projects at foreign universities (from the strategy of expanding global cooperation and exchange projects).

8) Each quarter, policy briefing sessions and Q&A sessions are held in universities to guide students in applying for support resources (derived from the interpretation and connection strategies of government innovation support policies).

9) Regularly invite successful local alumni who have started businesses or conducted research to return to the school for exchanges, to share their experiences and guide thinking (from the Local Role Model Lecture Hall Program strategy).

10) Joint media promotion of students' innovative stories, using real cases to inspire more students to take action (from the social publicity and guidance mechanism strategy)

This implementation measure systematically matches each strategy with its primary focus area and functional orientation, which helps to more clearly understand the specific methods and operational approaches for enhancing the innovation ability of college students from multiple developmental levels and dimensions. It not only highlights how different strategies target personal traits, institutional environments, or external ecosystems, but also illustrates the logical structure and internal coordination among them.

Phase 3. Results of evaluating the feasibility and adaptability of educational management strategies for enhancing sustainable innovation ability of college students in Shaanxi Province.

3.1 Feasibility and Adaptability Assessment and Analysis of educational management strategies for enhancing sustainable innovation ability of college students.

In the context of profound global technological change and accelerated socio-economic transformation, innovation has become a core driving force for national competitiveness, regional development, and the high-quality advancement of higher education. Universities are no longer merely sites for knowledge transmission, but have increasingly assumed the strategic role of cultivating innovative talent, generating new knowledge, and serving regional and national development goals.

Against this backdrop, the enhancement of college students' innovation capabilities is not only an educational issue, but also a strategic issue closely linked to national development agendas, regional revitalization, and the transformation of universities themselves. Based on this understanding, the following discussion systematically elaborates the vision, mission, and goals of innovation capability enhancement strategies for college students, aiming to clarify their strategic positioning, operational logic, and developmental orientation within the broader framework of higher education management and innovation-driven development.

Table 4.18 Analysis results of strategies evaluation

Strategies for the Sustainable Development of College Students' Innovation Ability Education and Management	Feasibility			Adaptability		
	$\bar{X}$	S.D.	result	$\bar{X}$	S.D.	result
1. Personal Traits	4.41	0.60	high	4.23	0.66	high
2. Educational and Learning Environment	4.04	0.70	high	4.21	0.64	high
3. Social and External Factors	4.13	0.54	high	4.25	0.64	High
Total	4.19	0.61	high	4.23	0.65	high

As can be seen from Table 4.18, the average fitness of the three strategic factors promoting the sustainable development of innovation ability education management for college students ranges from 4.04 to 4.41, and the average fitness of feasible projects ranges from 4.21 to 4.25, both at a relatively high level, indicating that the research strategy has high feasibility and adaptability in practical application. These results suggest that the proposed strategies are well aligned with the practical needs of universities and the actual status of educational management, reflecting a strong degree of contextual relevance. Moreover, the high fitness scores reflect strong expert consensus regarding the rationality, operability, and implementation potential of the strategies, providing solid empirical support, enhanced credibility,

and a reliable reference for their application, replication, and further promotion across different institutional and policy contexts.

In addition, the consistency of these evaluations indicates that the proposed strategic framework demonstrates theoretical coherence and practical operability, suggesting it can guide institutional decision-making and educational reform. The concentrated scoring implies stability in expert judgment, reducing uncertainty in implementation. Furthermore, these findings highlight the scalability of the strategies across university settings, supporting improvement in innovation education management and fostering development of students' innovation capabilities. This also provides a basis for policy optimization and evaluation of innovation education outcomes, while offering practical references for continuous monitoring, institutional adjustment, and long-term sustainable enhancement of innovation-oriented educational practices across diverse institutional contexts and evolving higher education development environments, while encouraging governance models, stakeholder engagement, and continuous policy refinement.

Table 4.19 The analysis results of the strategy for strengthening personal traits assessment

Assessment checklist	Feasibility			Adaptability		
	$\bar{X}$	S.D.	result	$\bar{X}$	S.D.	result
Strategies for Enhancing Personal Traits						
1. Task-based Innovation Training Camp	4.20	0.45	high	4.60	0.55	highest
2. Multidimensional Thinking Challenge Competition	4.60	0.55	highest	4.00	0.71	high
3. Personal project practice support	4.80	0.45	highest	4.60	0.55	highest
4. Emotion and Stress Management Workshop	4.20	0.45	high	3.60	0.55	High
5. Simulation drill for unexpected scenarios	4.20	0.45	high	4.20	0.84	high

Table 4.19 (Continued)

Assessment checklist	Feasibility			Adaptability		
	$\bar{X}$	S.D.	result	$\bar{X}$	S.D.	result
6. Decision-making and Execution Training Camp	4.20	0.45	high	4.60	0.55	highest
7. Responsibility and Commitment Experience Program	4.60	0.55	highest	4.40	0.55	high
8. Expression and Communication Skills Enhancement Camp	4.60	0.55	highest	4.60	0.55	highest
9. Time Management and Efficiency Salon	4.60	0.55	highest	4.40	0.89	high
10. Interdisciplinary Interest Guidance Course	4.60	0.55	highest	3.60	0.89	high
11. Design Thinking Enlightenment Course	4.25	0.50	high	4.20	0.84	high
12. Career and Strengths Planning Guidance	4.40	0.55	high	4.00	0.71	high
13. Growth Record and Reflection System	4.40	0.55	high	4.40	0.55	high
14. Mentorship follow-up and feedback mechanism	4.60	0.55	highest	3.80	0.84	high
15. Post-mortem analysis of failures and fault-tolerance systems	4.40	0.55	high	3.80	0.45	high
16. Cross-grade Experience Sharing Session	4.40	0.89	high	4.80	0.45	highest
17. Regular innovation capability assessment	4.00	0.71	high	4.40	0.55	high
18. Personalized Growth Plan Document	4.40	0.89	high	4.20	0.84	High
Total	4.41	0.60	high	4.23	0.66	high

According to Table 4.19, the average suitability of the strategic factors for strengthening personal traits to promote the sustainable development of innovation ability education management for college students ranges from 4.00 to 4.80, and the average suitability of feasible projects ranges from 3.60 to 4.80, both being at a relatively high to the highest level. This indicates that the strategy of strengthening personal traits has high adaptability and feasibility. Moreover, these results reflect strong expert recognition of the practicality, relevance, and implementation potential of the proposed measures, suggesting that they can be effectively integrated into existing educational management systems to support the long-term development of students' innovation abilities.

Table 4.20 The analysis results of the strategy for strengthening Education and learning environment assessment

Assessment checklist	Feasibility			Adaptability		
	$\bar{X}$	S.D.	result	$\bar{X}$	S.D.	result
Strategies for Improving the Educational and Learning Environment						
1. Innovative modular design of specialized courses	3.60	0.55	high	4.20	0.84	high
2. Interdisciplinary Joint Innovation Practice Course	3.60	0.89	high	4.20	0.45	high
3. Project-based classroom reform	3.80	0.84	high	4.60	0.55	highest
4. Hybrid innovation platform integrating online and offline elements	4.20	0.45	high	4.20	0.84	High
5. Teacher Enterprise Practice Rotation Training Program	4.40	0.55	high	4.20	0.45	high
6. Innovative achievements are incorporated into course evaluations.	4.00	0.71	high	4.20	0.84	High
7. The co-working space is fully open.	3.80	0.84	high	4.40	0.89	high

Table 4.20 (Continued)

Assessment checklist	Feasibility			Adaptability		
	$\bar{X}$	S.D.	result	$\bar{X}$	S.D.	result
8. A funding support mechanism for small-scale projects	4.60	0.55	highest	4.40	0.55	high
9. Incentive policies for cross-disciplinary teams	4.00	0.71	high	4.60	0.55	highest
10. A joint innovation guidance mechanism for teachers and students	4.20	0.84	high	4.60	0.55	highest
11. A regularized platform for showcasing achievements	3.80	0.84	high	3.80	0.84	high
12. Student Innovation Credit Bank	3.60	0.89	high	4.00	0.71	high
13. The mechanism of jointly building courses by schools and enterprises	4.20	0.84	high	4.00	0.71	high
14. Enterprise projects directly enter the classroom	4.00	0.71	high	4.00	0.71	high
15. Long-term Special Innovation Funding	4.20	0.84	high	3.60	0.55	high
16. Teaching Methods and Practice Workshop	4.00	0.71	high	4.40	0.55	high
17. Data-driven teaching feedback system	4.20	0.45	high	4.20	0.45	high
18. Inter-school Resource Co-construction Alliance	4.20	0.84	high	4.20	0.84	high
19. Innovation mentor rotation system	4.20	0.45	high	3.80	0.45	high
20. Student Innovation Clubs and Communities	4.20	0.45	high	4.80	0.45	highest
Total	4.04	0.70	high	4.21	0.64	high

According to Table 4.20, the average fitness of the optimization of the educational and learning environment for promoting the sustainable development of innovation ability education management among college students ranges from 3.60 to 4.60, and the average fitness of feasible projects ranges from 3.60 to 4.80, both of which are at a relatively high to the highest level. This indicates that the strategy of optimizing the educational and learning environment has high adaptability and feasibility. Furthermore, the results suggest that the proposed measures are well aligned with the actual status of universities and the developmental needs of innovation education. The high fitness scores also reflect strong expert agreement on the effectiveness, operability, and implementation value of these strategies, indicating that they can be systematically incorporated into existing educational management frameworks. Through continuous optimization of teaching resources, learning spaces, and support mechanisms, these strategies can effectively enhance the quality and sustainability of innovation ability cultivation in higher education institutions.

Table 4.21 The analysis results of the strategy for strengthening social and external factors assessment

Assessment checklist	Feasibility			Adaptability		
	$\bar{X}$	S.D.	result	$\bar{X}$	S.D.	result
Strategies for Enhancing Social and External Factors						
1. University-Community Integration Innovation Base	4.20	0.45	high	4.00	0.71	high
2. The real project cooperation mechanism for local enterprises	3.80	0.45	high	3.80	0.84	high
3. Social resource matching platform	4.40	0.55	high	4.40	0.55	high
4. Government-led school–local coordination	4.20	0.45	high	4.20	0.45	high

Table 4.21 (Continued)

Assessment checklist	Feasibility			Adaptability		
	$\bar{X}$	S.D.	result	$\bar{X}$	S.D.	result
5. Policy Interpretation and Matching Guidance Meeting	4.40	0.55	high	4.00	0.71	high
6. Local talent and project incentive policies	4.40	0.55	high	4.20	0.45	high
7. Local Innovation Festivals and Competition Events	4.20	0.45	high	4.20	0.84	high
8. Joint platform of universities, enterprises and research institutions	4.20	0.84	high	4.40	0.89	high
9. One-stop service for student project incubation	3.80	0.45	high	4.20	0.84	high
10. Local Innovation Role Model Sharing	4.20	0.45	high	4.20	0.45	high
11. Regional innovation competition mechanism	4.20	0.45	high	4.00	0.71	high
12. Joint media promotion mechanism	4.20	0.45	high	4.80	0.45	highest
13. International Exchange and Cooperation Support Program	4.20	0.84	high	4.80	0.45	highest
14. International Competition Participation Funding Policy	3.60	0.55	high	4.20	0.45	high
15. Open public experimental and data resources	4.00	0.71	high	4.40	0.55	high
16. Camp for "Innovation Internship" among Schools, Enterprises and the Government	4.00	0.71	high	4.20	0.84	high
Total	4.13	0.54	high	4.25	0.64	high

As can be seen from Table 4.21, the average fitness of the social and external factors promoting the sustainable development of innovation ability education management for college students ranges from 3.60 to 4.40, which is at a relatively high level. The average fitness of feasible projects ranges from 3.80 to 4.80, all at a relatively high to the highest level, indicating that the social and external factor strategies have high feasibility and adaptability.

The growth of innovation ability is essentially the continuous release of individual potential. By establishing a personalized incentive mechanism oriented towards interests, abilities and growth goals, it can effectively awaken students' awareness of active exploration and creative desire, providing an internal driving force for innovative behavior. In line with the current "student-centered" educational concept, it is conducive to stimulating autonomous learning and in-depth thinking; with the help of technical means such as psychological assessment and learning analysis, it has the operability supported by data; the mentor system and growth archives and other mechanisms have a good foundation and are ready for promotion. A three-in-one mechanism of "dynamic assessment + stage incentives + growth feedback" should be constructed to transform students' interests into stable innovative momentum. At the same time, the integration of artificial intelligence and educational data platforms should be strengthened to improve the accuracy and timeliness of personalized portraits.

Teaching systems and learning environments are the core carriers for the generation of innovation capabilities. Through classroom reform, project-based learning, interdisciplinary collaboration, and the introduction of real-world tasks, students can exercise their comprehensive abilities and creativity in complex and dynamic status. Higher education institutions already have a foundation of teaching reform pilots, which can be directly integrated into the new round of "classroom revolution". The gradual popularization of multi-disciplinary courses and project-driven teaching is conducive to enhancing the diversity of educational supply. Digital tools and virtual simulation platforms provide technical support for environmental optimization. A teaching closed loop of "problem-driven - process-oriented -

collaborative reflection" should be constructed, and cross-departmental collaboration should be encouraged to jointly create innovative course clusters. Teacher capacity building should be strengthened, and innovation teaching awards and training mechanisms should be established to promote a structural transformation from "teaching" to "learning".

The actual growth of students' innovation capabilities should be placed within the context of the social ecosystem. By establishing an innovation community among universities, enterprises, governments, and research institutions, resources, problem scenarios, and paths for the transformation of achievements can be provided for students, achieving an integrated education model of industry-university-research-application. The national policy supports "mass entrepreneurship and innovation" education, and local governments and enterprises have shown a stronger willingness to cooperate. Many universities have explored a collaborative education model of "enterprises posing problems and students solving them". Incubators, maker spaces, and other platforms provide physical spaces and project implementation sites. Promote institutionalized and regularized cooperation mechanisms, set up "regional innovation experimental fields" or "joint innovation centers", and form a diversified collaborative mechanism led by the government, with the participation of enterprises and the dominance of schools. Further improve the collaborative framework of "resource sharing - achievement co-construction - responsibility sharing", and promote students' role transformation and ability leap in real tasks.

Enhancing the innovation ability of college students is a systematic project that requires coordinated efforts from three aspects: individualized incentives, teaching environment, and social collaboration. By strengthening personalized incentive mechanisms, the intrinsic motivation of students can be stimulated. Optimizing the teaching system and learning environment can build an innovation practice field centered on problem-oriented and interdisciplinary integration. At the same time, an external collaborative innovation network should be established to promote in-depth integration between universities and enterprises, governments, and

research institutions, providing students with real-world problems, resource support, and paths for the transformation of achievements. These three strategic paths are interlinked, forming a three-dimensional innovation ecosystem of "driving - carrying - transforming", laying a solid foundation for the continuous improvement of college students' innovation ability.

In summary, the research findings in this chapter indicated that educational management for enhancing sustainable innovation ability in Shaanxi Province still exhibited significant gaps in the educational and learning environment, and social and external factors. educational and learning environment, and social and external factors., despite students possessing notable strengths in operational commitment. Consequently, the researcher synthesized 54 strategic measures covering personal traits, educational and learning environment, and social and external factors. Expert evaluations confirmed that these strategies possessed a high level of adaptability and feasibility, and were ready for implementation to enhance students' innovation capacity in a tangible and sustainable manner.

Chapter 5

Conclusion Discussion and Recommendations

This study aims to explore the development of educational management strategies for enhancing the sustainable innovation ability of college students, with the following objectives: 1) To study the current and desired status of sustainable innovation ability of college students in Shaanxi Province; 2) To develop educational management strategies for enhancing sustainable innovation ability of college students in Shaanxi Province; 3) To evaluate the feasibility and adaptability of educational management strategies for enhancing sustainable innovation ability of college students in Shaanxi Province. The sample group consists of 384 college students from Shaanxi Province, 10 experts for in-depth interviews, 10 experts for focus group discussions, and 5 experts for strategy feasibility and adaptability assessment. The research instruments include a questionnaire, an interview form, a draft of educational management strategies, and a strategy evaluation form. Data analysis first employed descriptive statistical methods, including frequency, percentage, mean, and standard deviation, as well as the modified priority needs index (PNI modified). Then, content analysis was conducted on the qualitative data obtained from interviews. The results from quantitative and qualitative analyses were integrated through SWOT analysis, PEST analysis, and TOWS matrix to develop educational management strategies. Finally expert discussions to synthesize and extract key themes and suggestions. The conclusions, discussions, and recommendations of this study were also elaborated accordingly.

Conclusion

Research on the development of educational management strategies for enhancing the sustainable innovation capability of college students was conducted using a mixed-methods approach and implemented in three sequential research objectives, as outlined below:

1. Studying the current and desired status of education management for enhancing sustainable innovation ability of college students in Shaanxi Province.

2. Developing the educational management strategies for enhancing sustainable innovation ability of college students in Shaanxi Province.

3. evaluating the feasibility and adaptability of educational management strategies for enhancing sustainable innovation ability of college students in Shaanxi Province.

The details are presented as follows.

1. Results of the current and desired status of education management for enhancing sustainable innovation ability of college students in Shaanxi Province

The current and desired status of education management for enhancing sustainable innovation ability of college students can be summarized into three aspects: personal traits, educational and learning environment, and social and external factors. All these three aspects have necessary development demands, and the specific status are as follows:

The development of personal traits in the 10 sub-variables, from the highest to the lowest level of demand assessment values, is as follows: "Being able to make quick decisions and take action when faced with multiple choices", "Effectively managing stress and emotions", "Reasonably arranging time and maintaining high work efficiency", "Tending to think independently when solving problems", "Actively taking on important responsibilities and tasks in the team", "Often thinking about problems from different perspectives and proposing new ideas", "Being able to quickly adjust methods to deal with undesired problems", "Having a strong interest in learning innovative content", "Actively seeking solutions when faced with innovative tasks", "Effectively expressing one's opinions and viewpoints in team cooperation".

The value of the demand assessment in the aspects of education and learning environment ranks from high to low as follows: "Opportunities to participate in interdisciplinary cooperation and innovation activities", "Sufficient opportunities to participate in innovative experiments and practical projects", "The school's curriculum

content", "The school's teaching philosophy and teaching methods", "The school's evaluation system", "The school's learning atmosphere", "The school's talent cultivation system", "Specialized innovation education courses", "Adequate extracurricular activity support", "Teachers have sufficient ability and resources to guide students' innovation".

The development of social and external factors in terms of the value of demand assessment from the highest to the lowest level is as follows: "The society can provide the resources needed for innovation", "There are abundant cross-field cooperation opportunities in the society that can promote innovation and development", "The local industry provides rich innovation opportunities to promote the application of new technologies and new ideas", "Globalization provides more opportunities for innovation", "The current social and economic environment provides sufficient opportunities for innovative talents", "The local cultural atmosphere encourages innovation and entrepreneurship", "The society's recognition of innovation achievements can motivate you to continue innovating", "The society has relevant policies for attracting innovative talents", "The current level of scientific and technological development promotes innovation and the application of new technologies", "The government provides support policies in innovation to promote the development of innovative talents".

In this results of interview study, based on the level of the demand assessment values, 2 to 3 variables were selected for conducting SWOT analysis and TOWS matrix analysis. The relevant content will be presented in Section 2 below.

2. Results on the educational management strategies for enhancing sustainable innovation ability of college students in Shaanxi Province.

The second phase of this research aims to directly address the research questions and achieve the research objectives, with a particular focus on formulating sustainable educational management strategies to enhance the sustainable innovation ability of college students in Shaanxi Province. Based on the empirical research results of the first phase, the results of the Priority Needs Index (PNI), qualitative synthesis of expert interviews, and comprehensive SWOT, PEST, and

TOWS analyses, three strategic directions have been developed. These strategies are designed to work together at the levels of personal traits, educational and learning environments, and social and external factors, ensuring a comprehensive and multi-level approach to promoting students' sustainable innovation capabilities. The specific contents are as follows:

2.1 Vision

The vision for enhancing the sustainable innovation capability of college students in Shaanxi Province is to build an open, inclusive, and future-oriented higher education innovation ecosystem through systematic optimization of educational management, deepening educational reforms, and strengthening collaboration among universities, industry, and research sectors. Within this vision, universities should not only strengthen professional knowledge and innovative methodologies but also emphasize the development of critical thinking, interdisciplinary integration, and social responsibility, enabling students to continuously generate innovative outcomes in complex and rapidly changing social and technological contexts. Furthermore, through policy support, resource integration, and regional collaborative innovation platforms, higher education institutions can better serve regional economic and social development while facilitating the transformation of scientific and technological achievements into practical applications. Ultimately, this vision aims to cultivate innovative talents with global perspectives, lifelong learning capabilities, and a strong sense of social responsibility, providing sustained intellectual and human resource support for regional high-quality development and educational modernization.

2.2 Mission

1) To be oriented towards ability generation, a comprehensive growth system for students' innovative qualities should be established: focusing on the entire development cycle of college students, promote systematic cultivation from the enlightenment of innovative consciousness, training of thinking patterns to the reshaping of ability structures, and form a mechanism for ability improvement that runs through "cognition - practice - feedback". Emphasize the development of core

qualities such as critical thinking, independent judgment, cross-border integration, and stress resistance and adaptability, guiding students to become innovative talents with continuous learning ability and problem-solving ability.

2) Taking teaching reconstruction as a fulcrum, a highly integrated and practical educational supply system is to be built: Deepen the collaborative innovation of the curriculum system and teaching mode, and promote the interactive linkage of the "innovation + professional" dual-core curriculum, the "project + classroom" driving model, and the "ability + achievement" oriented evaluation method. Through promoting the construction of interdisciplinary courses, the application of intelligent teaching platforms, and the improvement of teachers' teaching abilities, the renewal of educational content and the transformation of learning methods are achieved, enhancing the precise matching ability of universities in cultivating innovative talents.

3) Based on resource sharing, build a collaborative and open education ecosystem both inside and outside the campus: integrate the resource advantages of universities, research institutions, enterprises and the government, and establish multi-level and multi-scenario practice platforms to support students' in-depth participation, cross-border collaboration and achievement incubation in real-world problems. Promote the implementation of long-term operation mechanisms for maker spaces, innovation laboratories, and university-enterprise co-construction bases, and achieve the co-construction and sharing, as well as two-way openness of on-campus and social resources.

4) Guaranteed by mechanism innovation, a sustainable and multi-participation management support system should be improved: the whole-process governance mechanism from strategic planning, system design, project management to evaluation and incentive should be refined. It is necessary to encourage universities to set up a department for coordinating innovation capabilities, establish student growth records, teacher incentive policies, ability assessment systems and teaching quality feedback mechanisms, so as to enhance the systematicness and sustainability of innovation education.

5) Taking regional services as the driving force, a cooperative community for the integration of universities into local innovation and development is constructed: Based on the innovation-driven development strategy of Shaanxi Province, the educational resources of universities are precisely matched with the economic and social demands of the local area, and a multi-party collaborative education mechanism involving universities, local governments, enterprises and research institutions is established. Through industrial question banks, local internships, technology transfer and policy alignment, a "two-way empowerment" between talent cultivation and regional development is achieved, creating a model area for college students' innovation education in the western region.

2.3 Goals

1) Establish a systematic innovation literacy cultivation system to deeply stimulate the potential and self-motivation of college students: Build a comprehensive innovation literacy training framework covering cognitive awakening, thinking training, practical exercise and psychological adjustment, to promote students to form critical thinking, cross-border integration ability, entrepreneurial spirit and teamwork ability, and drive them to transform from passive learning to active exploration and independent innovation, laying a foundation for innovative talents with high adaptability and sustainable development ability.

2) Promote fundamental changes in the educational structure and teaching concepts of colleges and universities, and achieve deep integration of innovative education and professional education: by reshaping the curriculum system, updating teaching content, innovating teaching methods and assessment and evaluation systems, establish a new teaching ecosystem driven by projects, featuring cross-disciplinary integration and industry-education collaboration. Strengthen the educational concepts oriented towards practice and ability, enhance teachers' innovative teaching capabilities and students' comprehensive qualities, and create a high-quality education system for cultivating compound and innovative talents.

3) Build an open and shared multi-level innovation practice platform and create a real application scenario and collaborative ecosystem: Promote the

interconnection and intercommunication of resources among on-campus innovation laboratories, maker spaces and off-campus enterprises and industrial parks, achieving seamless integration of theory and practice. Through diverse forms such as project incubation, technology transformation, and innovation competitions, stimulate students' enthusiasm for innovation and practical experience, forming a "learning - application - creation" closed loop, and enhancing college students' ability to solve complex problems and market competitiveness.

4) Improve the multi-faceted and interactive policy support system and build a stable and efficient guarantee mechanism for innovative education: Formulate and refine a comprehensive policy system covering resource input, incentive evaluation, teacher training, achievement transformation and data feedback to promote the innovation of the management system for innovative education. Strengthen the strategic planning and execution of innovative education in universities, enhance management efficiency, and ensure the scientificity, continuity and sustainability of the path for cultivating innovative talents.

5) Deepen the in-depth integration of universities with local economic and social development, and build a mutually beneficial and win-win regional innovation development community: guided by local industrial demands and regional development strategies, promote the precise alignment of university innovation resources with local economies, and facilitate the transformation of innovation achievements and the localization of talent services. Establish an integrated collaboration mechanism of industry-university-research-application, expand the social service functions of education, assist regional innovation-driven and high-quality development, and create a demonstration area for enhancing the innovation capabilities of college students.

2.4 Measures

Measures for Enhancing Personal Traits

- 1) Task-based Innovation Training Camp
- 2) Multidimensional Thinking Challenge Competition
- 3) Personal project practice support

- 4) Emotion and Stress Management Workshop
- 5) Simulation drill for unexpected scenarios
- 6) Decision-making and Execution Training Camp
- 7) Responsibility and Commitment Experience Program
- 8) Expression and Communication Skills Enhancement Camp
- 9) Time Management and Efficiency Salon
- 10) Interdisciplinary Interest Guidance Course
- 11) Design Thinking Enlightenment Course
- 12) Career and Strengths Planning Guidance
- 13) Growth Record and Reflection System
- 14) Mentorship follow-up and feedback mechanism
- 15) Post-mortem analysis of failures and fault-tolerance systems
- 16) Cross-grade Experience Sharing Session
- 17) Regular innovation capability assessment
- 18) Personalized Growth Plan Document

These initiatives form a comprehensive personal development strategy for cultivating college students' innovation ability. Centered on task-based training, multidimensional thinking, and project practice, the framework integrates cognitive development, emotional regulation, decision-making, and execution skills. Through interdisciplinary learning, design thinking, mentorship, reflective assessment, and personalized growth planning, the program systematically enhances students' innovative awareness, resilience, communication capacity, and self-management skills, providing sustained internal motivation for the long-term development of innovation capability.

Measures for Improving the Educational and Learning Environment

- 1) Innovative modular design of specialized courses
- 2) Interdisciplinary Innovation Practice Course across Colleges
- 3) Project-based classroom reform
- 4) Hybrid innovation platform integrating online and offline elements
- 5) Teacher Enterprise Practice Rotation Training Program

- 6) Innovative achievements are incorporated into course evaluations
- 7) The co-working space is fully open
- 8) A funding support mechanism for small-scale projects
- 9) Incentive policies for cross-disciplinary teams
- 10) Incentive policies for cross-disciplinary teams
- 11) A regularized platform for showcasing achievements
- 12) Student Innovation Credit Bank
- 13) The mechanism of jointly building courses by schools and enterprises
- 14) Enterprise projects directly enter the classroom
- 15) Long-term Special Innovation Funding
- 16) Teaching Methods and Practice Workshop
- 17) Data-driven teaching feedback system
- 18) Inter-school Resource Co-construction Alliance
- 19) Innovation mentor rotation system
- 20) Student Innovation Clubs and Communities

These measures constitute a comprehensive strategy for optimizing the educational and learning environment to enhance college students' innovation ability. By promoting modular and interdisciplinary curriculum design, project-based and enterprise-integrated teaching, and hybrid innovation platforms, the framework strengthens the integration of theory and practice. Supported by open collaborative spaces, sustained funding, incentive mechanisms, data-driven feedback, and innovation communities, this system fosters cross-disciplinary collaboration, continuous engagement, and the sustainable development of innovation-oriented teaching and learning in higher education.

Measures for enhancing social and external factors

- 1) University-Community Integration Innovation Base
- 2) The real project cooperation mechanism for local enterprises
- 3) Social resource matching platform
- 4) University-Industry Joint Fund for Real Estate
- 5) Policy Interpretation and Matching Guidance Meeting

- 6) Local talent and project incentive policies
- 7) Local Innovation Festivals and Competition Events
- 8) joint platform of universities, enterprises and research institutions
- 9) One-stop service for student project incubation
- 10) Local Innovation Role Model Sharing Program
- 11) Regional innovation competition mechanism
- 12) Joint media publicity mechanism
- 13) International Exchange and Cooperation Support Program
- 14) International Competition Participation Funding Policy
- 15) Open public experimental and data resources
- 16) Campus-Enterprise-Government "Innovation Internship" Camp

These initiatives establish a comprehensive social and external support framework for enhancing college students' innovation ability. By strengthening university–industry–community collaboration, integrating real enterprise projects, and improving access to policy guidance, funding, and public resources, the framework expands students' practical innovation opportunities. Supported by innovation platforms, role model programs, regional and international competitions, and incubation services, this system fosters real-world engagement, global perspectives, and the sustainable development of innovation ecosystems in higher education.

2.5 Guidelines for implementing strategies in educational institutions

To implement educational management strategies for enhancing sustainable innovation ability of college students based on personal traits, educational and learning environments, social and external factors, we will categorize these strategies according to their key points and objectives. The following is the classification of the strategies:

1) Personal traits

Personal traits serve as the internal foundation for the development of college students' innovative capabilities, directly influencing their innovative motivation, thinking patterns, and sustained action ability. Positive personality traits such as curiosity, openness, autonomy, and risk-taking awareness help to stimulate

the desire for exploration and creative potential; while good emotional regulation, self-efficacy, and resilience support them in maintaining persistence and reflection when facing complex problems and failures. Individual differences determine the expression methods of innovative potential. Therefore, respecting individuality and teaching students in accordance with their aptitudes are the key paths to stimulating the innovative vitality of college students.

(1) Each semester, a 24-hour "Thinking Marathon" is held, featuring three types of competition questions (logical analysis, innovative conception, and quick decision-making), and inviting cross-disciplinary judges to provide immediate feedback (adopted from the multi-dimensional thinking training camp strategy).

(2) Arrange for entrepreneurs or media professionals from outside the school to share their "start-up stories", and have students participate in "pain point co-creation" on the spot (a strategy from the innovation interest stimulation course).

(3) One event is held every month, inviting senior students to share their failed innovative projects and how they iteratively improved them, with joint comments from both teachers and students (from the cross-grade innovation sharing meeting strategy).

(4) Set up a "Problem-solving Laboratory", where students sign up independently for one difficult problem each month and go through the entire process from research to presentation of solutions (from the design strategy of the independent thinking module).

(5) A topic selection competition is held once a week. Student teams need to formulate a plan, assign tasks and submit an execution report within 48 hours (from the training camp of decision-making and execution ability strategy).

(6) Please invite experts to design a "storytelling" training course to help participants clearly explain complex issues within three minutes, enhancing their persuasive power and presentation skills (a strategy from the Expression and Communication Workshop).

(7) Through sandplay, group counseling and meditation exercises, students are helped to identify high-pressure states and establish a self-control

mechanism of "stress alert - quick adjustment" (a strategy from the course on emotion and stress management).

(8) Establish electronic files for each student, recording their innovative projects, competition achievements and mentor evaluations, to facilitate the connection between the credit system and honor certification (from the strategy of the innovative growth file system).

(9) Through MBTI and strength tests, students are guided to find their "most suitable position for innovation" (derived from self-awareness and career planning guidance strategies).

(10) The supervisor has a one-on-one meeting with the student for one hour every month to follow up on the project progress, difficulties and mindset, and form feedback records (from the mentorship system combined with the feedback mechanism strategy).

2) Education and learning environment

The educational and learning environment is a key carrier for cultivating innovation ability of college students. It not only provides a platform for knowledge acquisition but also shapes their thinking patterns and practical abilities. An open and inclusive teaching atmosphere, interdisciplinary integrated course design, and project-based and problem-oriented learning models can effectively stimulate students' innovative thinking and their ability to solve complex problems. Meanwhile, good teacher guidance, resource support, and evaluation mechanisms help to build a learning ecosystem where students "dare to think, dare to try, and dare to make mistakes", enabling them to continuously attempt, reflect, and break through in real status, thus achieving systematic growth in their innovative abilities.

(1) An "Innovative Thinking" module is added after professional courses. Students need to complete small projects and write innovative suggestions (derived from the development of embedded innovation courses).

(2) Invite local enterprises to provide one real case as the final assignment of the course, which will be included in the course grade (from the strategy of embedding enterprise projects into the classroom).

(3) Enterprise representatives serve as co-instructors for the courses and participate in the course design and project review process (from the strategy of collaborative course construction between schools and enterprises).

(4) Establish a dual support mechanism of MOOC and on-campus discussion rooms to break through geographical limitations and strengthen practical interaction (from the construction strategy of online and offline hybrid teaching platforms)

(5) Implement regular evaluations of teaching satisfaction and ability growth, and promptly adjust the course content and methods based on feedback from the teaching experiment data mechanism.

(6) The grades of each related course are composed of three parts: examination, project and team performance. The proportion of the project is no less than 40% (from the innovative course evaluation reform strategy).

(7) The mentor team is composed of teachers, enterprise mentors and students, tracking the project life cycle (derived from the strategy of the joint innovation guidance system for teachers and students).

(8) Teachers should participate in short-term internships or practical training in enterprises at least once a year and bring back cases to the classroom (as per the strategy of the teacher enterprise practice training program).

(9) Monthly theme exhibitions or tea parties are held to allow students to share their achievements in public presentations (derived from the strategy of regularized display channels for innovation achievements).

(10) Integrate innovation participation records into the semester report and GPA calculation system (a strategy reflecting innovation ability from the evaluation system)

3) Social and external factors

Social and external factors provide the practical soil and real driving force for the development of innovation ability of college students. Policy support, enterprise participation, scientific research resources and social demands jointly build a diverse and open innovation ecosystem, which prompts students to apply their

learned knowledge to real scenarios and enhance their ability to perceive and solve problems. External mechanisms such as school-enterprise cooperation, training bases and competition platforms not only broaden students' horizons and resource channels, but also encourage them to transform their creativity into achievements. A good social support system can strengthen college students' innovation awareness, enhance their result-oriented and responsibility awareness, and thus promote the full release of their innovation potential.

(1) Jointly build innovation workshops in the park, and operate a student internship and project-based model throughout the year (from the strategy of establishing a school and local integration innovation platform)

(2) During winter and summer vacations, 2-week enterprise internship and project attachment opportunities are provided, allowing for real contact with industrial processes (from the local entrepreneurship internship base construction strategy).

(3) The government facilitates the release of demand lists by enterprises, and student teams apply for solutions based on the themes (from the strategy of open participation mechanism for local industrial projects).

(4) Regularly hold innovation roadshow events and introduce investment institutions to support student projects (from the strategy of the joint support system of social capital)

(5) Provincial laboratories and data platforms are open for students to make reservations and use them (as per the public innovation resource platform's open policy).

(6) Provide legal, market and capital guidance, and offer a "one-stop" service package for student projects (derived from the improved strategy of the innovation transformation and incubation mechanism).

(7) Every year, 5 to 10 students are selected to go abroad for exchange programs or joint research projects at foreign universities (from the strategy of expanding global cooperation and exchange projects).

(8) Each quarter, policy briefing sessions and Q&A sessions are held in universities to guide students in applying for support resources (derived from the interpretation and connection strategies of government innovation support policies).

(9) Regularly invite successful local alumni who have started businesses or conducted research to return to the school for exchanges, to share their experiences and guide thinking (from the Local Role Model Lecture Hall Program strategy).

(10) Joint media promotion of students' innovative stories, using real cases to inspire more students to take action (from the social publicity and guidance mechanism strategy)

This implementation measure matches each strategy with its main focus area, which helps to understand the methods for enhancing the innovation ability of college students from various development levels.

3. Results of evaluating the feasibility and adaptability of educational management strategies for enhancing sustainable innovation ability of college students in Shaanxi Province.

The feasibility and adaptability of the 54 measures in three aspects of educational management strategies for enhancing sustainable innovation ability of college students are between a relatively high level and the highest level. Among them, in the aspect of personal traits, the adaptability of 7 measures is at the highest level, and the feasibility of 5 measures is at the highest level; in the aspect of education and learning environment, the adaptability of 1 measure is at the highest level, and the feasibility of 4 measures is at the highest level; in the aspect of social and external factors, the feasibility of 2 measures is at the highest level.

1) The feasibility and adaptability analysis results of the 54 measures in 3 aspects of the sustainable development strategy for college students' innovation ability education management range from 3.60 to 4.80, all at a relatively high or the highest level, indicating that these strategies have relatively high adaptability or the highest adaptability.

2) The adaptability analysis results of the 54 measures in 3 aspects of the sustainable development strategy for college students' innovation ability education management range from 3.60 to 4.80, all at a relatively high or the highest level, indicating that these strategies have relatively high feasibility or the highest feasibility.

Discussion

Based on the research results of the sustainable development strategies for the innovation ability education management of college students, the research findings can be classified and discussed in the following three stages according to the research objectives:

1. The results of studying the current status, desired status and supporting factors for promoting education management for enhancing sustainable innovation ability of college students.

2. The development achievements of educational management strategies for enhancing sustainable innovation ability of college students.

3. Evaluation Results on the feasibility and adaptability of educational management strategies for enhancing sustainable innovation ability of college students. The details of the research discussion are as follows:

- 1. The results of studying the current and desired status and supporting factors for promoting education management for enhancing sustainable innovation ability of college students.**

When studying the current condition, desired status and promoting factors of education management for enhancing sustainable innovation ability of college students, a questionnaire survey was conducted on three aspects of variables: personal traits, educational and learning environment, and social and external factors. In terms of personal traits, they can be classified as important variables, including: 1) being able to make quick decisions and take actions when facing multiple choices; 2) effectively managing stress and emotions; 3) reasonably arranging time and maintaining high work efficiency; 4) tending to think independently when solving problems; 5) actively taking on important responsibilities and tasks in the

team; 6) often thinking from different perspectives and proposing new ideas; 7) being able to quickly adjust methods to deal with undesired problems; 8) having a strong interest in learning innovative content; 9) actively seeking solutions when facing innovative tasks; 10) effectively expressing opinions and viewpoints in team cooperation. Regarding the educational and learning environment, which includes important variables, they are: 1) having the opportunity to participate in interdisciplinary cooperation and innovation activities; 2) having sufficient opportunities to participate in innovative experiments and practical projects; 3) the school's course content; 4) the school's teaching philosophy and teaching methods; 5) the school's evaluation system; 6) the school's learning atmosphere; 7) the school's talent cultivation system; 8) specialized innovation education courses; 9) sufficient extracurricular activity support; 10) teachers having sufficient ability and resources to guide students in innovation. As for the social and external factors, which also include important variables, they are: 1) society can provide resources needed for innovation; 2) there are abundant cross-disciplinary cooperation opportunities in society, which can promote innovation development; 3) local industries provide rich innovation opportunities to promote the application of new technologies and new ideas; 4) globalization provides more innovation opportunities; 5) the current social and economic environment provides sufficient opportunities for innovative talents; 6) the local cultural atmosphere encourages innovation and entrepreneurship; 7) social recognition of innovation achievements can motivate continuous innovation; 8) society has relevant policies to attract innovative talents; 9) the current level of technological development promotes innovation and the application of new technologies; 10) the government provides supportive policies in innovation to promote the development of innovative talents. Through the analysis of the results, the average values, standard deviations and demand assessment values of personal traits, educational and learning environment, and social and external factors were obtained. It was found that they all need to be developed and are important factors in formulating strategies. The cultivation of college students' innovation ability is the result of the synergy of individual potential stimulation,

educational process support and social environment drive. Howard Gardner's (1983) theory of multiple intelligences points out that individuals possess various types of intelligence, such as language, logic, space, and interpersonal intelligence. Education should attach importance to the development of differentiated potential to stimulate students' creative expression and thinking diversity. Lev Vygotsky's (1978) theory of the Zone of Proximal Development (ZPD) emphasizes that the growth of innovation ability depends on students achieving cognitive improvement and ability breakthroughs in the "zone of proximal development" through the guidance of teachers or peers. At the same time, Urie Bronfenbrenner's (1979) ecological system theory indicates that individual development is influenced by multiple-level systems such as family, school, society, and policy. External practice platforms, policy support, and social cultural atmosphere play an important role in the formation of students' innovative consciousness and the transformation of their abilities. Therefore, the cultivation of innovation ability should build a multi-dimensional collaborative system that combines individual stimulation, educational support, and social linkage.

2. The development of educational management strategies for enhancing sustainable innovation ability of college students.

This study proposes strategies for educational management for enhancing sustainable innovation ability of college students, mainly including strengthening personal quality and ability, optimizing the educational and learning environment, and improving social and external factors. The research results show that the application degree of these strategies is at a high or the highest level. All strategies are important factors for promoting the sustainable development of innovation ability education and management for college students. Regarding the strengthening of personal quality and ability, as Guilford (1950) proposed in his divergent thinking theory, innovation ability is essentially the external manifestation of an individual's flexibility and uniqueness in thinking; while Rogers (1961) pointed out from a humanistic perspective that the growth process of an individual is itself the process of generating innovation ability. It can be seen that the improvement of individual

quality not only lays the psychological foundation for innovative thinking but also serves as an important driving force for continuous innovative behavior. To optimize the educational and learning environment, as Dewey (1938) proposed, "meaningful experience" is the core support for the development of innovative thinking; Piaget (1950s) emphasized the promoting effect of challenging environments on cognitive restructuring; Vygotsky (1978) pointed out that only in a social support and cooperative environment can an individual break through the limits of their own ability and enter a higher level of development. These theories jointly reveal a core view: by creating a real, challenging, and supportive educational and learning environment, students' thinking vitality, problem awareness, and exploration motivation can be stimulated, thereby effectively promoting the development of their innovation ability. Research shows that a good educational and learning environment not only provides a place for the input of knowledge and skills but also serves as a core ecosystem for stimulating innovation motivation, promoting deep thinking, and practicing abilities, which plays a decisive role in the formation and sustainable development of college students' innovation ability. This view is consistent with this study. The study found that although the current educational and learning environment can play a role, it still needs to be improved to fully support the sustainable development of college students' innovation ability. Regarding social and external factors, as Bronfenbrenner (1979) emphasized in his ecological system theory, the multi-level social environment has a synergistic impact on individual growth; Bandura (1977) pointed out in his social learning theory that social interaction and role models are important mechanisms for stimulating innovative behavior; and Schein (1985) proposed from the perspective of organizational culture that the continuous occurrence of innovative behavior cannot be separated from a good value orientation and institutional environment. The three together indicate that the cultivation of innovation ability is not only an educational issue but also a social system project. It is necessary to build a collaborative education mechanism involving education, enterprises, government, and communities. A complete social and external factor not only provides resource

guarantees and practical platforms for college students' innovation but also builds a multi-dimensional, collaborative, and continuously empowering innovation ecosystem through policy guidance, cultural influence, and institutional support, greatly expanding the development space and transformation channels for students' innovation ability.

3. Evaluation Results on the feasibility and adaptability of educational management strategies for enhancing sustainable innovation ability of college students.

The assessment results of the feasibility and adaptability of educational management strategies for enhancing sustainable innovation ability of college students show that its feasibility is at a relatively high level and its adaptability has reached a high level. This result indicates that the formulated strategy not only conforms to the regional reality and the demands of colleges and universities but also has been systematically evaluated by experts and verified through academic procedures, thus having a solid implementation foundation. Strategic assessment is not only an important link in the implementation of strategies but also a core means for continuous monitoring and optimization. As Wheelen and Hunger (2022) pointed out, effective strategic assessment helps ensure that organizational actions are consistent with long-term goals and achieve continuous improvement and adaptation in a dynamic environment. Kaplan and Norton (2021) also emphasized that through strategic assessment, resources can be allocated more scientifically, performance optimized, and the strategic responsiveness of the organization enhanced. Meanwhile, Porter (2020) believes that through the continuous tracking of key performance indicators (KPIs), organizations can make more data-supported decisions, thereby enhancing innovation ability and organizational flexibility. Overall, strategic assessment not only enhances the transparency and accountability of strategy implementation but also provides a scientific framework for continuous optimization and dynamic adjustment of the innovation capacity building in colleges and universities.

Recommendation

This study investigated the current and desired status of educational management for enhancing college students' sustainable innovation ability in Shaanxi Province. The findings show that although universities have made steady progress in cultivating innovation awareness and practical competence, the overall level remains moderate and still falls short of the expected developmental goals. A clear gap exists between current practices and the desired conditions, particularly in areas such as innovation culture construction, interdisciplinary learning opportunities, and systematic educational management support. Three major influencing dimensions were identified: individual traits, educational and learning environment, and social or external factors, all of which jointly shape students' sustainable innovation development.

The research outcomes are applicable to multiple stakeholders, including students, teachers, higher education institutions, and broader social sectors such as government agencies, enterprises, and research organizations. Universities serve as the central platform for cultivating innovation-oriented talent, teachers function as facilitators and mentors of innovative learning, students act as active participants in innovation practices, while society provides policy guidance, industrial collaboration opportunities, and cultural support. The coordinated participation of these groups is essential for establishing a sustainable innovation education ecosystem.

Regarding practical application, the study highlights the importance of integrating innovation-oriented educational management into curriculum design, teaching reform, institutional governance, and external cooperation mechanisms. This includes promoting interdisciplinary learning, strengthening project-based and experiential education, enhancing university-industry collaboration, improving innovation policy support, and fostering a campus culture that values creativity, collaboration, and lifelong learning. Such comprehensive strategies can optimize educational management conditions and strengthen the systematic cultivation of innovation ability.

The expected outcomes include improved student competitiveness, stronger practical and innovative capacities, higher educational quality, and closer alignment between higher education development and regional economic and social needs. In the long term, these efforts will contribute to building a sustainable innovation culture, enhancing universities' strategic role in national innovation systems, and cultivating innovative talents with social responsibility, adaptability, and continuous learning capacity, thereby supporting both educational modernization and sustainable societal development.

General recommendation

1. For students:

Firstly, promoting the sustainable development of college students' innovation ability education management is conducive to comprehensively enhancing students' overall quality and core competitiveness. Integrating innovative concepts into the teaching system can encourage students to pay more attention to the improvement of critical thinking, logical reasoning, interdisciplinary integration and practical abilities. This not only enriches students' learning content and methods, but also stimulates their enthusiasm for active exploration and autonomous learning, enabling them to possess stronger problem-solving abilities and future adaptability.

Secondly, establishing a sustainable innovative education management system can help guide students to form clear career development goals and independent growth paths. Under the support of a systematic innovative education, students can accumulate real experience and skills through participating in project-based learning, entrepreneurial practice, scientific research training, etc., and enhance their ability to apply what they have learned. The diverse evaluation system and personalized development space provided by the school also help students realize their self-worth, increase their sense of achievement and confidence, and lay a solid foundation for their future employment and further studies.

Finally, incorporating innovation abilities into the core of educational management helps cultivate students' sense of social responsibility and mission for the times. Against the backdrop of social and technological changes, college students

should not only be learners of knowledge but also active participants in promoting social development. Through participating in social practices, university-enterprise collaborations, and innovation and entrepreneurship competitions, students can better understand the actual demands for talents in national strategies and regional development, enhance their awareness of serving society and contributing to the country, and thus grow into new-era talents with ideals and beliefs, innovative spirit, and practical abilities.

2. For teachers:

Firstly, enhancing the sustainable innovation ability of college students helps promoting teachers' professional qualities and educational innovation abilities. Against this backdrop, teachers are not only knowledge disseminators but also guides of students' innovative thinking and cultivators of their practical abilities. By participating in teaching innovation practices such as curriculum reform, project-based teaching, and interdisciplinary integration, teachers can continuously expand their educational concepts and teaching skills, and enhance their control over teaching content and methods. This continuous professional growth enables teachers to become core drivers of educational change.

Secondly, the introduction of the concept of sustainable development has prompted teachers to re-examine their teaching goals and educational values. In the process of cultivating students' innovation capabilities, teachers should not only focus on imparting knowledge but also pay attention to shaping students' thinking patterns, problem awareness and practical abilities. This transformation has pushed teachers to shift from the traditional "lecture-based" role to a "guiding" and "collaborative" one, thereby forming a student-centered teaching perspective. In this process, teachers will gain a higher level of professional identity and a sense of value realization.

Finally, establishing an education management system centered on the cultivation of innovation capabilities will help create a teaching atmosphere that encourages cooperation and open co-creation. The collaborative research and teaching among teachers, the advancement of joint teaching projects between

schools and enterprises, and the formation of interdisciplinary teams will enhance teachers' sense of teamwork and social responsibility, and stimulate their enthusiasm for participating in educational reform and talent cultivation innovation. This mutually supportive and mutually promoting working ecosystem not only boosts teachers' teaching motivation and sense of belonging but also creates status for them to gain broader development space in educational practice.

3. For schools:

Firstly, integrating the concept of sustainable development into the management system for cultivating college students' innovative abilities can help promote the modernization of university education governance. As a crucial base for talent cultivation, universities can enhance the scientificity and systematicness of management and improve the synergy and foresight of educational policy implementation by introducing the concepts of sustainable development and innovative management in teaching content, curriculum systems, and evaluation mechanisms. By optimizing the allocation and operation mechanisms of educational resources and building a more flexible and efficient educational ecosystem, a solid institutional guarantee can be provided for the cultivation of college students' innovative abilities.

Secondly, promoting the deep integration of innovation capacity education and sustainable development can help strengthen the strategic support role of universities in the national innovation system. With the country's increasing emphasis on new quality productivity and high-quality development, universities must undertake the dual mission of leading scientific and technological innovation and talent reserve. By establishing an education management mechanism that is in line with industrial development and social transformation, and constantly exploring new talent cultivation models and teaching methods, it can stimulate students' critical thinking and practical abilities, and inject new vitality into regional economic and social development.

Finally, promoting the sustainable development of innovation ability education management for college students is conducive to building a positive and

upward cultural atmosphere within universities. Excellent education management is not only a system arrangement but also a cultural guidance. By establishing a campus environment centered on innovation, collaboration, and autonomous learning, it can stimulate the enthusiasm and creativity of teachers and students for education, and promote the continuous improvement of professional qualities and educational capabilities of educators and managers. This virtuous educational ecosystem will provide a solid support for universities to continuously attract high-quality teachers, build first-class disciplines, and cultivate outstanding innovative talents, ultimately helping Shaanxi Province to build a new pattern of coordinated development between higher education and regional development.

4. For Society

First of all, from a social perspective, enhancing the innovation ability of college students first requires creating a favorable macro innovation environment. The government should improve the innovation policy system and public service platforms, provide stable guarantees for college students' participation in innovation activities through institutional guidance and resource support, and stimulate their innovative consciousness and enthusiasm for participation.

On this basis, the collaborative role between social forces and universities should be further strengthened, and enterprises, research institutions and other entities should be encouraged to deeply participate in the cultivation of college students' innovation capabilities. Through the integration of industry, academia and research and the connection of practical projects, real innovation scenarios are provided for college students to promote the continuous improvement of their innovation capabilities in practice.

Ultimately, the continuous improvement of college students' innovation ability also depends on the long-term cultivation of a social innovation culture. By promoting the spirit of innovation, tolerating trial and error as well as failure, and guiding the formation of a social value orientation that respects innovation, college students can maintain their continuous innovative drive in a good atmosphere and achieve the sustainable development of their innovation capabilities.

Suggestions for further research

1) Conduct comparative studies across regions or internationally, and implement longitudinal studies to track the development and changes of college students' innovation capabilities over time. These studies will help identify best practices, regional differences, and the long-term impact on the growth of innovation capabilities.

2) Conduct research on the influence of cultural factors on innovation ability and explore the role of technology in enhancing innovation ability. This research will provide insights into how traditional cultural values and modern digital tools can support the sustainable development of innovation ability among college students.

3) Conduct in-depth research on the relationship between teachers' management capabilities and the effectiveness of their innovation capabilities, investigate students' understanding and demands for the cultivation of innovation capabilities, and analyze the influence mechanism of educational policies on innovative development. Such research will provide a scientific basis for optimizing the support system and improving educational policies, and effectively promote the systematic improvement and sustainable development of college students' innovation capabilities.

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Appendices

Appendix A

List of Specialists and Letters of Specialists Invitation
for IOC Verification

List of Specialists Invitation for IOC Verification

NO.	Name of Experts	Position
1	Sunate thaveethavornswat	Associate Professor Dr. Bansomdejchaopraya Rajabhat University
2	Narongwat Mingmit	Associate Professor Dr. Bansomdejchaopraya Rajabhat University
3	Areeya juichamlong	Assistant professor Dr. Bansomdejchaopraya Rajabhat University
4	Wan Shengxin	Professor Xianyang Normal University
5	zhanghong	Professor Xi'an University of Posts and Telecommunications

List of Experts For Interview

Name of Experts	Position/Office
1. Professor Zhang Keying	Dean of the School of Management, Xi'an Polytechnic University
2. Professor Wang Yuan	Vice Dean of the School of Management, Xi'an Polytechnic University
3. Professor Zhang Zhenglin	Director of the Marketing Department of the School of Management, Xi 'an Polytechnic University
4. Professor Chen Heng	Vice Dean of the School of Management, Xi 'an Polytechnic University
5. Associate Professor Li Yumei	Vice Dean of the School of Fashion of Shaanxi Fashion Engineering University
6. Professor Guo Shouku	Dean of the School of Economics and Management of Shaanxi Fashion Engineering University
7. Associate Professor Lai Yan	Vice Dean of the School of Economics and Management of Shaanxi Fashion Engineering University
8. Associate Professor Geng Xixi	Director of the Employment Center of Shaanxi University of International Trade & Commerce
9. Associate Professor Shi Wenqi	Assistant to the Dean of the Fashion Art College of Shaanxi University of International Trade & Commerce
10. Associate Professor Zhou Chuanyu	Director of the Innovation and Entrepreneurship Teaching and Research Section of the Fashion Art College of Shaanxi University of International Trade & Commerce

List of Experts For Focus Group Discussion

Name of Experts	Position/Office
1. Professor Hao Jianjun	Deputy Director of the Science and Technology Department of Shaanxi Fashion Engineering University
2. Professor Luo Wenqian	Director of Science and Technology Department of Shaanxi Fashion Engineering University
3. Professor Liu Xueyi	Deputy Director of the Academic Affairs Office Of Shaanxi Fashion Engineering University
4. Professor Men Yaling	Dean of the Normal College of Xianyang Polytechnic
5. Professor Feng Hua	Director of the Academic Affairs Office of Xianyang Polytechnic College
6. Professor Feng Weigang	Dean of the School of Information Engineering, Xianyang Polytechnic
7. Guo Zhaohao (Enterprise expert)	Deputy Manager of Xi 'an Kaiyuan Securities
8. Han Junguang (Enterprise expert)	Deputy Manager of Xi 'an Branch of China Life Insurance
9. Chang Chong (Enterprise expert)	Deputy Manager of Xi 'an Lianjia Branch
10. Liu Houxin (Enterprise expert)	Manager of Boerxing Education Technology Co., LTD

List of Specialists Invitation for Strategies Evaluation

The following individuals have been invited to serve as assessment experts to evaluate the feasibility and adaptability of educational management strategies for enhancing sustainable innovation ability of college students in Shaanxi Province.

NO.	Name of Experts	Position
1	Zhang Jianning	Professor Weinan Normal University
2	Wang Xinhong	Professor Xi'an University of Science and Technology
3	Qin Xuanlong	Professor Xi'an University of Finance and Economics
4	Li Chunging	Professor Northwest University
5	Yang Shengbo	Xianyang Normal University

Appendix B

Official Letter



Ref.No. MHESI 0643.14/131

Bansorndejchaopraya Rajabhat University
1061 Itsaraparb Hirunrujee
Thonburi Bangkok 10600

3 January 2025

Subject Invitation to validate research instrument

Dear Associate Professor Dr. Sunate thaveethavornsawat

Attachment A set of research instrument

Mr. Guo Tingting is a graduate student in the Doctor of Philosophy Program in Educational Management for Sustainable Development program of Bansorndejchaopraya Rajabhat University. he is conducting research entitled "Development of Educational Management Strategies For Enhancing Sustainable Innovation ability of College Students in Shaanxi Province"

A dissertation advisory committee has considered that you are an expert in this topic. Your recommendations would be useful for further improvement of this research instrument.

With your expertise, we would like to ask your permission to validate the attached research instrument. Would like to avail ourselves of this opportunity to express our sincere thanks and appreciation for your help.

Thank you for considering this invitation. We look forward to your kind support.

Yours faithfully

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Ref.No. MHESI 0643.14/1.32

Bansomdejchaopraya Rajabhat University
1061 Itsaraparb Hirunrujee
Thonburi Bangkok. 10600

3 January 2025

Subject Invitation to validate research instrument

Dear Associate Professor Dr. Narongwat Mingmit

Attachment A set of research instrument

Mr. Guo Tingting is a graduate student in the Doctor of Philosophy Program in Educational Management for Sustainable Development program of Bansomdejchaopraya Rajabhat University. he is conducting research entitled "Development of Educational Management Strategies For Enhancing Sustainable Innovation ability of College Students in Shaanxi Province"

A dissertation advisory committee has considered that you are an expert in this topic. Your recommendations would be useful for further improvement of this research instrument.

With your expertise, we would like to ask your permission to validate the attached research instrument. Would like to avail ourselves of this opportunity to express our sincere thanks and appreciation for your help.

Thank you for considering this invitation. We look forward to your kind support.

Yours faithfully

(Asst. Prof. Dr. Tanaput Chanchaen)

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Ref.No. MHESI 0643.14/133

Bansorndejchaopraya Rajabhat University
1061 Itsaraparb Hirunrujee
Thonburi Bangkok 10600

3 January 2025

Subject Invitation to validate research instrument

Dear Assistant professor Dr. Areeya Julchamlong

Attachment A set of research instrument

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Ref.No. MHESI 0643.14/134

Bansomdejchaopraya Rajabhat University
1061 It saraparb Hirunrujee
Thonburi Bangkok 10600

3 January 2025

Subject Invitation to validate research instrument

Dear Professor Wan Shengxin

Attachment A set of research instrument

Mr. Guo Tingting is a graduate student in the Doctor of Philosophy Program in Educational Management for Sustainable Development program of Bansomdejchaopraya Rajabhat University. he is conducting research entitled "Development of Educational Management Strategies For Enhancing Sustainable Innovation ability of College Students in Shaanxi Province"

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Ref.No. MHESI 0643.14/235

Bansomdejchaopraya Rajabhat University
1061 Itsaraparb Hirunrujee
Thonburi Bangkok 10600

3 January 2025

Subject Invitation to validate research instrument

Dear Professor zhanghong

Attachment A set of research instrument

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Yours faithfully

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RefNo. MHESI 0643.14/7.43

Bansomdejchaopraya Rajabhat University
1061 Itsaraparb Hirunrujee
Thonburi Bangkok 10600

5 February 2025

Subject Invitation to join an interview as an expert

Dear Professor Zhang Keying

Attachment Interview form

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Ref.No. MHESI 0643.14/1.44

Bansomdejchaopraya Rajabhat University
1061 Itsaraparb Hirunrujee
Thonburi Bangkok 10600

5 February 2025

Subject Invitation to join an interview as an expert

Dear Professor Wang Yuan

Attachment Interview form

Mr. Guo Tingting is a graduate student in the Doctor of Philosophy Program in Educational Management for Sustainable Development program of Bansomdejchaopraya Rajabhat University. he is conducting research entitled "Development of Educational Management Strategies For Enhancing Sustainable Innovation ability of College Students in Shaanxi Province"

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RefNo: MHESI 0643.14/71.45

Bansomdejchaopraya Rajabhat University
1061 Itsaraparb Hirunrujee
Thonburi Bangkok 10600

5 February 2025

Subject Invitation to join an interview as an expert

Dear Professor Zhang Zhenglin

Attachment Interview form

Mr. Guo Tingting is a graduate student in the Doctor of Philosophy Program in Educational Management for Sustainable Development program of Bansomdejchaopraya Rajabhat University. he is conducting research entitled "Development of Educational Management Strategies For Enhancing Sustainable Innovation ability of College Students in Shaanxi Province"

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Ref.No. MHESI 0643.14/71.46

Bansomdejchaopraya Rajabhat University
1061 Itsaraparb Hirunrujee
Thonburi Bangkok 10600

5 February 2025

Subject Invitation to join an interview as an expert

Dear Professor Chen Heng

Attachment Interview form

Mr. Guo Tingting is a graduate student in the Doctor of Philosophy Program in Educational Management for Sustainable Development program of Bansomdejchaopraya Rajabhat University. he is conducting research entitled "Development of Educational Management Strategies For Enhancing Sustainable Innovation ability of College Students in Shaanxi Province"

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Ref.No. MHESI 0643.14/1.47

Bansomdejchaopraya Rajabhat University
1061 Itsaraparb Hirunrujee
Thonburi Bangkok 10600

5 February 2025

Subject Invitation to join an interview as an expert

Dear Associate Professor Li Yumei

Attachment Interview form

Mr. Guo Tingting is a graduate student in the Doctor of Philosophy Program in Educational Management for Sustainable Development program of Bansomdejchaopraya Rajabhat University. he is conducting research entitled "Development of Educational Management Strategies For Enhancing Sustainable Innovation ability of College Students in Shaanxi Province"

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Ref.No. MHESI 0643.14/71.48

Bansomdejchaopraya Rajabhat University
1061 Itsaraparb Hirunrujee
Thonburi Bangkok 10600

5 February 2025

Subject Invitation to join an interview as an expert

Dear Professor Guo Shouku

Attachment Interview form

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Yours faithfully,

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RefNo. MHESI 0643.14/7.49

Bansomdejchaopraya Rajabhat University
1061 Itsaraparb Hirunrujee
Thonburi Bangkok 10600

5 February 2025

Subject Invitation to join an interview as an expert

Dear Associate Professor Lai Yan

Attachment Interview form

Mr. Guo Tingting is a graduate student in the Doctor of Philosophy Program in Educational Management for Sustainable Development program of Bansomdejchaopraya Rajabhat University. he is conducting research entitled "Development of Educational Management Strategies For Enhancing Sustainable Innovation ability of College Students in Shaanxi Province"

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RefNo: MHESI 0643.14/71.50

Bansomdejchaopraya Rajabhat University
1061 Itsaraparb Hirunrujee
Thonburi Bangkok 10600

5 February 2025

Subject Invitation to join an interview as an expert

Dear Associate Professor Geng Xinxi

Attachment Interview form

Mr. Guo Tingting is a graduate student in the Doctor of Philosophy Program in Educational Management for Sustainable Development program of Bansomdejchaopraya Rajabhat University. he is conducting research entitled "Development of Educational Management Strategies For Enhancing Sustainable Innovation ability of College Students in Shaanxi Province"

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Ref.No. MHESI 0643.14/P.51

Bansomdejchaopraya Rajabhat University
1061 Itsaraparb Hirunrujee
Thonburi Bangkok 10600

5 February 2025

Subject Invitation to join an interview as an expert

Dear Associate Professor Shi Wenqi

Attachment Interview form

Mr. Guo Tingting is a graduate student in the Doctor of Philosophy Program in Educational Management for Sustainable Development program of Bansomdejchaopraya Rajabhat University. he is conducting research entitled "Development of Educational Management Strategies For Enhancing Sustainable Innovation ability of College Students in Shaanxi Province"

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Ref.No. MHESI 0643.14/1.52

Bansomdejchaopraya Rajabhat University
1061 Itsaraparb Hirunrujee
Thonburi Bangkok 10600

5 February 2025

Subject Invitation to join an interview as an expert

Dear Associate Professor Zhou Chuanyu

Attachment Interview form

Mr. Guo Tingting is a graduate student in the Doctor of Philosophy Program in Educational Management for Sustainable Development program of Bansomdejchaopraya Rajabhat University. he is conducting research entitled "Development of Educational Management Strategies For Enhancing Sustainable Innovation ability of College Students in Shaanxi Province"

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Ref.No. MHEI 0643.14/262

Bansomdejchaopraya Rajabhat University
1061 Itsaraparb Hirunrujee
Thonburi Bangkok 10600

1 May 2025

Subject Invitation to join a focus group discussion as an expert

Dear Professor Hao Jianjun

Attachment A focus group discussion schedule

Mr. Guo Tingting is a graduate student in the Doctor of Philosophy Program in Educational Management for Sustainable Development program of Bansomdejchaopraya Rajabhat University. he is conducting research entitled "Development of Educational Management Strategies For Enhancing Sustainable Innovation ability of College Students in Shaanxi Province"

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Ref.No. MHESI 0643.14/263

Bansomdejchaopraya Rajabhat University
1061 Itsaraparb Hirunrujee
Thonburi Bangkok 10600

1 May 2025

Subject Invitation to join a focus group discussion as an expert

Dear Professor Luo Wenqian

Attachment A focus group discussion schedule

Mr. Guo Tingting is a graduate student in the Doctor of Philosophy Program in Educational Management for Sustainable Development program of Bansomdejchaopraya Rajabhat University. he is conducting research entitled "Development of Educational Management Strategies For Enhancing Sustainable Innovation ability of College Students in Shaanxi Province"

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Ref.No. MHESI 0643.14/2.64

Bansomdejchaopraya Rajabhat University
1061 Itsaraparb Hirunrujee
Thonburi Bangkok 10600

1 May 2025

Subject Invitation to join a focus group discussion as an expert

Dear Professor Liu Xueyi

Attachment A focus group discussion schedule

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RefNo. MHESI 0643.14/1.65

Bansomdejchaopraya Rajabhat University
1061 Itsaraparb Hirunrujee
Thonburi Bangkok 10600

1 May 2025

Subject Invitation to join a focus group discussion as an expert

Dear Men Yalin

Attachment A focus group discussion schedule

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Ref.No. MHES 0643.14/1.66

Bansomdejchaopraya Rajabhat University
1061 Itsaraparb Hirunrujee
Thonburi Bangkok 10600

1 May 2025

Subject Invitation to join a focus group discussion as an expert

Dear Feng Hua

Attachment A focus group discussion schedule

Mr. Guo Tingting is a graduate student in the Doctor of Philosophy Program in Educational Management for Sustainable Development program of Bansomdejchaopraya Rajabhat University. he is conducting research entitled "Development of Educational Management Strategies For Enhancing Sustainable Innovation ability of College Students in Shaanxi Province"

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RefNo. MHESI 0643.14/167

Bansomdejchaopraya Rajabhat University
1061 Itsaraparb Hirunrujee
Thonburi Bangkok 10600

1 May 2025

Subject: Invitation to join a focus group discussion as an expert

Dear Professor Feng Weigang

Attachment: A focus group discussion schedule

Mr. Guo Tingting is a graduate student in the Doctor of Philosophy Program in Educational Management for Sustainable Development program of Bansomdejchaopraya Rajabhat University. he is conducting research entitled "Development of Educational Management Strategies For Enhancing Sustainable Innovation ability of College Students in Shaanxi Province"

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Ref.No. MHESI 0643.14/1.68

Bansomdejchaopraya Rajabhat University
1061 Itsaraparb Hirunrujee
Thonburi Bangkok 10600

1 May 2025

Subject Invitation to join a focus group discussion as an expert

Dear Guo Zhaohao (Enterprise expert)

Attachment A focus group discussion schedule

Mr. Guo Tingting is a graduate student in the Doctor of Philosophy Program in Educational Management for Sustainable Development program of Bansomdejchaopraya Rajabhat University. he is conducting research entitled "Development of Educational Management Strategies For Enhancing Sustainable Innovation ability of College Students in Shaanxi Province"

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RefNo. MHESI 0643.14/1.69

Bansomdejchaopraya Rajabhat University
1061 Itsaraparb Hirunrujee
Thonburi Bangkok 10600

1 May 2025

Subject Invitation to join a focus group discussion as an expert

Dear Han Junguang (Enterprise expert)

Attachment A focus group discussion schedule

Mr. Guo Tingting is a graduate student in the Doctor of Philosophy Program in Educational Management for Sustainable Development program of Bansomdejchaopraya Rajabhat University. he is conducting research entitled "Development of Educational Management Strategies For Enhancing Sustainable Innovation ability of College Students in Shaanxi Province"

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Ref.No. MHESI 0643.14/1.70

Bansomdejchaopraya Rajabhat University
1061 Itsaraparb Hirunrujee
Thonburi Bangkok 10600

1 May 2025

Subject Invitation to join a focus group discussion as an expert

Dear Chang Chong (Enterprise expert)

Attachment A focus group discussion schedule

Mr. Guo Tingting is a graduate student in the Doctor of Philosophy Program in Educational Management for Sustainable Development program of Bansomdejchaopraya Rajabhat University. he is conducting research entitled "Development of Educational Management Strategies For Enhancing Sustainable Innovation ability of College Students in Shaanxi Province"

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Ref.No. MHE9 0643.14/2.71

Bansomdejchaopraya Rajabhat University
1061 Itsaraparb Hirunrujee
Thonburi Bangkok 10600

1 May 2025

Subject Invitation to join a focus group discussion as an expert

Dear Liu Houxin (Enterprise expert)

Attachment A focus group discussion schedule

Mr. Guo Tingting is a graduate student in the Doctor of Philosophy Program in Educational Management for Sustainable Development program of Bansomdejchaopraya Rajabhat University. he is conducting research entitled "Development of Educational Management Strategies For Enhancing Sustainable Innovation ability of College Students in Shaanxi Province"

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Ref.No. MHESI 0643.14/1.85

Bansomdejchaopraya Rajabhat University
1061 Itsaraparb Hirunrujee
Thonburi Bangkok 10600

15 July 2025

Subject Invitation to join Strategy Evaluation as an expert

Dear Professor Zhang Janning

Attachment Strategy Evaluation Form

Mr. Guo Tingting is a graduate student in the Doctor of Philosophy Program in Educational Management for Sustainable Development program of Bansomdejchaopraya Rajabhat University. He is conducting research entitled "Development of Educational Management Strategies For Enhancing Sustainable Innovation ability of College Students in Shaanxi Province".

The thesis advisory committee, along with the student, recognizes your expertise in this field. As such, the graduate school would like to formally invite you to join Strategy Evaluation as an expert, where your insights and suggestions will greatly contribute to the advancement of the student's research.

Thank you for considering this invitation.

Yours faithfully

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RefNo. MHESI 0643.14/2.86

Bansorndejchaopraya Rajabhat University
1061 Itsaraparb Hirunrujee
Thonburi Bangkok 10600

15 July 2025

Subject: Invitation to join Strategy Evaluation as an expert

Dear Professor Wang Xinhong

Attachment: Strategy Evaluation Form

Mr. Guo Tingting is a graduate student in the Doctor of Philosophy Program in Educational Management for Sustainable Development program of Bansorndejchaopraya Rajabhat University. He is conducting research entitled "Development of Educational Management Strategies For Enhancing Sustainable Innovation ability of College Students in Shaanxi Province"

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Ref.No. MHESI 0643.14/187

Bansomdejchaopraya Rajabhat University
1061 Itsaraparb Hirunrujee
Thonburi Bangkok, 10600

15 July 2025

Subject Invitation to join Strategy Evaluation as an expert

Dear Professor Qin Xuanlong

Attachment Strategy Evaluation Form

Mr. Guo Tingting is a graduate student in the Doctor of Philosophy Program in Educational Management for Sustainable Development program of Bansomdejchaopraya Rajabhat University. He is conducting research entitled "Development of Educational Management Strategies For Enhancing Sustainable Innovation ability of College Students in Shaanxi Province"

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RefNo. MHES/ 0643.14/188

Bansomdejchaopraya Rajabhat University
1061 Itsaraparb Hirunrujee
Thonburi Bangkok 10600

15 July 2025

Subject Invitation to join Strategy Evaluation as an expert

Dear Professor Li Chungqing

Attachment: Strategy Evaluation Form

Mr. Guo Tingting is a graduate student in the Doctor of Philosophy Program in Educational Management for Sustainable Development program of Bansomdejchaopraya Rajabhat University. He is conducting research entitled "Development of Educational Management Strategies For Enhancing Sustainable Innovation ability of College Students in Shaanxi Province"

The thesis advisory committee, along with the student, recognizes your expertise in this field. As such, the graduate school would like to formally invite you to join Strategy Evaluation as an expert, where your insights and suggestions will greatly contribute to the advancement of the student's research.

Thank you for considering this invitation.

Yours faithfully

(Asst. Prof. Dr. Tanaput Chanchaen)

Vice Dean of Graduate School for Dean of Graduate School

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Ref.No. MHESI 0643.14/1.89

Bansomdejchaopraya Rajabhat University
1061 Itsaraparb Hirunrujee
Thonburi Bangkok 10600

15 July 2025

Subject Invitation to join Strategy Evaluation as an expert

Dear Professor Yang Shengbo

Attachment Strategy Evaluation Form

Mr. Guo Tingting is a graduate student in the Doctor of Philosophy Program in Educational Management for Sustainable Development program of Bansomdejchaopraya Rajabhat University. He is conducting research entitled "Development of Educational Management Strategies For Enhancing Sustainable Innovation ability of College Students in Shaanxi Province"

The thesis advisory committee, along with the student, recognizes your expertise in this field. As such, the graduate school would like to formally invite you to join Strategy Evaluation as an expert, where your insights and suggestions will greatly contribute to the advancement of the student's research.

Thank you for considering this invitation.

Yours faithfully

(Asst. Prof. Dr. Tanaput Chanchaoen)

Vice Dean of Graduate School for Dean of Graduate School

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Appendix C

Research Instrument



Questionnaire

Studying on current and desired status of sustainable innovation ability of college students in Shaanxi Province (For Students)

Direction:

1. This questionnaire is part of a research on development of educational management strategies for enhancing sustainable innovation ability of college students in Shaanxi Province. This research aims to 1) study the current and desired status of education management for enhancing sustainable innovation ability of college students in Shaanxi Province. 2) develop educational management strategies for enhancing sustainable innovation ability of college students in Shaanxi Province and 3) evaluate the feasibility and adaptability of educational management strategies for enhancing sustainable innovation ability of college students in Shaanxi Province.

2. This questionnaire is intended for expert review and is divided into two parts, containing thirty questions and related suggestions.

3. Your opinions on this This questionnaire will be helpful in development of educational management strategies for enhancing sustainable innovation ability of college students in Shaanxi Province. Completing this This questionnaire will not have any impact on you personally. All collected data will only be used for general analysis, and researchers will strictly use this information for academic research purposes.

Thank you very much for taking the time to participate in this This questionnaire.
Your views are of great significance to this research.

Mr. Guo Tingting

A doctoral student in Educational Management for Sustainable Development
Bansomdejchaopraya Rajabhat University

Part I: Participants' Demographic Characteristics

1. Gender:

- ☐ Male
- ☐ Female

2. Grade:

- ☐ First grade
- ☐ Second grade
- ☐ Third grade
- ☐ Fourth grade
- ☐ Postgraduate or above

3. Professional background:

- ☐ Engineering
- ☐ Literature
- ☐ Science
- ☐ Business
- ☐ Art
- ☐ Other

PartII: Questionnaire on Current status and Desired status of education management for enhancing sustainable innovation ability of college students

5 indicates the highest level of education management for cultivating college students' innovation ability and sustainable development.

4 indicates a high level of education management for cultivating college students' innovation ability and sustainable development.

3 indicates a medium level of education management for cultivating college students' innovation ability and sustainable development.

2 indicates a low level of education management for cultivating college students' innovation ability and sustainable development.

1 indicates the lowest level of education management for cultivating college students' innovation ability and sustainable development.

Assessment Items		Current status					Desired status				
		5	4	3	2	1	5	4	3	2	1
	environment provide sufficient opportunities for innovative talents?										
22	Does the government offer supportive policies in innovation to promote the development of innovative talents?										
23	Has the current level of technological development promoted innovation and the application of new technologies?										
24	Does the local cultural atmosphere encourage innovation and entrepreneurship?										
25	Does the local industry offer abundant opportunities for innovation to promote the application of new technologies and new ideas?										
26	Are there abundant cross-disciplinary cooperation opportunities in society that can promote innovative development?										
27	Does society provide the resources needed for innovation, such as funds and technological platforms?										
28	Does the recognition of your innovative achievements by society motivate you to keep innovating?										
29	Does the society have relevant policies for attracting innovative talents?										
30	Has globalization provided you with more opportunities for innovation?										

Thank you again for your participation and wish you all the best!



Interview Form

Development of Educational Management Strategies For Enhancing Sustainable Innovation Ability of College Students (For Experts)

Description:

1. This interview form is part of a research on development of educational management strategies for enhancing sustainable innovation ability of college students in Shaanxi Province. This research aims to 1) study the current status and desired status of education management for enhancing sustainable innovation ability of college students in Shaanxi Province. 2) develop educational management strategies for enhancing sustainable innovation ability of college students in Shaanxi Province and 3) evaluate the feasibility and adaptability of educational management strategies for enhancing sustainable innovation ability of college students in Shaanxi Province.

2. This interview form is intended for expert review and is divided into two parts, containing five questions and related suggestions.

3. Your opinions on this interview form will be helpful in development of educational management strategies for enhancing sustainable innovation ability of college students in Shaanxi Province. Completing this interview will not have any impact on you personally. All collected data will only be used for general analysis, and researchers will strictly use this information for academic research purposes.

Thank you very much for taking the time to participate in this interview.
Your views are of great significance to this research.

Mr. Guo Tingting

A doctoral student in Educational Management for Sustainable Development
Bansomdejchaopraya Rajabhat University

Part I: Participants' Demographic Characteristics

Interviewer.....Interview Date.....

Interview Time.....Interviewee.....

Part II: The factors enhancing the development of education management for enhancing sustainable innovation ability of college students

Questions
1. What are the significant weaknesses or behavioral gaps you have observed in students' ability to execute innovation tasks, and why do current educational approaches fall short in preparing them for sustainable task-driven innovation?
2. To enhance innovation ability sustainably, what specific gaps in students' multidimensional or systems thinking skills should be prioritized for development within the current educational management system in Shaanxi Province?
3. What are your perspectives on the learning factors or elements that play a significant role in fostering students' independent thinking, and how might these elements influence the transformation of students into sustainable innovators?

.....
4. Regarding the creation of innovation that meets current social and economic demands, how significant is the promotion of interdisciplinary collaboration and university-industry partnerships for the sustainability of innovation outcomes? Furthermore, what practical procedures should educational institutions develop to achieve effective resource integration?
5. In order for educational management to sustainably enhance students' innovation ability, what core components should the strategy consist of, and how should these components be interconnected to ensure continuous outcomes?

Suggestion

.....

.....

.....

Signed: Interviewer

(.....)

Date/...../.....



Evaluation Form

Development Strategies for enhancing sustainable innovation ability of college students in Shaanxi Province. (For Experts)

Description:

1. This evaluation form is part of a research on development of educational management strategies for enhancing sustainable innovation ability of college students in Shaanxi Province. This research aims to 1) study the current and desired status of education management for enhancing sustainable innovation ability of college students in Shaanxi Province. 2) develop educational management strategies for enhancing sustainable innovation ability of college students in Shaanxi Province and 3) evaluate the feasibility and adaptability of educational management strategies for enhancing sustainable innovation ability of college students in Shaanxi Province.

2. This evaluation form is intended for expert review and is divided into two parts, containing 54 questions and suggestions.

3. Your opinions on this This questionnaire will be helpful in development of educational management strategies for enhancing sustainable innovation ability of college students in Shaanxi Province. Completing this This evaluation form will not have any impact on you personally. All collected data will only be used for general analysis, and researchers will strictly use this information for academic research purposes.

Thank you very much for taking the time to participate in this This evaluation form. Your views are of great significance to this research.

Mr. Guo Tingting

A doctoral student in Educational Management for Sustainable Development
Bansomdejchaopraya Rajabhat University

Evaluation checklist	Feasibility					Adaptability				
	5	4	3	2	1	5	4	3	2	1
Support Program										
14. International Competition Participation Funding Policy										
15. Open public experimental and data resources										
16. Camp for "Innovation Internship" among Schools, Enterprises and the Government										

Suggestion

.....

.....

.....

Signed: Interviewer

(.....)

Date/...../.....



**Questionnaire Validity Assessment Form on the current and desired
status of Educational Management for enhancing sustainable innovation
ability of college students
(For Experts)**

Description:

1. This is the questionnaire validity assessment form regarding the current and desired status of educational management for enhancing sustainable innovation ability of college students, for experts to consider the consistency of the questionnaire and offer suggestions. It is part of the doctoral dissertation of the Education Management major at Bansomdejchaopraya Rajabhat University in Thailand. This study aims to explore the constituent elements of sustainable development of college students' innovation ability education management, formulate strategies for sustainable development of college students' innovation ability education management, and evaluate these strategies.

2. This questionnaire validity assessment form is divided into 3 parts, with a total of 30 questions about suggestions for formulating sustainable development strategies of college students' innovation ability education management.

3. Your opinions on the questionnaire validity assessment form will help formulate education management strategies to promote the formulation of sustainable development strategies for college students' innovation ability education management. Filling out this questionnaire will not have any impact on you personally. The collected data will be used for an overall overview, and the researcher will only use the data for research purposes. Thank you for your cooperation in answering this questionnaire.

Thank you for your cooperation in answering this interview form.

Mr. Guo Tingting

Bansomdejchaopraya Rajabhat University

Part I: Participants' Demographic Characteristics

Assessor _____ Workplace _____

Position _____

Part II: The Validity Assessment Table of This Questionnaire, Regarding the Current status and Influencing Factors of education management for enhancing sustainable innovation ability of college students

Direction: Please take into account the factors of the current status and the consistency of the factors influencing educational management strategies for enhancing sustainable innovation ability of college students. After consideration, please tick the corresponding box. Please use the following criteria for assessment. A score of +1 indicates "conforms to the definition". A score of 0 indicates "uncertain whether it conforms to the definition". A score of -1 indicates "does not conform to the definition".

Factors	Assessment Items	Assessment result			Remarks
		-1	0	1	
Personal traits					
1	When faced with an innovative task, you will actively seek solutions.				
2	You often think about problems from different perspectives and put forward new viewpoints.				
3	When solving problems, you tend to think independently.				
4	You can stay calm and manage stress and emotions effectively.				
5	When encountering unexpected problems, you can quickly adjust your approach to deal with them.				

Factors	Assessment Items	Assessment result			Remarks
		-1	0	1	
6	When faced with multiple choices, you can make a quick decision and take action.				
7	You will take the initiative to shoulder important responsibilities and tasks within the team.				
8	In team collaboration, you can effectively express your opinions and viewpoints.				
9	You can manage your time reasonably and maintain work efficiency.				
10	You have a great interest in innovative learning content.				
Education and learning environment					
11	You think that the course content in school is of great help to you in enhancing your innovative ability.				
12	You think that the teaching methods in school can effectively stimulate your innovative thinking.				
13	You think that the learning atmosphere at the school encourages innovation and free exploration.				
14	The school provides sufficient support for extracurricular activities to help enhance students' innovative abilities.				
15	The school has launched specialized innovation education courses to help students enhance their innovation capabilities.				
16	Teachers have sufficient ability and resources to guide students to be innovative.				

Factors	Assessment Items	Assessment result			Remarks
		-1	0	1	
17	You have ample opportunities to participate in innovative experiments and practical projects.				
18	You have the opportunity to participate in interdisciplinary cooperation and innovation activities.				
19	You believe that the school's training system effectively supports the growth of innovative talents.				
20	You think that the evaluation system of your school can truly reflect your innovative ability.				
Social and external factors					
21	The current social and economic environment provides sufficient opportunities for innovative talents.				
22	The government provides supportive policies in innovation to promote the development of innovative talents.				
23	The current level of technological development has promoted innovation and the application of new technologies.				
24	The local cultural atmosphere encourages innovation and entrepreneurship.				
25	The local industries offer abundant opportunities for innovation to promote the application of new technologies and new concepts.				
26	There are abundant opportunities for interdisciplinary cooperation in society, which can promote innovative development.				

Factors	Assessment Items	Assessment result			Remarks
		-1	0	1	
27	Society provides the resources needed for innovation, such as funds and technological platforms.				
28	The recognition of your innovative achievements by society encourages you to keep innovating.				
29	The society has relevant policies to attract innovative talents.				
30	Globalization offers you more opportunities for innovation.				



Assessment form for validity for the interview form of education management strategies for enhancing sustainable innovation ability of college students

Description:

1. This is an assessment form for the validity of the interview on the educational management strategies for enhancing sustainable innovation ability of college students. for experts to consider the consistency of the interview form and offer suggestions. It is part of a doctoral dissertation in the field of educational management at Bansomdejchaudhuny Rajabhat University in Thailand. This research aims to 1) study the current status and desired status of education management for enhancing sustainable innovation ability of college students in Shaanxi Province. 2) develop educational management strategies for enhancing sustainable innovation ability of college students in Shaanxi Province and 3) evaluate the feasibility and adaptability of educational management strategies for enhancing sustainable innovation ability of college students in Shaanxi Province.

2. This assessment form for the validity of the interview form is divided into two parts, with a total of 3 questions and suggestions.

3. Your opinions on the validity of the interview form in this assessment form will help develop educational management strategies to promote the the educational management strategies for enhancing sustainable innovation ability of college students. Answering this questionnaire will not have any impact on you personally. The collected data will only be used for an overall overview, and the researcher will only use the data for research purposes.

Thank you for your cooperation in answering this assessment form for validity of the interview form

Mr. Guo Tingting
Bansomdejchaopraya Rajabhat University

Part I: Personal Information of respondents

Assessor _____ Workplace _____

Position _____

Part II: Assessment form for validity of the interview form of education management for enhancing sustainable innovation ability of college students

Direction: Please consider the consistency of the factors enhancing sustainable innovation ability of college students. After consideration, please tick the corresponding box. Please use the following criteria for assessment. A score of +1 indicates "conforms to the definition". A score of 0 indicates "uncertain whether it conforms to the definition". A score of -1 indicates "does not conform to the definition"

Factors	Questions	Assessment result			Remarks
		-1	0	+1	
1	What are the significant weaknesses or behavioral gaps you have observed in students' ability to execute innovation tasks, and why do current educational approaches fall short in preparing them for sustainable task-driven innovation?				
2	To enhance innovation ability sustainably, what specific gaps in students' multidimensional or systems thinking skills should be prioritized for development within the current educational management system in Shaanxi Province?				
3	What are your perspectives on the learning factors or elements that play a significant role in fostering students' independent thinking, and				

Factors	Questions	Assessment result			Remarks
		-1	0	+1	
	how might these elements influence the transformation of students into sustainable innovators?				
4	Regarding the creation of innovation that meets current social and economic demands, how significant is the promotion of interdisciplinary collaboration and university-industry partnerships for the sustainability of innovation outcomes? Furthermore, what practical procedures should educational institutions develop to achieve effective resource integration?				
5	In order for educational management to sustainably enhance students' innovation ability, what core components should the strategy consist of, and how should these components be interconnected to ensure continuous outcomes?				

Suggestion

.....

.....

.....

Signed: Interviewer

(.....)

Date/...../.....



**Assessment form for validity
of the Evaluation form of education management
for enhancing sustainable innovation ability of
college students in Shaanxi Province**

Description:

1. This is an assessment form for the validity of the evaluation form is part of the research on development of educational management strategies for enhancing sustainable innovation ability of college students in Shaanxi Province. This research aims to 1) study the current and desired status of education management for enhancing sustainable innovation ability of college students in Shaanxi Province. 2) develop educational management strategies for enhancing sustainable innovation ability of college students in Shaanxi Province and 3) evaluate the feasibility and adaptability of educational management strategies for enhancing sustainable innovation ability of college students in Shaanxi Province.

2. This assessment form for the validity of the evaluation form is intended for expert review and is divided into two parts, containing 54 questions and suggestions.

3. Your opinions on this assessment form for the validity of the evaluation form will be helpful in development of educational management strategies for enhancing sustainable innovation ability of college students in Shaanxi Province. Completing this This assessment form for the validity of the evaluation form will not have any impact on you personally. All collected data will only be used for general analysis, and researchers will strictly use this information for academic research purposes.

Thank you very much for taking the time to participate in this assessment form for the validity of the evaluation form. Your views are of great significance to this research.

Mr. Guo Tingting

A doctoral student in Educational Management for Sustainable Development
Bansomdejchaopraya Rajabhat University

Evaluation checklist	Assessment result			Remarks
	-1	0	1	
Strategies for Enhancing Personal Traits				
1. Task-based Innovation Training Camp				
2. Multidimensional Thinking Challenge Competition				
3. Personal project practice support				
4. Emotion and Stress Management Workshop				
5. Simulation drill for unexpected scenarios				
6. Decision-making and Execution Training Camp				
7. Responsibility and Commitment Experience Program				
8. Expression and Communication Skills Enhancement Camp				
9. Time Management and Efficiency Salon				
10. Interdisciplinary Interest Guidance Course				
11. Design Thinking Enlightenment Course				
12. Career and Strengths Planning Guidance				
13. Growth Record and Reflection System				
14. Mentorship follow-up and feedback mechanism				
15. Post-mortem analysis of failures and fault-tolerance systems				
16. Cross-grade Experience Sharing Session				
17. Regular innovation capability assessment				
18. Personalized Growth Plan Document				
Strategies for enhancing the Educational and Learning Environment				
1. Innovative modular design of specialized courses				
2. Interdisciplinary Joint Innovation Practice Course				
3. Project-based classroom reform				
4. Hybrid innovation platform integrating online and offline elements				

Evaluation checklist	Assessment result			Remarks
	-1	0	1	
5. Teacher Enterprise Practice Rotation Training Program				
6. Innovative achievements are incorporated into course evaluations				
7. The co-working space is fully open				
8. A funding support mechanism for small-scale projects				
9. Incentive policies for cross-disciplinary teams				
10. A joint innovation guidance mechanism for teachers and students				
11. A regularized platform for showcasing achievements				
12. Student Innovation Credit Bank				
13. The mechanism of jointly building courses by schools and enterprises				
14. Enterprise projects directly enter the classroom				
15. Long-term Special Innovation Funding				
16. Teaching Methods and Practice Workshop				
17. Data-driven teaching feedback system				
18. Inter-school Resource Co-construction Alliance				
19. Innovation mentor rotation system				
20. Student Innovation Clubs and Communities				
Strategies for Enhancing Social and External Factors				
1. University-Community Integration Innovation Base				
2. The real project cooperation mechanism for local enterprises				

Evaluation checklist	Assessment result			Remarks
	-1	0	1	
3. Social resource matching platform				
4.University-Industry Joint Fund for Real Estate				
5. Policy Interpretation and Matching Guidance Meeting				
6. Local talent and project incentive policies				
7. Local Innovation Festivals and Competition Events				
8. Joint platform of universities, enterprises and research institutions				
9. One-stop service for student project incubation				
10. Local Innovation Role Model Sharing Program				
11. Regional innovation competition mechanism				
12. Joint media promotion mechanism				
13. International Exchange and Cooperation Support Program				
14. International Competition Participation Funding Policy				
15. Open public experimental and data resources				
16. Camp for "Innovation Internship" among Schools, Enterprises and the Government				

Appendix D

The Results of the Quality Analysis of Research Instruments

The Quality Analysis Results of Research Instruments

The consistency assessment results of the questionnaire survey on the current status of educational management for enhancing sustainable innovation ability of college students

1.The quality analysis results of Questionnaire

clause	The current status of education management for enhancing sustainable innovation ability of college students	Experts					ioc	Conclustion
		1	2	3	4	5		
Personal qualities								
1	When faced with an innovative task, you will actively seek solutions.	1	1	1	1	1	1.00	consistent
2	You often think about problems from different perspectives and put forward new viewpoints.	1	1	1	1	1	1.00	consistent
3	When solving problems, you tend to think independently.	1	1	1	1	1	1.00	consistent
4	You can stay calm and manage stress and emotions effectively.	1	1	1	1	1	1.00	consistent
5	When encountering unexpected problems, you can quickly adjust your approach to deal with them.	1	1	1	1	1	1.00	consistent
6	When faced with multiple choices, you can make a quick decision and take action.	1	1	1	1	1	1.00	consistent
7	You will take the initiative to shoulder important responsibilities and tasks within the team.	0	1	1	1	0	0.60	consistent

clause	The current status of education management for enhancing sustainable innovation ability of college students	Experts					ioc	Conclustion
		1	2	3	4	5		
8	In team collaboration, you can effectively express your opinions and viewpoints.	1	1	1	1	1	1.00	consistent
9	You can manage your time reasonably and maintain work efficiency.	1	1	1	1	1	1.00	consistent
10	You have a great interest in innovative learning content.	1	1	1	1	0	0.80	consistent
Education and learning environment								
1	You think that the course content in school is of great help to you in enhancing your innovative ability.	1	1	1	1	1	1.00	consistent
2	You think that the teaching methods in school can effectively stimulate your innovative thinking.	1	1	1	1	1	1.00	consistent
3	You think that the learning atmosphere at the school encourages innovation and free exploration.	1	1	1	1	1	1.00	consistent
4	The school provides sufficient support for extracurricular activities to help enhance students' innovative abilities.	1	1	1	1	1	1.00	consistent
5	The school has launched specialized innovation education courses to help students enhance their innovation abilities.	1	1	1	1	1	1.00	consistent

clause	The current status of education management for enhancing sustainable innovation ability of college students	Experts					ioc	Conclustion
		1	2	3	4	5		
6	Teachers have sufficient ability and resources to guide students to be innovative.	1	1	1	1	1	1.00	consistent
7	You have ample opportunities to participate in innovative experiments and practical projects.	1	1	1	1	1	1.00	consistent
8	You have the opportunity to participate in interdisciplinary cooperation and innovation activities.	1	1	1	1	1	1.00	consistent
9	You believe that the school's training system effectively supports the growth of innovative talents.	1	0	1	1	1	0.80	consistent
10	You think that the evaluation system of your school can truly reflect your innovative ability.	1	1	1	1	1	1.00	consistent
Social and external factors								
1	The current social and economic environment provides sufficient opportunities for innovative talents.	1	1	1	1	1	1.00	consistent
2	The government provides supportive policies in innovation to promote the development of innovative talents.	1	1	1	1	1	1.00	consistent
3	The current level of technological development has promoted innovation and the application of new technologies.	1	1	1	1	1	1.00	consistent

clause	The current status of education management for enhancing sustainable innovation ability of college students	Experts					ioc	Conclustion
		1	2	3	4	5		
4	The local cultural atmosphere encourages innovation and entrepreneurship.	1	1	1	1	1	1.00	consistent
5	The local industries offer abundant opportunities for innovation to promote the application of new technologies and new concepts.	1	1	1	1	1	1.00	consistent
6	There are abundant opportunities for interdisciplinary cooperation in society, which can promote innovative development.	1	1	1	1	1	1.00	consistent
7	Society provides the resources needed for innovation, such as funds and technological platforms.	1	1	1	1	1	1.00	consistent
8	The recognition of your innovative achievements by society encourages you to keep innovating.	1	1	1	1	1	1.00	consistent
9	The society has relevant policies to attract innovative talents.	1	1	1	1	1	1.00	consistent
10	Globalization offers you more opportunities for innovation.	1	1	1	1	1	1.00	consistent

The quality analysis results of Interview form

clause	The factors enhancing development	Experts					ioc	conclusion
		1	2	3	4	5		
1	What are the significant weaknesses or behavioral gaps you have observed in students' ability to execute innovation tasks, and why do current educational approaches fall short in preparing them for sustainable task-driven innovation?	1	1	1	1	1	1.00	consistent
2	To enhance innovation ability sustainably, what specific gaps in students' multidimensional or systems thinking skills should be prioritized for development within the current educational management system in Shaanxi Province?	1	1	1	1	1	1.00	consistent
3	What are your perspectives on the learning factors or elements that play a significant role in fostering students' independent thinking, and how might these elements influence the transformation of students into sustainable innovators?	1	1	1	1	1	1.00	consistent
4	Regarding the creation of innovation that meets current social and economic demands, how significant is the promotion of interdisciplinary collaboration and university-industry partnerships for the sustainability of innovation outcomes? Furthermore,	1	1	1	1	1	1.00	consistent

clause	The factors enhancing development	Experts					ioc	conclusion
		1	2	3	4	5		
	what practical procedures should educational institutions develop to achieve effective resource integration?							
5	In order for educational management to sustainably enhance students' innovation ability, what core components should the strategy consist of, and how should these components be interconnected to ensure continuous outcomes?	1	1	1	1	1	1.00	consistent

2. The quality analysis results of evaluation form

Evaluation checklist	Experts					ioc	Conclusion
	1	2	3	4	5		
Strategies for Enhancing Personal Traits							
1. Task-based Innovation Training Camp	1	1	1	1	1	1.00	consistent
2 .Multidimensional Thinking Challenge Competition	1	1	1	1	1	1.00	consistent
3. Personal project practice support	1	1	1	1	1	1.00	consistent
4. Emotion and Stress Management Workshop	1	1	1	1	1	1.00	consistent
5. Simulation drill for unexpected scenarios	1	1	1	1	1	1.00	consistent
6. Decision-making and Execution Training Camp	1	1	1	1	1	1.00	consistent
7. Responsibility and Commitment Experience Program	1	1	1	1	1	1.00	consistent
8. Expression and Communication Skills Enhancement Camp	1	1	1	1	1	1.00	consistent
9. Time Management and Efficiency Salon	1	1	1	1	1	1.00	consistent
10. Interdisciplinary Interest Guidance Course	1	1	1	1	1	1.00	consistent
11. Design Thinking Enlightenment Course	1	1	1	1	1	1.00	consistent
12. Career and Strengths Planning Guidance	1	1	1	1	1	1.00	consistent
13. Growth Record and Reflection System	1	1	1	1	1	1.00	consistent
14. Mentorship follow-up and feedback mechanism	1	1	1	1	1	1.00	consistent

Evaluation checklist	Experts					ioc	Conclusion
	1	2	3	4	5		
15. Post-mortem analysis of failures and fault-tolerance systems	1	1	1	1	1	1.00	consistent
16. Cross-grade Experience Sharing Session	1	1	1	1	1	1.00	consistent
17. Regular innovation capability assessment	1	1	1	1	1	1.00	consistent
18. Personalized Growth Plan Document	1	1	1	1	1	1.00	consistent
Strategies for enhancing the Educational and Learning Environment							
1. Innovative modular design of specialized courses	1	1	1	1	1	1.00	consistent
2. Interdisciplinary Joint Innovation Practice Course	1	1	1	1	1	1.00	consistent
3. Project-based classroom reform	1	1	1	1	1	1.00	consistent
4. Hybrid innovation platform integrating online and offline elements	1	1	1	1	1	1.00	consistent
5. Teacher Enterprise Practice Rotation Training Program	1	1	1	1	1	1.00	consistent
6. Innovative achievements are incorporated into course evaluations	1	1	1	1	1	1.00	consistent
7. The co-working space is fully open	1	1	1	1	1	1.00	consistent
8. A funding support mechanism for small-scale projects	1	1	1	1	1	1.00	consistent
9. Incentive policies for cross-disciplinary teams	1	1	1	1	1	1.00	consistent
10. A joint innovation guidance mechanism	1	1	1	1	1	1.00	consistent

Evaluation checklist	Experts					ioc	Conclusion
	1	2	3	4	5		
for teachers and students							
11. A regularized platform for showcasing achievements	1	1	1	1	1	1.00	consistent
12. Student Innovation Credit Bank	1	1	1	1	1	1.00	consistent
13. The mechanism of jointly building courses by schools and enterprises	1	1	1	1	1	1.00	consistent
14. Enterprise projects directly enter the classroom	1	1	1	1	1	1.00	consistent
15. Long-term Special Innovation Funding	1	1	1	1	1	1.00	consistent
16. Teaching Methods and Practice Workshop	1	1	1	1	1	1.00	consistent
17. Data-driven teaching feedback system	1	1	1	1	1	1.00	consistent
18. Inter-school Resource Co-construction Alliance	1	1	1	1	1	1.00	consistent
19. Innovation mentor rotation system	1	1	1	1	1	1.00	consistent
20. Student Innovation Clubs and Communities	1	1	1	1	1	1.00	consistent
Social and external factors							
1. University-Community Integration Innovation Base	1	1	1	1	1	1.00	consistent
2. The real project cooperation mechanism for local enterprises	1	1	1	1	1	1.00	consistent
3. Social resource matching platform	1	1	1	1	1	1.00	consistent
4. University-Industry Joint Fund for Real Estate	1	1	1	1	1	1.00	consistent

Evaluation checklist	Experts					ioc	Conclusion
	1	2	3	4	5		
5. Policy Interpretation and Matching Guidance Meeting	1	1	1	1	1	1.00	consistent
6. Local talent and project incentive policies	1	1	1	1	1	1.00	consistent
7. Local Innovation Festivals and Competition Events	1	1	1	1	1	1.00	consistent
8. Joint platform of universities, enterprises and research institutions	1	1	1	1	1	1.00	consistent
9. One-stop service for student project incubation	1	1	1	1	1	1.00	consistent
10. Local Innovation Role Model Sharing Program	1	1	1	1	1	1.00	consistent
11. Regional innovation competition mechanism	1	1	1	1	1	1.00	consistent
12. Joint media promotion mechanism	1	1	1	1	1	1.00	consistent
13. International Exchange and Cooperation Support Program	1	1	1	1	1	1.00	consistent
14. International Competition Participation Funding Policy	1	1	1	1	1	1.00	consistent
15. Open public experimental and data resources	1	1	1	1	1	1.00	consistent
16. Camp for "Innovation Internship" among Schools, Enterprises and the Government	1	1	1	1	1	1.00	consistent

Reliability analysis of research instruments

Results of variable reliability correlation analysis

Reliability

Scale: all variables

Case handling summary			
		N	%
case	effective	384	100
	Excluded	0	0
	Total	384	100
a. List deletion based on all variables in this program.			

Reliability statistics		
Cronbach's Alpha	Based on standardized items Cronbachs Alpha	Number of terms
.97	.97	30

Interviewee

Interviewer 1

1. How about the problem of the current status of individual traits related to innovation ability of college students and how to enhance the development of these traits under the strategies for sustainable development of innovation education management?

I think 1) Offer courses on "Self-awareness and Potential Development" to help students understand their own personalities and innovative tendencies. 2) Regularly hold psychological quality training camps to enhance students' emotional regulation and resilience to setbacks. 3) Guide students to set personal goals in innovation projects and strengthen their internal drive mechanism. 4) Invite psychology experts to the campus to give special lectures on "Creative Personality". 5) Introduce individual personality assessment tools and implement personalized innovation

potential growth file management. 6) Set up an innovation personality development counseling station to provide individual counseling and consultation services.

2. How about the problem of the current status of the educational and learning environment for the sustainable development strategy of innovation ability education management among university students, and how to promote the development strategies of the educational and learning environment?

I think 1) Optimize the course structure and set up more innovative courses that integrate multiple disciplines. 2) Strengthen the connection between courses and the actual regional industries to enhance their applicability. 3) Develop "challenging task-driven" courses to guide students to explore actively. 4) Encourage teachers to collaborate with industry experts in designing course content. 5) Incorporate "innovation skills training" into the general education modules of all majors. 6) Promote the modularization of courses and the flexibility of elective courses to increase students' space for independent choice.

3. How about the problem of the current status of social and external factors in the sustainable development strategy of innovation ability education management among university students, and how to promote the development strategies of social and external factors?

I think 1) Promote the formulation of local special policies to support the development of college students' innovation capabilities. 2) Set up a provincial "Special Fund for Enhancing College Students' Innovation Capabilities" for resource guidance. 3) Issue detailed policies to encourage enterprises to participate in innovation education in colleges and universities. 4) Encourage local education bureaus and universities to jointly build regional innovation practice platforms. 5) Promote the formation of a multi-department collaborative management mechanism to jointly serve students' innovative growth. 6) Establish a fast channel for feedback of college students' innovation achievements to policy consultation.

Interviewer 2

1. How about the problem of the current status of individual traits related to university students' innovation ability and how to promote the

development of these traits under the strategies for sustainable development of innovation education management?

I think 1) Guide students to participate in real projects and temper their initiative and sense of responsibility in the tasks. 2) Stimulate students' curiosity and desire to explore through the "Innovation Experience Day" activities. 3) Establish a "Student Innovation Mentorship System" to provide personalized guidance and incentives. 4) Encourage students to form "Creative Clubs" to foster an innovative culture of free expression. 5) Set up differentiated innovation development channels and projects for students with different traits. 6) Incorporate the dimensions of innovative spirit and individual growth into the student evaluation system.

2. How about the problem of the current status of the educational and learning environment for the sustainable development strategy of innovation ability education management among university students, and how to promote the development strategies of the educational and learning environment?

I think 1) Promote innovative teaching models such as project-based learning, flipped classrooms, and PBL. 2) Encourage teachers to design real-world tasks to stimulate students' critical thinking. 3) Establish a teaching innovation reward mechanism to enhance teachers' motivation for reform. 4) Introduce "Introduction to Academic Exploration" in the first-year curriculum to guide students to engage in research early on. 5) Provide teachers with training on teaching methods to strengthen their ability to organize diverse classrooms. 6) Build a student-led classroom co-creation mechanism to increase student participation.

3. How about the problem of the current status of social and external factors in the sustainable development strategy of innovation ability education management among university students, and how to promote the development strategies of social and external factors?

I think 1) Establish a long-term strategic cooperation mechanism between universities and enterprises, not limited to short-term projects. 2) Set up an "Enterprise Innovation Mentor Group" to participate in the entire process of student projects. 3) Promote the integration of real enterprise innovation tasks into university curricula. 4) Establish "Enterprise-Named Innovation Competitions" to stimulate

students' market-oriented innovation thinking. 5) Universities should regularly organize "Industry Problem Challenge Camps", inviting enterprises to set problems and students to solve them. 6) Encourage enterprises to open their R&D facilities for students to conduct practical training and real-world innovation.

Interviewer 3

1. How about the problem of the current status of individual traits related to university students' innovation ability and how to promote the development of these traits under the strategies for sustainable development of innovation education management?

I think 1) Conduct a comprehensive survey on the innovative personality traits of college students to understand the current distribution of these traits. 2) Incorporate a module on "Personal Traits and Academic Development" into the orientation program for freshmen. 3) Promote the "Challenge Task" teaching model to cultivate students' awareness of risk-taking. 4) Design dedicated expression spaces for introverted students to enhance their participation and confidence. 5) Establish a "Failure Review Plan" to foster resilience and a growth mindset. 6) Systematically integrate psychological quality education with the development of innovation capabilities.

2. How about the problem of the current status of the educational and learning environment for the sustainable development strategy of innovation ability education management among university students, and how to promote the development strategies of the educational and learning environment?

I think 1) Establish an "Innovative Teacher Development Support Platform" to provide teaching resources and consultation. 2) Set up a "Teaching Demonstration Class Program" to promote outstanding and innovative teaching cases. 3) Organize teachers to participate in off-campus enterprise training to enhance practical teaching abilities. 4) Increase the proportion of dual-qualified teachers to integrate theoretical and practical teaching. 5) Build a "Teaching Synergy Community" to promote cross-disciplinary teacher collaboration and innovation. 6) Strengthen professional training for teachers in evaluating and guiding students' innovation abilities.

3. How about the problem of the current status of social and external factors in the sustainable development strategy of innovation ability education management among university students, and how to promote the development strategies of social and external factors?

I think 1) Leverage the resources of outstanding alumni to provide role models and practical platforms for students' innovation and entrepreneurship. 2) Establish a joint entrepreneurship support mechanism for alumni and students. 3) Guide social forces to set up a "College Students' Innovation Practice Fund". 4) Build an "Alumni Enterprises - Students' Innovation Matching Platform" to achieve resource sharing. 5) Invite renowned alumni to return to campus to share their innovation experiences and offer guidance. 6) Set up an "Alumni Innovation Mentor Day" to enhance intergenerational dialogue and resource flow.

Interviewer 4

1. How about the problem of the current status of individual traits related to university students' innovation ability and how to promote the development of these traits under the strategies for sustainable development of innovation education management?

I think 1) Guide students to take the career interest and personality trait matching assessment to clarify the innovation path. 2) Offer a micro-course on "Personality and Innovation Style" to enhance students' self-awareness. 3) Establish an "Innovation Trait Talent Pool" to track the growth trajectories of outstanding students. 4) Invite alumni to share their experiences of personal traits and innovation growth. 5) Implement a teaching design of "Project-driven + Reflection Diary" to stimulate individual initiative. 6) Build an "Individual Trait Development Experimental Class" to provide refined cultivation.

2. How about the problem of the current status of the educational and learning environment for the sustainable development strategy of innovation ability education management among university students, and how to promote the development strategies of the educational and learning environment?

I think 1) Build flexible and open "innovative learning spaces" to break the traditional classroom structure. 2) Set up cross-departmental "maker spaces" and

"collaborative laboratories" to support team innovation. 3) Provide intelligent learning platforms to support students' personalized development. 4) Create "immersive learning environments" to enhance students' practical experiences. 5) Embed interactive learning resources in spaces such as libraries and dormitories. 6) Promote the concept of "space as curriculum" and integrate learning into daily life scenarios.

3. How about the problem of the current status of social and external factors in the sustainable development strategy of innovation ability education management among university students, and how to promote the development strategies of social and external factors?

I think 1) Encourage social public welfare organizations to jointly build innovative volunteer service projects with universities. 2) Set up a "Public Welfare Innovation Incubation Camp" to support students' social innovation practices. 3) Promote university students' participation in social problem research and solutions to enhance their sense of social responsibility. 4) Establish a "Non-profit Organization Innovation Task Matching Platform" to connect young talents. 5) Social organizations provide venues for innovation practices and real data resources. 6) Support universities in setting up "Social Innovation Courses" and integrating social reality challenges.

Interviewer 5

1. How about the problem of the current status of individual traits related to university students' innovation ability and how to promote the development of these traits under the strategies for sustainable development of innovation education management?

I think 1) Colleges and universities can collaborate with enterprises to match students' personality traits with job requirements, providing precise practical opportunities. 2) Establish an "Innovation Potential Incubation Camp" to implement stratified training for different trait groups. 3) Build a problem-oriented open innovation challenge platform. 4) Introduce the "Innovation Behavior Observation Method" for individual growth diagnosis of students. 5) Set up a "Multidimensional Ability Exhibition Day" to encourage students to express their creativity in diverse

ways. 6) Create an AI algorithm-based personalized innovation development recommendation system.

2. How about the problem of the current status of the educational and learning environment for the sustainable development strategy of innovation ability education management among university students, and how to promote the development strategies of the educational and learning environment?

I think 1) Establish a "University Students' Innovation Festival" to foster a strong atmosphere of innovation. 2) Support students in independently founding innovation organizations and project teams. 3) Guide students to combine their interests with scientific research to enhance their initiative in innovation. 4) Build a tripartite collaboration platform of "students-teachers-enterprises" to promote joint creation and research. 5) Cultivate a campus innovation culture that tolerates failure and encourages attempts. 6) Launch a "Campus Innovation Story Tour Exhibition" to publicize typical student innovation achievements.

3. How about the problem of the current status of social and external factors in the sustainable development strategy of innovation ability education management among university students, and how to promote the development strategies of social and external factors?

I think 1) Promote the joint establishment of innovation workstations for college students by local science and technology parks and universities. 2) Open up scientific research equipment and experimental resources for college students to use. 3) Guide science and technology incubators to provide technical support for college students' projects. 4) Set up a "Green Channel for Young Makers' Entry", lowering the threshold and costs. 5) Incorporate university innovation projects into local science and technology achievement transformation support plans. 6) Build a "University-Local Collaborative Innovation Platform" to support joint talent cultivation.

Interviewer 6

1. How about the problem of the current status of individual traits related to innovation ability of college students and how to promote the

development of these traits under the strategies for sustainable development of innovation education management?

I think 1) Incorporate a special module on "Identifying and Stimulating Students' Innovative Traits" into teacher training programs. 2) Organize cross-departmental innovation competitions to encourage collaboration among students with different personalities. 3) Create a "Personality-Enhancing" classroom environment that encourages free questioning and critical expression. 4) Encourage teachers to adopt diverse evaluation methods to accommodate individual trait differences. 5) Establish a "Teacher-Student Co-Growth" mechanism to foster a sense of trust in individual innovation. 6) Set up an "Innovative Trait Story Exhibition" to inspire individual exploration with real-life examples.

2. How about the problem of the current status of the educational and learning environment for the sustainable development strategy of innovation ability education management among university students, and how to promote the development strategies of the educational and learning environment?

I think 1) Open up teachers' research platforms and laboratory resources to undergraduate students. 2) Establish the "Undergraduate-Postgraduate Collaborative Innovation Project" to encourage cross-grade joint research. 3) Simplify the process for students to apply for research projects and lower the participation threshold. 4) Encourage teachers to lead students in participating in horizontal projects and enterprise projects. 5) Set up a "Student Research Credit System" to record innovative practical achievements. 6) Hold a special training camp for the "Student Research Capacity Enhancement Program".

3. How about the problem of the current status of social and external factors in the sustainable development strategy of innovation ability education management among university students, and how to promote the development strategies of social and external factors?

I think 1) Promote cooperation between cultural enterprises and universities in launching creative innovation projects. 2) Establish "Cultural and Creative Training Bases" to enhance the practical innovation capabilities of students majoring in humanities and social sciences. 3) Encourage students to transform local cultural

resources into innovative materials. 4) Support cultural industry alliances in funding innovative creation projects in universities. 5) Set up a cross-border cooperation mechanism of "Culture + Technology" to broaden students' innovative horizons. 6) Organize "University Students' Cultural and Creative Exhibition" to facilitate off-campus display and transformation.

Interviewer 7

1. How about the problem of the current status of individual traits related to university students' innovation ability and how to promote the development of these traits under the strategies for sustainable development of innovation education management?

I think 1) Incorporate the development of innovative traits among college students into the evaluation index system of local higher education. 2) Encourage universities to establish special funds for the development of innovative personalities. 3) Promote policy-based pilot projects and carry out the construction of demonstration universities for the cultivation of innovative personalities. 4) Support universities and research institutions in jointly building a "platform for individual trait data". 5) Issue local policies to encourage social organizations to participate in the cultivation of individual traits of students. 6) Promote the formation of a collaborative mechanism for the cultivation of innovative traits among universities, governments and enterprises.

2. How about the problem of the current status of the educational and learning environment for the sustainable development strategy of innovation ability education management among university students , and how to promote the development strategies of the educational and learning environment?

I think 1) Promote the smart classroom system to enhance teaching interaction and data management. 2) Introduce a big data analysis platform to track students' learning behaviors in real time. 3) Build an "online innovation resource library" to provide MOOCs and virtual simulation courses. 4) Encourage teachers to record "innovation skills micro-lessons" to expand learning time and space. 5) Develop AI-assisted learning tools to provide personalized feedback for students. 6) Utilize virtual reality technology to simulate real innovation problem-solving scenarios.

3. How about the problem of the current status of social and external factors in the sustainable development strategy of innovation ability education management among university students , and how to promote the development strategies of social and external factors?

I think 1) Call for the inclusion of innovation education in colleges and universities in the local economic and social development agenda. 2) Encourage local governments to establish "Innovation Development Support Centers for College Students". 3) Encourage county and district governments to jointly build local innovation pilot zones with universities. 4) Promote the application of college students' innovation achievements in solving local practical problems. 5) Launch the "Youth Innovation Suggestions" activity and incorporate it into the local policy consultation system. 6) Promote the formulation of a "Joint Cultivation Plan for Youth Innovation Talents" by enterprises, universities and the government.

Interviewer 8

1. How about the problem of the current status of individual traits related to university students' innovation ability and how to promote the development of these traits under the strategies for sustainable development of innovation education management?

I think 1) Build a "Personal Trait Development Archive for College Students" to record their growth trajectories. 2) Launch the "Innovative Trait Month" event to promote the diverse traits of innovative talents. 3) Design "Trait-Matched" student development paths, such as independent research and collaborative innovation. 4) Establish a "Student Self-Understanding and Reflection Platform" to facilitate internal growth. 5) Encourage the establishment of trait mentors to guide students in understanding their own strengths. 6) Organize activities such as "Personality and Innovation" themed speeches and debates to encourage expression.

2. How about the problem of the current status of the educational and learning environment for the sustainable development strategy of innovation ability education management among university students , and how to promote the development strategies of the educational and learning environment?

I think 1) Promote the joint development of innovative course modules by universities and enterprises. 2) Establish "university-enterprise joint workshops" to carry out problem-driven teaching based on real-world issues. 3) Invite enterprise mentors into classrooms to provide industry perspective guidance. 4) Introduce real enterprise projects into course tasks to enhance the practical challenge. 5) Set up a "credit exchange mechanism" to incorporate the results of practical training and internships into academic evaluations. 6) Organize "industry mentor days" to allow students to understand the latest industry trends.

3. How about the problem of the current status of social and external factors in the sustainable development strategy of innovation ability education management among university students, and how to promote the development strategies of social and external factors?

I think 1) Promote the joint development of innovative course modules by universities and enterprises. 2) Establish "university-enterprise joint workshops" to carry out problem-driven teaching based on real-world issues. 3) Invite enterprise mentors into classrooms to provide industry perspective guidance. 4) Introduce real enterprise projects into course tasks to enhance the practical challenge. 5) Set up a "credit exchange mechanism" to incorporate the results of practical training and internships into academic evaluations. 6) Organize "industry mentor days" to allow students to understand the latest industry trends.

Interviewer 9

1. How about the problem of the current status of individual traits related to university students' innovation ability and how to promote the development of these traits under the strategies for sustainable development of innovation education management?

I think 1) Integrate innovative personality assessment elements into student affairs management. 2) Offer a series of workshops on "Self-Management and Innovation Ability". 3) Uncover students' potential through co-construction activities between counselors and students. 4) Support student organizations in undertaking small-scale innovation projects based on interests. 5) Conduct "Personality-Driven"

career development planning counseling. 6) Collaborate with families to carry out theme activities on "Personalized Growth with Family Support".

2. How about the problem of the current status of the educational and learning environment for the sustainable development strategy of innovation ability education management among university students, and how to promote the development strategies of the educational and learning environment?

I think 1) Establish a "Learning Support Center" to provide assistance to students with diverse needs. 2) Enhance students' autonomous learning ability through training in learning consultation, time management, and learning strategies. 3) Implement a "Student Growth File" system to record the entire process of their ability development.

4) Set up a dual-tutoring system of "Academic Mentors + Psychological Mentors" to offer comprehensive support. 5) Launch a "Learning Style Identification and Matching Guidance" service to align teaching strategies. 6) Strengthen innovative support policies for disadvantaged groups to ensure fair development opportunities.

3. How about the problem of the current status of social and external factors in the sustainable development strategy of innovation ability education management among university students, and how to promote the development strategies of social and external factors?

I think 1) Establish a "Learning Support Center" to provide assistance to students with diverse needs. 2) Enhance students' autonomous learning ability through training in learning consultation, time management, and learning strategies. 3) Implement a "Student Growth File" system to record the entire process of their ability development. 4) Set up a dual-tutoring system of "Academic Mentors + Psychological Mentors" to offer comprehensive support. 5) Launch a "Learning Style Identification and Matching Guidance" service to align teaching strategies. 6) Strengthen innovative support policies for disadvantaged groups to ensure fair development opportunities.

Interviewer 10

1. How about the problem of the current status of individual traits related to university students' innovation ability and how to promote the

development of these traits under the strategies for sustainable development of innovation education management?

I think 1) Utilize AI tools to analyze student behavior data and identify innovative tendencies and trait characteristics. 2) Build a personalized innovative learning platform based on learning styles. 3) Establish a "virtual innovation companion system" to provide customized tasks for students with different personalities. 4) Promote "human-machine-human collaborative" teaching design to stimulate individual creative expression. 5) Develop a "trait incentive point mechanism" to quantify and encourage innovative behaviors. 6) Form a student innovative trait growth curve map based on intelligent data.

2. How about the problem of the current status of the educational and learning environment for the sustainable development strategy of innovation ability education management among university students, and how to promote the development strategies of the educational and learning environment?

I think 1) Establish an innovative education quality assessment system to monitor the effectiveness of courses and teaching environments. 2) Introduce a student feedback mechanism to dynamically adjust the allocation of teaching and learning resources. 3) Organize teaching supervision teams, focusing on the process improvement of innovative teaching. 4) Set up a "Student Innovation Ability Tracking Platform" to quantify their growth paths. 5) Incorporate innovation ability achievements into the graduation assessment system. 6) Promote the establishment of an "Innovative Teaching Annual Report" system within universities to strengthen the quality loop.

3. How about the problem of the current status of social and external factors in the sustainable development strategy of innovation ability education management among university students, and how to promote the development strategies of social and external factors?

I think 1) Optimize the policy support for college students' entrepreneurship in terms of registration, financing, taxation, etc. 2) Promote the establishment of "one-stop service windows for innovation and entrepreneurship" in universities. 3) Encourage local governments to set up a "reward mechanism for introducing

innovative projects by college students". 4) Build an integrated innovation ecosystem that combines policies, capital and resources. 5) Universities should enhance the education and guidance on policy application skills for students. 6) Organize "College Students' Policy Application Challenge" to guide them to actively connect with external resources.

Appendix E

Certificate of English



This is to certify that

Mr. Guo Tingting

Achieved BSRU English Proficiency Test (BSRU-TEP) level

C1

Given on 7th February 2025

A handwritten signature in blue ink, appearing to read 'K. A.', is positioned above the name of the Assistant Professor.

Assistant Professor Dr Kulsirin Aphiratvoradej

Director

Appendix F

The Document for Acceptance Research

**The Editorial Board of Higher Education Studies
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February 1, 2026

Dear Tingting Guo,

Thanks for your submission to *Higher Education Studies*.

We have the pleasure to inform you that your manuscript has been accepted for publication. It will be published in the issue of Vol. 16, No. 1, in March 2026.

Title: Development of Educational Management Strategies for Enhancing Sustainable Innovation Ability of College Students in Shaanxi Province

Authors: Tingting Guo, Phisanu Bangkheow, Phatchareephorn Bangkheow & Touchakorn Suwancharas

If you have any questions, please do not hesitate to contact with us.

Sincerely,

Sherry Lin



On behalf of,
The Editorial Board of *Higher Education Studies*
Canadian Center of Science and Education

Development of Educational Management Strategies for Enhancing Sustainable Innovation Ability of College Students in Shaanxi Province

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Abstract

The objectives of this research were: (1) to study the current status and desired status of education management for enhancing the sustainable innovation ability of college students in Shaanxi Province; (2) to develop educational management strategies for enhancing sustainable innovation ability of college students in Shaanxi province; (3) to evaluate the feasibility and adaptability of educational management strategies for enhancing sustainable innovation ability of college students in Shaanxi province.

This study employed stratified sampling to select 384 college students for questionnaire surveys, conducted in-depth interviews with 15 experts, organized focus group discussions with 10 experts, and evaluated the developed strategies with 5 experts. All participating experts had more than five years of experience in higher education management and were familiar with college development plans, teaching management practices, and students' specific status. The research instruments included questionnaires, interview guidelines, educational management strategies, and evaluation forms. Data were analyzed using percentages, means, standard deviations, the Modified Priority Needs Index (PNI_{modified}), and content analysis.

The results revealed that the current status and desired status of education management for the sustainable innovation ability of college students consisted of three essential aspects: personal traits, the educational and learning environment, and social and external factors, all of which were necessary for development. Based on these findings, educational management strategies were developed, comprising a clear vision, mission, and goals, as well as three strategic dimensions and corresponding measures, including strategies to promote the development of personal traits, optimize the educational and learning environment, and enhance support from social and external factors. Furthermore, the evaluation results indicated that the feasibility and adaptability of the proposed educational management strategies were at high and highest levels, respectively.

Keywords: Development of strategies, Sustainable Innovation ability, College students

1. Introduction

In the contemporary era of accelerated innovation, countries worldwide have increased investment in scientific research to stimulate original innovation and enhance global competitiveness. China has elevated innovation to a strategic priority. The Fifth Plenary Session of the 19th CPC Central Committee (2020) emphasized that innovation should occupy a central position in China's modernization agenda, with scientific and technological self-reliance serving as a strategic pillar. It further aims to significantly enhance China's innovation capacity during the Fourteenth Five-Year Plan period, targeting a leading global position by 2035. According to the Global Innovation Index (World Intellectual Property Organization, 2021), countries with strong innovation capabilities demonstrate superior economic growth and competitiveness, highlighting the critical role of innovation in national

development.

Innovation capability is a key indicator of both national competitiveness and individual development. The OECD (2018) emphasizes that innovation capability has become a core competence for adapting to future social and economic transformations. Rapid technological advancement and globalization have increased the demand for individuals equipped with innovative thinking and problem-solving skills. College students, as primary recipients and disseminators of knowledge and emerging technologies, play a crucial role in cultivating these capabilities. Drawing on Schumpeter's theory, innovation is a process of "creative destruction," challenging existing paradigms and generating novel solutions, which underscores the importance of critical thinking and problem-solving skills (Schumpeter, 1934; Facione, 2015).

Despite its importance, challenges remain in fostering college students' innovation capability. Weak innovation awareness, underutilization of educational resources, and traditional teaching models that emphasize rote learning constrain development (Li, 2021; Zhao & Wang, 2019). Therefore, cultivating innovation capability is a long-term and systematic endeavor requiring coordinated efforts from governments, universities, and society. By deepening educational reform, optimizing curricula and teaching methods, strengthening practical and research-based learning, and fostering an open and inclusive innovation environment, universities can more effectively stimulate students' innovative potential and prepare them to contribute to national development (Etzkowitz & Leydesdorff, 2000).

In summary, innovation capability is both a driver of national competitiveness and an essential individual competency in the knowledge-based economy. Developing students' innovation capability requires systematic educational support, practical experiences, and exposure to real-world challenges. By integrating policy guidance, theoretical frameworks, and empirical evidence, universities can cultivate innovative talents capable of addressing societal needs while enhancing their own career potential.

1.1 Research Questions

- 1) What are the current status and desired status of education management for enhancing sustainable innovation ability of college students in Shaanxi Province?
- 2) What are the educational management strategies for enhancing sustainable innovation ability of college students in Shaanxi Province?
- 3) What are the levels of the feasibility and adaptability of educational management strategies for enhancing sustainable innovation ability of college students in Shaanxi Province?

1.2 Research Objectives

- 1) To study the current status and desired status of education management for enhancing sustainable innovation ability of college students in Shaanxi Province.
- 2) To develop educational management strategies for enhancing sustainable innovation ability of college students in Shaanxi Province.
- 3) To evaluate the feasibility and adaptability of educational management strategies for enhancing sustainable innovation ability of college students in Shaanxi Province.

1.3 Literature Review

- 1) **Theoretical Perspectives on Innovation and Educational Management**
Innovation is widely recognized as a key driver of socio-economic transformation and competitiveness. In educational contexts, innovation capability represents the ability of individuals and institutions to generate, apply, and sustain novel ideas that contribute to continuous improvement. Schumpeter (1934) conceptualized innovation as a process of "creative destruction," highlighting how new ideas disrupt established systems and create value. Building on this, Lawson and Samson (2001) proposed the Innovation Capability Framework, emphasizing the organizational capacity to systematically foster creativity, learning, and change — a principle now increasingly applied in higher education institutions. From a psychological perspective, Bandura's (1997) theory of self-efficacy and Tierney and Farmer's

(2002) concept of creative self-efficacy underline the importance of individuals' belief in their ability to produce creative outcomes. These concepts align closely with the development of students' sustainable innovation ability, which depends on internal confidence, persistence, and perceived competence. Similarly, Ryan and Deci's (2000, 2017) Self-Determination Theory (SDT) emphasizes intrinsic motivation as a foundation for creativity and long-term engagement in innovation-related tasks. Together, these frameworks explain how personal traits such as self-efficacy, creativity tendency, and motivation underpin innovative performance in educational environments. In the context of educational management, leadership and strategy development are critical mechanisms for cultivating innovation. Bush (2011) noted that educational management involves aligning institutional vision, structures, and resources to achieve learning outcomes. Effective management thus provides the enabling environment where innovation can thrive through participatory decision-making, resource optimization, and professional support. Finally, innovation in higher education should also be interpreted through the lens of sustainable development. According to UNESCO (2019) and the WCED (1987) report on sustainable development, education plays a transformative role in equipping learners with the competencies necessary for sustainability — including systems thinking, anticipatory skills, and collaborative innovation. When integrated with innovation theory, sustainability adds a long-term and value-driven dimension to innovation education.

2) Educational Management and Innovation in Practice
Teaching and Learning Environment

Teaching approaches and curriculum design play a pivotal role in shaping students' innovative abilities. Freeman et al. (2014) demonstrated that active learning approaches - including problem-based, project-based, and inquiry-based learning - significantly improve students' engagement, critical thinking, and creativity compared to traditional lecture models. Similarly, Prince (2016) found that interactive learning promotes the practical application of knowledge and fosters adaptability. Curriculum design also influences innovation capacity. Biggs and Tang (2015) argue that well-aligned curricula should integrate interdisciplinary content and experiential learning opportunities to encourage creativity and reflection. Li and Wang (2018) further emphasized the necessity of access to diverse educational resources such as laboratories, maker spaces, and digital tools for cultivating students' innovation capabilities.

Teacher support is another determinant. Wentzel (2016) and Fan & Williams (2018) found that positive teacher-student relationships and constructive feedback significantly enhance students' confidence, motivation, and persistence - key precursors of sustainable innovation ability. Institutional Culture and Educational Management Practices

Beyond individual teaching practices, institutional management and culture profoundly shape innovation outcomes. Shalley, Zhou, and Oldham (2017) found that organizational culture emphasizing experimentation and tolerance of failure directly promotes creative output. Chen and Liu (2019) similarly demonstrated that universities cultivating innovation-oriented cultures through collaboration, entrepreneurship, and knowledge sharing foster greater student engagement in creative projects. Educational management also determines how innovation policies are translated into action. Bush (2011) described strategic educational management as involving planning, implementation, and evaluation processes that align institutional goals with innovation objectives. This perspective is reinforced by Etzkowitz and Leydesdorff's (2000) Triple Helix Model, which positions universities, industries, and governments as interdependent partners in innovation ecosystems. For Chinese higher education, this model is particularly relevant, as national strategies such as "Mass Entrepreneurship and Innovation" encourage integrated collaborations between these sectors.

External and Societal Factors

Students' innovation ability does not develop in isolation; it is shaped by multiple external and social influences. Tang et al. (2017) and Zhang & Chen (2019) found that family support - both emotional and material - fosters students' creative confidence and risk-taking behavior. Li & Liu (2018) emphasized that favorable policy environments (e.g., government funding, innovation competitions) enhance students' motivation for innovation activities. Moreover, industry-university collaboration provides practical contexts that transform theoretical learning into innovation capability. Chen, Li, & Wang (2017) and Liu & Zhang (2019) showed that internships, joint research projects, and innovation labs strengthen students' applied problem-solving

skills. Regional innovation ecosystems also matter: Wu & Li (2018) highlighted that regions rich in technological clusters and incubators create fertile ground for student innovation.

3) Synthesis, Research Gap, and Conceptual Framework

The reviewed literature consistently demonstrates that students' sustainable innovation ability results from the interaction of personal traits, institutional factors, and external environments. Personal factors (e.g., creativity tendency, motivation, and self-efficacy) shape students' potential for innovation; institutional and educational factors (e.g., teaching, curriculum, and campus culture) provide the structural foundation; and external factors (e.g., policy support, family, and industry collaboration) enable sustained engagement and application. However, existing studies often examine these dimensions in isolation. Few have proposed an integrated educational management strategy that simultaneously aligns internal (institutional) and external (societal) systems to foster sustainable innovation ability. Moreover, most empirical studies have focused on developed economies or elite universities, leaving a gap in understanding how provincial-level institutions, such as those in Shaanxi Province, can systematically cultivate innovation in alignment with national policies. Therefore, this study constructs a conceptual framework based on three strategic dimensions - personal traits, educational and learning environment, and social/external factors - to develop and evaluate educational management strategies that enhance sustainable innovation ability among college students.

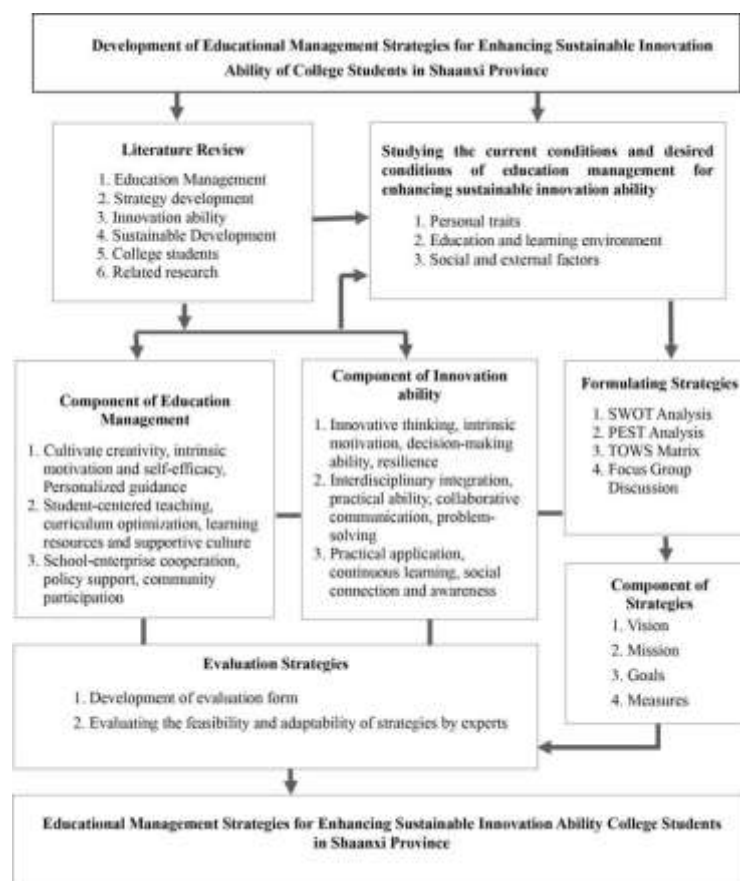


Figure 1 Conceptual Framework

2. Methods

This research adopted a mixed-method design consisting of three sequential phases that combined quantitative and qualitative approaches. The mixed-method strategy was chosen to ensure comprehensive data triangulation, allowing both numerical measurement of current and desired status and in-depth expert interpretation for developing feasible educational management strategies.

Phase 1: Analysis of Current and Desired status

The first phase aimed to examine the current and desired status of educational management for enhancing the sustainable innovation ability of college students in Shaanxi Province. The population comprised approximately 1,926,879 college students across multiple universities in the province. Using Cochran's (1977) formula at a 95% confidence level and a .05 margin of error, a total of 384 students were selected through stratified random sampling to ensure representativeness by gender, academic level, and discipline. Data were collected using a structured questionnaire designed to assess three dimensions: (1) personal traits, (2) educational and learning environment, and (3) social and external factors. The questionnaire's content validity was verified by 15 experts in higher education management, innovation education, and educational research. Revisions were made based on expert feedback to enhance clarity, relevance, and cultural appropriateness. Quantitative data were collected online via WeChat and institutional email systems, ensuring anonymity and voluntary participation. Data were analyzed using descriptive statistics (percentage, mean, and standard deviation) and the Modified Priority Needs Index (PNI_modified) to determine gaps between current and desired status. In addition, qualitative data from expert consultations were analyzed using content analysis to contextualize the quantitative findings.

Phase 2: Development of Educational Management Strategies

The second phase focused on developing strategies for enhancing sustainable innovation ability based on the results from Phase 1. A purposive sampling method was used to recruit 10 experts with extensive experience in educational administration, innovation pedagogy, and higher education policy.

Data collection involved two stages: (1) Individual in-depth interviews, where experts provided insights into critical success factors and barriers related to innovation education; and (2) Focus group discussions, conducted to refine and validate key strategic themes. Qualitative data were analyzed through thematic and comparative analysis, leading to the identification of core strategic dimensions. The strategy formulation process followed the SWOT Analysis, PEST Analysis and TOWS Matrix framework, integrating internal strengths and weaknesses with external opportunities and threats. The PEST analysis was also incorporated to examine the broader political, economic, social, and technological contexts influencing educational innovation.

Phase 3: Evaluation of Feasibility and Adaptability

In the third phase, the developed educational management strategies were evaluated in terms of feasibility and adaptability to determine their practical applicability within higher education institutions in Shaanxi Province. A total of five experts specializing in higher education administration, innovation pedagogy, and educational policy were selected using purposive sampling. This method ensured that all participants possessed relevant professional expertise to critically assess the proposed strategies based on contextual realities and institutional needs. A structured evaluation form was employed as the main research instrument. The form consisted of two key dimensions: (1) feasibility, referring to the practicality and potential for implementation of the strategies, and (2) adaptability, referring to the suitability and flexibility of the strategies across different higher education contexts. Experts rated each item using a five-point Likert scale ranging. The collected data were analyzed using descriptive statistics, including mean ($\bar{X}$) and standard deviation (S.D.), to determine the overall level of feasibility and adaptability. Qualitative comments provided by experts were examined through content analysis to extract additional insights and suggestions for improving implementation procedures.

These findings confirmed that the developed educational management framework was contextually appropriate and could effectively support the enhancement of sustainable innovation ability among college students. The details of the research methods are shown in Figure 2.

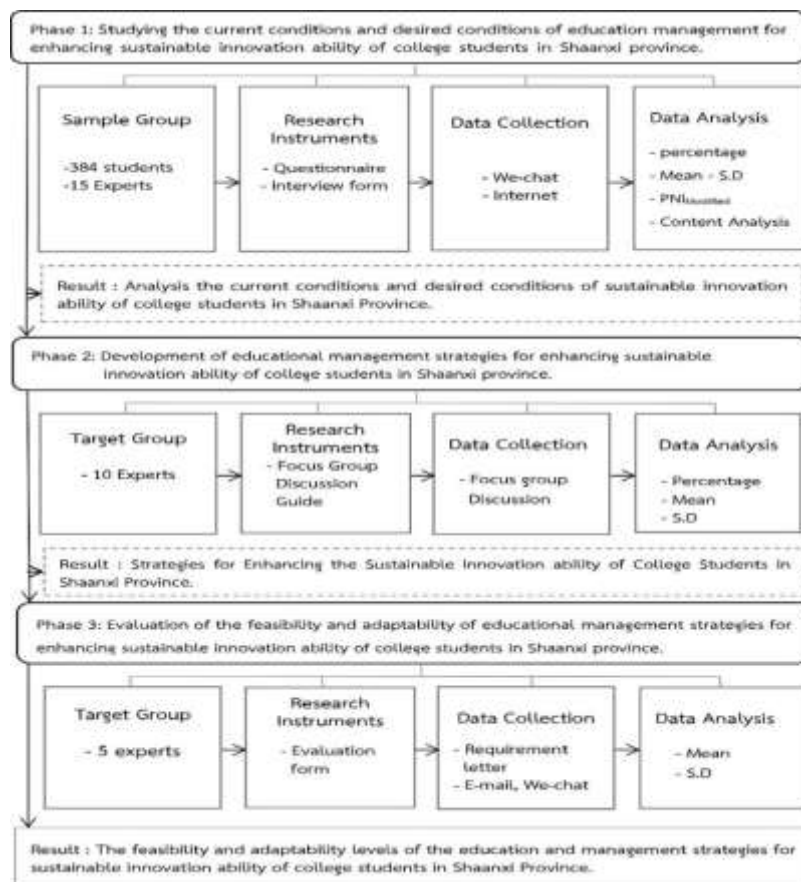


Figure 2: Research Methods

3. Results

This study aims to explore strategies for enhancing sustainable innovation ability of college students in the context of educational management, in the context of educational management, with a focus on personal traits, educational and learning environments, as well as social and external factors. Firstly, the SWOT analysis method is employed to identify the internal strengths and weaknesses of the educational management system, while the PEST analysis method is used to examine the external environment to determine potential opportunities and threats. On this basis, a TOWS Matrix is conducted to systematically match internal factors (strengths and weaknesses) with external factors (opportunities and threats), thereby generating strategic options that can leverage strengths, address weaknesses, seize opportunities, and counter potential threats. This provides a solid foundation for formulating targeted and effective strategies for cultivating college students' innovation capabilities.

3.1 Current and Desired status of Educational Management

Based on the questionnaire survey and expert interviews, the results revealed clear differences between the current and desired status of educational management in cultivating college students' sustainable innovation capability. The SWOT analysis showed that current educational management practices possess certain strengths, including institutional support for innovation-related activities and the gradual integration of innovation elements into curricula. However, significant weaknesses were also identified, such as insufficient innovation-oriented teaching methods, limited interdisciplinary collaboration, and inadequate incentive mechanisms for students' innovative engagement.

In contrast, the desired status emphasize a more student-centered and innovation-driven management approach. Experts highlighted the importance of flexible curriculum design, enhanced practical and experiential learning opportunities, and stronger collaboration among universities, industries, and society to support students' long-term innovation development. Furthermore, the PEST analysis

indicated that favorable national education policies and rapid technological advancement provide substantial external opportunities for improving educational management systems, while increasing competition in higher education and fast-changing socio-economic demands pose potential threats to the sustainable development of students' innovation capabilities. Details are as shown in the table 1.

Table 1: Results on the Current status and Desired status of Education Management for Enhancing Sustainable Innovation Ability of College Students

The Sustainable Development of College Students' Innovation Ability	Current status(D)		Desired status(I)		PNI modified (I-D)/D	Rank
	$\bar{X}$	S.D.	$\bar{X}$	S.D.		
1. Personal Traits	2.26	0.86	3.15	0.76	0.394	3
2. Educational and Learning Environment	2.19	0.92	3.07	0.83	0.402	2
3. Social and External Factors	2.13	0.87	3.02	0.79	0.418	1
Total	2.19	0.88	3.08	0.79	0.405	

3.2 Development of Educational Management Strategies

The factors listed in Table 2 were systematically identified through a two-step process combining quantitative and qualitative data. First, questionnaire responses from 384 students across ten universities were analyzed using frequency and percentage statistics to highlight the most commonly mentioned elements influencing educational management and innovation capability. Second, these preliminary findings were further refined and supplemented based on in-depth expert interviews conducted with ten higher education professionals. Through content analysis, recurring themes and consensus points from experts were extracted, categorized into strengths, weaknesses, opportunities, and threats, and incorporated into the final SWOT Analysis, PEST Analysis and TOWS Matrix framework presented in the table. This combined approach ensures that the table reflects both broad student perspectives and expert judgments, enhancing the validity and reliability of the identified factors.

Table 2: Results on SWOT Analysis

S	W
1) Strong learning ability and solid foundation	1) Lack of practical experience
2) The awareness of innovation has been gradually enhanced	2) Limited innovative thinking
3) Hardworking, enduring hardships and having strong adaptability	3) Weak self-awareness
4) The universities have a solid resource foundation and a strong research atmosphere	3) Uneven distribution and unbalanced development of resources among schools
5) The implementation of policies promoting innovation and entrepreneurship has been quite vigorous	5) The curriculum is out of touch with reality
6) Rich in cultural heritage and academic atmosphere	6) The learning environment is insufficiently tolerant of innovation
7) Policy-driven impetus continues to strengthen	7) Uneven regional development and resource allocation
	8) Insufficient support from enterprises for innovative education in colleges and universities

8) Agglomeration of regional scientific research and educational resources	9) The society has a low acceptance rate for the transformation and application of innovative educational achievements
9) The integration of military and civilian sectors and the linkage with high-tech industries have been strengthened	
O	T
1) National policies support "mass entrepreneurship and innovation" education 2) Expansion of the school-enterprise cooperation platform 3) The popularization of digital tools 4) The country is vigorously promoting the reform of innovation and entrepreneurship education 5) Under the background of the "Western Development Initiative", policy inclination is obvious 6) Digital educational technology is constantly becoming more widespread 7) The digital economy and industrial upgrading drive the growth of innovation demand 8) The "Belt and Road Initiative" strategy expands international resources 9) Local governments promote the coordinated development of schools and the local area	1) Unbalanced regional economic development 2) Employment pressure forces conservative choices 3) The external outstanding talents have great appeal 4) The eastern region has a strong appeal in terms of educational resources, but there is a serious outflow of talent 5) Society's understanding of innovation ability is still not comprehensive 6) There is a lack of in-depth collaborative mechanisms among universities 7) The phenomenon of high-level talent outflow is prominent 8) There is insufficient recognition of the value of innovative education in society 9) Uncertainty brought about by adjustments in macro policies

To comprehensively examine the external status shaping the sustainable development of college students' innovation ability, this study employs the PEST analytical framework, focusing on political, economic, social, and technological dimensions. From a sustainability perspective, the cultivation of innovation ability is not only influenced by internal educational management practices, but also deeply embedded in policy support systems, economic structures, social and cultural environments, and technological advancement trends. By analyzing innovation-related education policies, regional economic support mechanisms, social participation and collaborative networks, as well as emerging digital and intelligent technologies, this framework helps identify both enabling factors and potential challenges affecting students' long-term innovation development. The PEST analysis thus provides a systematic foundation for optimizing educational management strategies, strengthening multi-level collaboration, and promoting the continuous, balanced, and high-quality development of college students' innovation capabilities. Details are as shown in the table 3.

Table 3: Results of PEST Analysis for Strategies Development.

P	E
P1 Promoting the implementation of innovative education policies and balanced regional development	E1 Strengthen the connection between innovation education and key industries in regional economic development
P2 Establish a collaborative innovation governance mechanism involving "government - universities - enterprises"	E2 Improve the economic support system of "university - enterprise collaboration - project- driven - achievement transformation"
P3 Strengthen policy publicity and guidance to enhance students' policy literacy and innovative awareness	E3 Enhance students' economic awareness and business innovation literacy.
S	T
S1 Build an inclusive, diverse and collaborative innovation culture atmosphere.	T1 The system promotes the in-depth integration of cutting-edge technologies such as AI, big data, and virtual simulation in innovative education.
S2 Deepen the integration of social practice and service-oriented innovation projects.	T2 Narrow the gap in technical resources and promote the development of "digital educational equity"
S3 Build a trilateral collaborative education model involving universities, social organizations and families.	T3 Strengthening technical ethics education and information literacy construction.

Drawing on the analysis of current and desired status obtained from questionnaire surveys and expert interviews, this study developed an integrated framework of educational management strategies to enhance college students' sustainable innovation ability. The development process involved qualitative content analysis of expert interview transcripts and thematic coding of questionnaire data to identify key areas for intervention. Through iterative discussions with the research team and validation by higher education experts, 54 targeted measures were systematically formulated and categorized into three key dimensions—personal traits, educational and learning environment, and social and external factors (see Table 2). The framework emphasizes the coordinated development of individual capacities, instructional reform, and external collaboration, aiming to foster innovative awareness, adaptability, and decision-making skills, while promoting interdisciplinary curricula, practical learning platforms, and diversified evaluation mechanisms. By aligning with policy directives and leveraging social resources, the framework provides a practical and sustainable approach for innovation-oriented educational management in higher education.

Table 4 List of Strategies

Aspects of Strategies	Numbers of Measures
1. Personal traits	18
2. Educational and learning environment	20
3. Social and external environmental aspects	16
Total	54

Figure 1 centers on the core objective of "developing educational management strategies to enhance the sustainable innovation capabilities of college students", and constructs a systematic educational management strategy framework composed of three dimensions: personal traits, educational and learning environment, and social and external factors. In the dimension of personal traits, the focus is on stimulating innovation awareness, cultivating innovative thinking, enhancing innovation skills, strengthening resilience to setbacks, clarifying individual development positioning, and optimizing time management skills, to systematically promote the formation and development of students' individual abilities and innovative thinking. In the dimension of educational and learning environment, efforts are made to reconstruct the curriculum system, transform teaching models, improve evaluation mechanisms, build practical teaching platforms, and strengthen mentor guidance, in order to continuously optimize the teaching system and campus innovation ecosystem. In the dimension of social and external factors, the aim is to integrate social mentor resources, establish multi-party collaboration mechanisms, build communication and interaction platforms, connect with industrial resources, expand off-campus practice bases, and improve relevant policy support, to strengthen the supporting role of the external environment in college innovation education. Through the coordinated interaction of the three dimensions, this framework systematically reveals the realization path of educational management in promoting the sustainable innovation capabilities of college students at multiple levels.

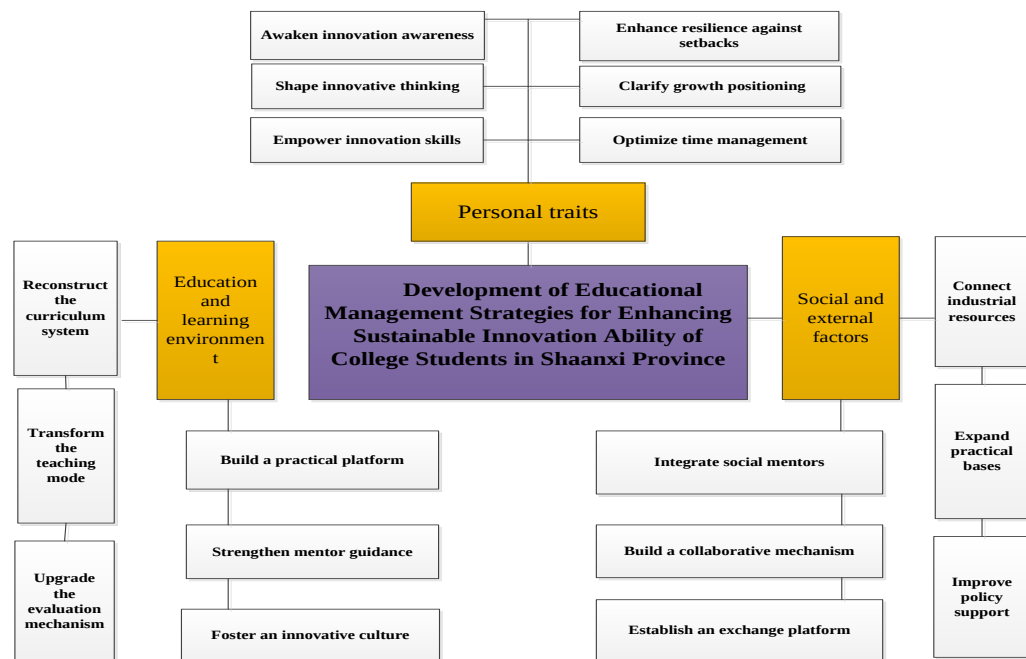


Figure 3 Educational Management Strategies for Enhancing Sustainable Innovation Ability of College Students

3.3 Evaluation of Feasibility and Adaptability

The proposed educational management strategies were evaluated by experts in higher education management for their feasibility and adaptability. Results indicate that all three strategic dimensions—personal traits, educational and learning environment, and social and external factors—achieved high scores for both feasibility and adaptability (Table 3), demonstrating that the strategies are practical, implementable, and well-aligned with policy guidance and social resources. These findings confirm that the framework provides a viable and sustainable approach for enhancing innovation-oriented educational management in colleges and universities.

Table 5: Analysis Results of Strategies Evaluation

Strategies for the Sustainable Development of College Students' Innovation Ability Education and Management	Feasibility			Adaptability		
	$\bar{X}$	S.D.	result	$\bar{X}$	S.D.	result
1. Personal Traits	4.41	0.60	high	4.23	0.66	high
2. Educational and Learning Environment	4.04	0.70	high	4.21	0.64	high
3. Social and External Factors	4.13	0.54	high	4.25	0.64	high
Total	4.19	0.61	high	4.23	0.65	high

In summary, the integrated framework of educational management strategies provides a systematic approach for enhancing college students' sustainable innovation ability. By addressing personal traits, optimizing the educational and learning environment, and strengthening social and external support, the strategies collectively foster students' innovative awareness, adaptability, and practical skills. Expert evaluation confirms that these strategies are both feasible and adaptable, indicating that the framework can be effectively implemented in higher education settings. Overall, this study offers a comprehensive, policy-aligned, and sustainable pathway for promoting innovation-oriented educational management and guiding future practice and research in cultivating students' long-term innovation capabilities.

4. Conclusions

4.1 Research Recommendations

In accordance with the three research objectives, this study explored the current and desired status of educational management for enhancing the sustainable innovation ability of college students in Shaanxi Province, developed strategic management approaches, and assessed their feasibility through expert validation.

The findings highlight that while existing educational management systems provide a solid foundation for innovation-oriented learning, there remain significant gaps—particularly in cultivating students' creative confidence, interdisciplinary engagement, and self-directed learning capacities.

The results of the PNI (Modified Priority Needs Index) analysis indicated that personal traits had the highest need for development, followed by educational environment and social/external factors. This suggests that the enhancement of innovation capability depends not only on institutional reforms but also on the systematic empowerment of individual learners. The subsequent SWOT-TOWS analyses yielded three strategic directions: (1) empowering students' innovative capacity through self-driven learning and creative self-efficacy; (2) optimizing institutional ecosystems to strengthen interdisciplinary curriculum design, resource integration, and faculty support; and (3) fostering external collaboration networks among universities, industries, and government sectors to create a synergistic innovation environment.

The validation results demonstrated high feasibility ($M = 4.60$) and adaptability ($M = 4.57$), confirming that the proposed strategies are both practical and contextually appropriate. These strategies align closely with China's national innovation-driven development agenda and can serve as a reference framework for other provinces seeking to enhance higher education innovation management. From a theoretical standpoint, the study reinforces the significance of integrating micro (individual), meso (institutional), and macro (policy) levels to strengthen sustainable innovation education.

Practically, the research provides a multi-dimensional management framework that university leaders and policymakers can employ to bridge the gap between innovation policy and educational practice. It also offers insights into how local higher education institutions can align their internal strategies with national goals for innovation and sustainable development.

Future research should extend this study by examining the long-term effects of implementing the proposed strategies on students' innovation performance and institutional transformation. Comparative

studies across different provinces or countries could further reveal contextual variables that influence innovation management in higher education systems.

In conclusion, sustainable innovation ability among college students is not merely the result of individual talent or isolated teaching efforts-it requires a coherent, systemic approach integrating educational management, institutional innovation, and societal collaboration. The strategic framework developed in this study offers a practical and theoretically grounded pathway toward realizing that vision.

Based on the findings and developed strategies, the following recommendations are proposed to enhance educational management for sustainable innovation development in higher education institutions within Shaanxi Province and beyond:

1. Strengthen Student-Centered Innovation Education. Universities should redesign curricula to emphasize creative problem-solving, interdisciplinary learning, and project-based activities. Academic programs should integrate real-world innovation challenges that enable students to develop both technical and social competencies.

2. Empower Educators and Academic Leaders. Higher education institutions should organize professional development programs for faculty members focusing on innovation pedagogy, mentoring, and design thinking. University administrators should create a supportive climate that rewards experimentation, collaboration, and innovative teaching practices.

3. Foster Cross-Sector Collaboration. Establish partnerships among universities, industries, and government agencies to provide students with access to practical innovation ecosystems. Collaborative platforms such as innovation hubs, incubators, and joint research centers can serve as bridges between academic learning and industrial innovation.

4. Enhance Institutional Innovation Systems. Universities should strengthen internal mechanisms for strategic management, including evaluation systems, incentive policies, and digital transformation. Integrating data-driven decision-making and adaptive management models will ensure continuous improvement in innovation capability.

5. Policy-Level Support and Funding. Policymakers at the provincial and national levels should expand funding opportunities and develop clear guidelines for innovation-based education management. Long-term policies that promote innovation-driven universities will help sustain the outcomes of strategic initiatives.

4.2 Future Research

For future research, several directions are suggested to deepen the understanding of innovation-oriented educational management:

1. Longitudinal Impact Assessment. Future studies should investigate the long-term effects of implementing the proposed strategies on students' innovation performance, employability, and sustainability awareness.

2. Comparative and Cross-Regional Studies. Conduct comparative studies between different provinces or countries to identify contextual variables influencing innovation management practices in higher education.

3. Mixed-Method Research Approaches. Employ mixed methods that combine large-scale quantitative data with qualitative insights (e.g., case studies, interviews) to capture the complexity of innovation education systems.

4. Integration of Emerging Technologies. Explore how technologies such as artificial intelligence, virtual reality, and data analytics can be integrated into innovation education to enhance students' creative thinking and problem-solving skills.

5. Cultural and Psychological Dimensions. Examine how cultural values, motivation, and creative self-efficacy influence students' innovation behavior within diverse educational environments.

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