

# Study on the Construction and Operation Mechanism of College Students' Innovation Teams Based on Sustainable Development

Xuejin Yang

School of Mechanical Engineering, Wuhan Polytechnic University, Wuhan, Hubei, 430048, China

**Abstract:** Against the backdrop of higher education focusing on cultivating talents needed by innovative industries, college students' innovation teams have become a core force for enhancing students' innovation awareness and collaborative abilities. However, current teams often face issues such as short existence time, unbalanced guidance effects, and lack of incentive and constraint measures, which hinder their long-term stable development. Combining the practical needs of professional construction and teaching reform, this paper explores the operation methods for the sustainable development of college students' innovation teams from three aspects: hierarchical team construction, optimization of supervisors' responsibilities, and improvement of constraint and incentive mechanisms. It provides practical references for improving students' comprehensive quality and cultivating high-level innovative talents.

**Keywords:** college students' innovation teams, sustainable development, echelon construction, operation mechanism, supervisors

## 1. Introduction

College students shoulder the important responsibility of enhancing the whole nation's innovation awareness and improving the country's innovation capability, and they are the most critical human resource for achieving China's strategic goals. Currently, most college students' innovation teams are established based on short-term projects, leading to problems such as "the team disbands once the project is completed" and "the inheritance is interrupted when senior students graduate". Additionally, it is common for supervisors to either interfere excessively or provide insufficient guidance, and for students to struggle to maintain their enthusiasm for participation. These issues result in difficulties in sustaining the teams in the long run and limited effectiveness in talent cultivation. Therefore, establishing an operation mechanism for innovation teams that suits the characteristics of different students and balances long-term development with short-term goals has become a key issue to solve current problems and improve the quality of innovative talent cultivation.

## 2. Practical Dilemmas in the Sustainable Development of College Students' Innovation Teams

### 2.1 Loose Team Structure and Insufficient Sustainability

Many current college students' innovation teams are assembled temporarily to apply for projects. Most members are from the same grade, lacking a stable team structure with collocation of different grades and majors. The lifespan of the team is basically tied to the duration of the project; once the project is completed, the team tends to disband, making it impossible to achieve long-term accumulation of technology, experience, and resources <sup>[1]</sup>. Moreover, as senior students graduate and leave, members with core competencies in the team are lost. Junior students, due to inadequate professional knowledge and lack of experience inheritance, struggle to continue the team's work. This interrupts the training process of

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"from introductory learning to ability improvement, and then to participating in competitions and conducting scientific research". Furthermore, the number of students covered by the team is limited—only a small number of students involved in projects can benefit, while many students with innovative ideas but insufficient abilities cannot join, ultimately failing to achieve the goal of "enhancing the innovation ability of all students".

## **2.2 Imbalanced Role of Supervisors and Insufficient Guidance Effectiveness**

Guidance from professional teachers is a core guarantee for the development of innovation teams. However, current supervisors face a "polarization" problem:

**Absent guidance:** Due to heavy teaching and research tasks, some teachers only participate in the project application and conclusion stages, and lack timely guidance on the team's daily research and technical difficulties encountered by students. This leads to students "having ideas but struggling to implement them", gradually diminishing their innovation enthusiasm.

**Overstepping guidance:** Some teachers excessively interfere in the team's work, dominating the entire process from scheme design to experiment implementation. Students only undertake simple tasks such as data recording and material organization, making it difficult for them to truly participate in the innovation process and exercise their innovation and independent thinking abilities.

Both extremes deviate from the cultivation principle of "student-oriented and teacher-led", restricting the exertion of the team's innovation vitality.

## **2.3 Lack of Constraints and Incentives, and Insufficient Initiative of Main Bodies**

Supervisors and students are the core components of the team, and their initiative to participate directly affects the efficiency of the team's work. However, there are currently no effective methods to standardize and arouse the enthusiasm of these two groups:

**For students:** Some join the team out of temporary interest without the willingness for long-term investment, easily showing high enthusiasm at the beginning which fades quickly. Additionally, there are no appropriate methods to assist students with insufficient abilities or fear of difficulties, making them hesitant to participate in the team's work [2].

**For supervisors:** The time and energy spent on team guidance are mostly not included in teaching workload or research assessment, and there are no clear reward measures. After investing a lot of time and energy, teachers rarely receive due recognition, which affects their initiative to guide the team.

The insufficient initiative of these two core groups has become a major obstacle to the long-term stable development of the team.

# **3. Construction Paths of College Students' Innovation Teams Based on Sustainable Development**

## **3.1 Echelon Construction: Building an "Inheritance-oriented" Team Structure**

Taking "professional construction" as the foundation, we should abandon the practice of "temporary team formation for projects" and build a cross-grade, hierarchical echelon team structure to realize the long-term inheritance of experience, technology, and resources. Specifically, in accordance with the training idea of "introduction - improvement - competition - scientific research", the team is divided into three levels:

**Introduction Layer:** Mainly composed of freshmen and sophomores. The core task at this stage is to solidify students' professional foundation. Students develop academic sensitivity through systematic literature reading exercises and improve their practical abilities through regular skill training courses (e.g., use of data analysis software, operation standards of experimental instruments). Under the "one-on-one" assistance of senior students, they participate in auxiliary work such as daily laboratory management and basic data collection. For example, in the biological engineering professional team, students in the Introduction Layer gradually establish a scientific research thinking framework by assisting graduate students in basic experiments such as strain cultivation and sample pretreatment, and stimulate innovative ideas in the process of practice [3].

**Improvement Layer:** Mainly composed of sophomores and juniors. The focus at this stage is on the incubation of

small-scale innovation projects and actual combat in university-level scientific and technological innovation competitions. Under the systematic guidance of teachers, students independently complete the whole process from project topic selection, scheme design to experiment implementation. The team regularly organizes "project roadshows" and "cross-reviews"; through activities such as simulated defenses and mutual evaluation among groups, students enhance their problem-solving abilities and sense of team collaboration. For example, in the mechanical design innovation team, students in the Improvement Layer design experimental schemes and produce prototypes around the topic of intelligent logistics equipment optimization. They accumulate project management experience through repeated debugging and improvement, significantly improving their practical innovation abilities.

**Core Layer:** Composed of juniors, seniors, and some graduate students. As the technical backbones and management core of the team, members of the Core Layer deeply participate in provincial-level and above competitions and teachers' research projects, undertaking core work such as key technology research and development and achievement transformation. At the same time, the Core Layer establishes a "tutorial training system", conducting weekly activities such as academic salons and experimental guidance to systematically cultivate junior members. For example, in the new energy materials research team, students in the Core Layer lead the Improvement Layer to complete the process optimization project of lithium battery cathode materials. This not only promotes the transformation of scientific research achievements into utility model patents but also realizes the intergenerational inheritance of technical experience through the "mentorship and knowledge transfer" mechanism, forming a positive inheritance atmosphere of "seniors guiding juniors and core members guiding basic-level members".

This structure not only ensures the stability of team members but also realizes the gradual cultivation of innovation abilities, laying a foundation for the sustainable development of the team.

### **3.2 Role Remodeling: Clarifying the "Three-Dimensional Positioning" of Supervisors**

To address the imbalanced role of supervisors, it is necessary to clearly define their functions from three dimensions—"guide, resource connector, and quality controller"—to achieve the goal of "exerting a leading role without undertaking everything, and providing guidance and support without absence".

**As a Guide:** At the initial stage of team formation, teachers assist students in clarifying research directions and formulating development plans. By offering a series of courses on "scientific research thinking training", they use the "Socratic questioning method" to encourage students to proactively discover and analyze problems. For example, in a computer vision project, instead of directly providing suggestions on algorithm selection, teachers stimulate students to independently consult literature and design experimental schemes by asking questions such as "What are the main error sources of current image recognition?". During the research process, a "biweekly seminar" model is adopted, with open-ended questions as guidance to encourage students to conduct critical discussions and cultivate their ability to independently solve problems<sup>[4]</sup>.

**As a Resource Connector:** Teachers need to build a "three-dimensional resource network": vertically connecting with on-campus laboratories and library databases; horizontally opening up cooperation channels with leading enterprises in the industry; and expanding international academic exchange platforms. For example, in the construction of an artificial intelligence team, teachers jointly build laboratories with enterprises to help students obtain real industrial scenario data for algorithm training. They regularly invite industry experts to conduct "cutting-edge technology workshops" and organize students to participate in enterprise technology research and development projects, ensuring that the team's research is closely aligned with industrial needs. In addition, by applying for funding for international academic conferences, they create opportunities for students to communicate and cooperate with overseas research teams, broadening their academic horizons.

**As a Quality Controller:** Teachers need to establish a "three-level quality monitoring system": in the project approval stage, verifying the feasibility of research schemes through expert demonstration meetings; in the mid-term inspection stage, evaluating research progress and phased achievements using a "milestone assessment mechanism"; and in the project conclusion and acceptance stage, organizing interdisciplinary reviews to ensure the academic value and application

prospects of the achievements. For example, in a chemical synthesis process research project, regarding the new catalyst preparation scheme proposed by students, teachers invite experts in materials science and chemical engineering to conduct joint reviews. This not only avoids technical risks caused by knowledge blind spots but also protects students' innovation enthusiasm through constructive feedback, achieving a balance between quality control and innovation incentives.

#### **4. Guarantee Mechanisms for the Sustainable Operation of College Students' Innovation Teams**

##### **4.1 Establishing a "Two-Way Incentive" Mechanism to Arouse the Initiative of Main Bodies**

Targeting students and teachers respectively, step-by-step incentive measures are developed:

For students: A dynamic evaluation system is built, incorporating factors such as team participation time, actual contributions, and progress range into the core indicators of "comprehensive quality evaluation". Special honors such as the "Innovation Pioneer Award" and "Potential Breakthrough Award" are established. For students who win national or provincial awards in disciplinary competitions or research projects, in addition to "bonus points for postgraduate recommendation and preference in scholarships", they also receive resource support such as recommendations for enterprise internships and qualifications for participating in academic conferences. For students in need of ability improvement, the "Innovation Ability Advancement Plan" is provided, offering training subsidies and one-on-one tutor assistance to support their full-process growth from basic skill learning to project practice.

For teachers: Innovation assessment dimensions and incentive methods are clarified: team guidance work is subdivided into modules such as topic selection guidance, process supervision, and achievement incubation, and converted into "innovation guidance credits" based on actual guidance time and quality, which are fully included in the teaching assessment system. The "Excellent Tutor Cultivation Fund" is established; for teachers who guide teams to win provincial-level and above awards or produce high-level scientific research achievements, "green channels" are provided in research fund approval and professional title evaluation. Relying on the "Innovation Education Cloud Platform", a supervisor exchange community is built, regularly organizing inter-university joint teaching and research activities and excellent case workshops to promote the interdisciplinary flow of guidance experience. In addition, a "Team Innovation Growth Fund Pool" is established; through annual performance evaluation, teams with sustainable development potential are selected to receive rolling fund support with a 3-5 year cycle, along with priority rights to use laboratory resources, ensuring the in-depth advancement of research projects [5].

##### **4.2 Improving the "Constraint Management" Mechanism to Standardize Team Operation**

The *Comprehensive Management Measures for College Students' Innovation Teams* is formulated to build an institutional system with clear responsibilities and powers:

In student management: A "three-dimensional assessment system" is implemented, converting daily attendance (20%), task completion (50%), and team collaboration performance (30%) into specific scores, and establishing a "red-yellow-blue three-level early warning mechanism". For members with three unexcused absences or two consecutive failures to meet standards, an exit process is initiated. Meanwhile, a "project replacement mechanism" is introduced, allowing eliminated members to regain team membership by participating in other projects.

In supervisor guidance management: A "dual-track supervision model" is implemented, requiring teachers to use a unified template to write guidance logs (detailing guidance content, student feedback, and improvement plans) and submit the *Innovation Guidance White Paper* (including team achievement analysis, problem diagnosis, and improvement plans) every semester. A "tripartite mutual evaluation mechanism among tutors, students, and experts" is established to conduct regular guidance quality evaluations.

At the same time, a progress management system of "weekly meetings + monthly reviews + quarterly defenses" is built: weekly progress exchange meetings are held combining online and offline methods; monthly phased achievement reports are organized; and quarterly mid-term reviews are conducted by inviting on-campus and off-campus experts. A supporting "achievement blockchain certification system" is implemented, uploading the team's research data, experimental records, and thesis drafts to the blockchain throughout the process, and regularly publishing them on the

campus innovation platform for supervision by teachers and students, fundamentally eliminating academic misconduct.

## **5. Conclusion**

The sustainable development of college students' innovation teams is the key to improving the quality of innovative talent cultivation. Current teams face problems such as loose structure, inadequate guidance, and insufficient incentives. These problems can be solved by realizing team inheritance through "echelon construction", optimizing teacher guidance through "role remodeling", and ensuring operation through "two-way incentives + constraint management". This team construction and operation mechanism based on sustainable development not only realizes the progressive cultivation of "introduction - improvement - competition - scientific research" but also fully mobilizes the enthusiasm of teachers and students, promoting the comprehensive improvement of students' knowledge, abilities, and comprehensive quality. It provides strong support for cultivating high-level innovative talents adapting to industrial needs. In the future, it is necessary to further refine mechanism design in combination with the characteristics of different majors, promote the in-depth integration of innovation team construction and professional teaching reform, and achieve higher-quality sustainable development.

### **Project:**

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### **Author Introduction:**

Xuejin Yang (November 1989-), male, Han nationality, born in Jianli, Hubei Province, associate professor, master's degree, research directions: collaborative robots, intelligent equipment.