



# Research on the Innovation Ability Training Model for Electrical Majors Based on ‘Discipline Competitions + AI Empowerment’

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**Abstract.** Employing artificial intelligence technology as the core enabling mechanism, a cyclical cultivation model is systematically constructed, incorporating capability progression, competition tiering, AI empowerment, and knowledge sedimentation, along with educational application scenarios characterized by distinctive contemporary features of AI. Emphasis is placed on the integration of theory and practice, with a focus on competency orientation. An integrated “Five-Stage Progression – Cyclical Enhancement” training pathway is designed and optimized, thereby establishing a new educational ecosystem centered on the endogenous growth of students' innovative capabilities, which integrates curricula, projects, competitions, and industrial demands.

**Keywords:** Discipline Competitions, AI Empowerment, Electrical Majors, Innovation Capability

## 1 Introduction

Discipline competitions have consistently been recognized as a key arena and core mechanism where students' innovative thinking is honed and stimulated. As a crucial link bridging theoretical knowledge and industrial innovation, electrical discipline competitions serve as a vital platform for fostering students' innovation capability. Currently, how education can be empowered by artificial intelligence, and how students' innovation capability can be cultivated through the practical vehicle of discipline competitions, have become urgent issues to be deeply investigated by scholars in and outside the province [1-3]. Current research is primarily focused on the integration of discipline competitions with practical teaching, the opening of laboratories, the evaluation methods for practical teaching, the consolidation of specialized curricula, and the development of comprehensive innovation capabilities. In some universities, extensive and well-tiered competition networks have been established, with personalized competition recommendations provided based on student capabilities. Practical course projects in certain institutions are directly derived from actual competition questions or adapted variants, achieving a model where "daily practice serves as competition preparation, and courses function as contests." Other universities adopt high-

level competitions as a platform, implementing systematic designs in competition management, topic selection, and environmental setup[4-5]. However, against the backdrop of rapid advancements in artificial intelligence technology, significant gaps remain in the conceptual, modal, and effectiveness-related adoption of AI-enabled education across many institutions. Specific manifestations include: firstly, existing training models often fragment course instruction, project practice, and discipline competitions, lacking a systematic design centered on "capability progression," and failing to construct a comprehensive innovation cultivation system that covers the entire student learning cycle with layered advancement; secondly, there is a shortage of innovative practice resources such as laboratories and intelligent platforms in some schools, and outstanding competition outcomes and process data are not promptly transformed into reusable educational resources, making it difficult to form a closed loop of "learning-competition-innovation"; thirdly, research on the implementation pathways and strategies for enhancing innovation capability lacks systematic planning, hindering the achievement of higher-order competency leaps.

## **2 Breaking the Bottleneck in Innovation Capability Cultivation through the 'Discipline Competitions + AI Empowerment' Model**

### **2.1 Towards Integration: Resolving the "Disjunction Between Competition and Teaching" to Build a Synergistic System for Competition and Innovation Capability Cultivation**

A misalignment is observed between the current competition system and the cultivation of innovation capabilities[6]. Despite the proliferation of various competitions, they are poorly aligned with the curriculum system and capability development objectives. As a result, competitions are often reduced to "extracurricular activities" for a minority of students, failing to effectively serve the large-scale cultivation of innovative talent. Consequently, the potential of competitions to enable practical learning remains underexploited.

### **2.2 Addressing the "Fragmentation in Cultivation" Through Designing a Systematic Progressive Capability Development Pathway**

Overcoming the dilemma of compartmentalization and lack of continuity in the cultivation process. In existing training models, various stages are often treated as separate entities, where an effective bridging mechanism from course learning to outcome incubation is lacking. Thus, a closed loop for continuously enhancing innovative talent cultivation has yet to be formed, which impedes the systematic development of students' innovation capabilities.

### **2.3 Addressing the Lack of a Closed Loop: Establishing a Sustainable Ecosystem for Outcome Transformation and Resource Feedback**

A shortage of practical platforms and intelligent tools is currently observed. High-quality outcomes and process data generated through competitions have not been effectively repurposed for educational use. This dual shortcoming hinders the timely updating of teaching resources, making it difficult to establish a virtuous cycle of mutual reinforcement among learning, competing, and innovation[7-8].

Through focused breakthroughs in these three key areas, this research will effectively address the key issues identified in the situational analysis, thereby promoting the innovation and development of a student innovation capability cultivation model from an artificial intelligence perspective.

## **3 Building an Innovation Training Model for Electrical Majors Through AI-Enhanced Competitions**

### **3.1 Constructing an Ecological Cycle Cultivation Model Featuring Progressive Competency Development, Tiered Competitions, AI Empowerment, and Knowledge Accumulation**

This project is grounded in the talent development program for electrical majors, with the primary goal of achieving innovation capability cultivation as its core orientation. The construction method of an innovation capability training system, using electrical discipline competitions as a carrier, is studied, and the time allocation and articulation mechanisms for each training component are scientifically defined.

Firstly, various high-level disciplinary competitions organized by national ministries, provincial government departments, universities, and faculties are systematically reviewed and analyzed. Based on their connotations and difficulty levels, a tiered model is established to construct a systematic competition system that aligns with the innovation capability training objectives for electrical majors, comprehensively covering the developmental needs from beginners to advanced innovators. The systematic mapping mechanism between competition tasks and innovation capability indicators is thoroughly investigated to achieve a "structural embedding" of the competition system within the innovation capability cultivation framework.

Secondly, to effectively support the research on the training model, methods for empowering the innovation capability cultivation system through AI are explored. Artificial intelligence technologies are employed to enable personalized competition recommendations and adaptive matching, while intelligent tools such as virtual simulations, algorithm optimization, and automated code generation are provided to students to enhance the efficiency and depth of innovative practices. Finally, efforts are focused on studying the transformation mechanism for converting outstanding works, solutions, and data resources generated from competitions into modular, reusable teaching cases and experimental projects. This promotes mutual verification and support between competition outcomes and classroom teaching content, forming a sus-

tainably evolving and continuously value-releasing "ecological cycle" teaching resource system.

### **3.2 Research on the Key Supporting Elements and Implementation Safeguards for Operating the Training Model**

To ensure the efficient, stable, and sustainable operation of this model, it is necessary to systematically establish its internal and external supporting conditions and implementation strategies, and to investigate the development path and technical architecture of an integrated and intelligent innovation practice platform. Emphasis should be placed on exploring synergistic coupling mechanisms between hardware infrastructure and software data platforms, constructing a practical environment that supports simulation, virtual project iteration, and multimodal data collection, and forming a technological foundation and enabling system that underpins competition training and innovation capability cultivation.

The formation mechanism and capacity development path of a "dual-qualified" instructor team should be studied. Systematic analysis should be conducted on the collaborative appointment, training, and incentive strategies for university faculty and experts from research institutes and enterprises. A dual-qualified development model focused on enhancing engineering practice and innovation guidance capabilities should be established, resulting in a high-quality instructor team construction plan that can steadily support the entire talent cultivation process.

Research should be carried out on the design of management systems that stimulate students' endogenous innovation motivation. Focusing on supporting mechanisms such as dynamic adjustment of credit recognition, a multi-level reward system, and policies supporting achievement transformation, a institutional guarantee system for a virtuous cycle of "competition-innovation-learning" should be explored to effectively translate the training model from theoretical construction to practical implementation.

### **3.3 Research on the Design and Optimization of an Integrated "Five-Stage Progressive, Cyclical Enhancement" Training Path**

A systematic study is conducted to construct a "Five-Stage Progression – Cyclical Enhancement" training pathway based on an ecological cycle model of "capability progression, competition tiering, AI empowerment, and knowledge sedimentation." Key focus is placed on exploring the cultivation mechanisms and organic articulation methods for key elements of students' innovation capabilities across various stages: "course learning, project practice, competition tempering, further research, and achievement incubation." Key research questions include: How to construct a complete educational closed-loop framework centered on tiered competitions, structured around capability progression, supported by AI technology, and reinforced by knowledge feedback;

How to introduce AI during the course learning phase to build personalized knowledge graphs that align with basic-level competition requirements, achieving the "integration of learning and competing";

How to utilize AI for assisted design, virtual simulation, algorithm optimization, and implementation during the project practice and competition tempering phases, connecting with intermediate and advanced competitions to systematically enhance students' engineering practice and innovation capabilities;

How to leverage AI for data mining and analysis in the subsequent research and achievement incubation phases to promote the deepening and transformation of innovative outcomes;

Finally, how to aggregate whole-process data through an intelligent innovation practice platform, which, after systematic extraction and reconstruction by AI, generates teaching cases, practical training projects, and innovation tools, thereby forming a sustainable smart education ecosystem that continuously feeds back into teaching and supports iterative optimization.

### **3.4 Comprehensive Analysis of Model Effectiveness and Research on Its Iterative Optimization Mechanism**

Through educational data mining and learning analytics techniques, the entire operation process of the model is monitored in multiple dimensions and subjected to attribution analysis. By employing methods such as comparative studies and case tracking, the actual effectiveness of the training model in enhancing students' innovation capabilities and facilitating outcome transformation is scientifically validated. Finally, based on multi-source data analysis results, a closed-loop iterative mechanism of "evaluation-feedback-optimization" is established, forming a data-driven paradigm that promotes the self-improvement of the training model, implementation pathways, and support systems, thereby ensuring the sustainable evolution and high-quality development of the entire ecosystem.

## **4 Conclusion**

The "Discipline Competitions + AI Empowerment" training model for innovative capabilities in electrical majors breaks through the limitations of traditional approaches by integrating artificial intelligence as a transformative technology throughout the entire innovation cultivation process. It organically combines course instruction and competition practice, using competitions to promote learning and innovation to enhance teaching, thereby increasing the relevance and challenge of educational content. This model addresses the disconnection issues in the integration of competitions and education.

Leveraging AI technology, it provides personalized learning support and intelligent practical guidance, incorporating a designed five-stage progressive training path to improve teaching efficiency and students' engineering practical abilities. Furthermore, through a knowledge sedimentation mechanism, it continuously feeds back into teaching resources, forming a closed-loop optimized ecosystem that drives iterative improvements in teaching quality. This offers a replicable and sustainable implementation paradigm for innovation and reform in electrical engineering education.

## Acknowledgments

2022 Education and Teaching Research Project of National University of Defense Technology "Research on the practical application of 'virtual simulation task driven' mode in electronic technology course teaching" (U2022021).

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