# Construction and Application of Case Library for Innovation and Entrepreneurship Competitions in Electronic Information Majors

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**Abstract.** In view of the needs of innovation and entrepreneurship competitions for undergraduates and graduate students in electronic information majors, this paper designs an innovation and entrepreneurship competition case library. The current situation and problems in case-based teaching for innovation and entrepreneurship competitions are analyzed. The principles for building a case library are presented. The case library constructed by these principles includes three categories: communication, electronics, and artificial intelligence (AI) plus, with distinct characteristics of the energy and power information and communication industry. The case library effectively stimulates students' interest in learning and enthusiasm for participating in competitions, inspires their thinking, cultivates their critical and creative thinking, inspires innovation and entrepreneurship inspiration, and achieves good application results.

**Keywords:** Case Library, Case-based Teaching, Electronic Information.

## 1    Introduction

The case-based teaching method relies on typical engineering or business cases to guide students to independently discover problems, learn to analyze and solve problems, and successfully apply it to talent cultivation in various fields and levels of education [1,2]. The "Opinions on Strengthening Case Teaching and Joint Training Base Construction for Professional Degree Graduate Students" (Teaching and Research [2015] No. 1) issued by the Ministry of Education in 2015 defined case-based teaching as "a teaching method that puts students at the center, based on cases, closely combines theory and practice by presenting case situations, guiding students to discover, analyze, and solve problems, thereby mastering theory, forming viewpoints, and improving abilities" [3]. The case-based teaching method is more in line with the concept of modern education and helps cultivate high-quality talents with critical thinking, innovative consciousness, and practical abilities. However, in practical applications, there are still problems such as a lack of case resources and outdated updates, improper case selection, and a lack of

practicality in case studies [4]. This paper focuses on the needs of innovation and entrepreneurship competitions for undergraduate and graduate students in electronic information majors, the construction of student knowledge systems, and the cultivation of innovation abilities. Combining with the characteristics of one's own discipline and professional electricity, a case library for innovation and entrepreneurship competitions has been designed to meet the needs of innovation and entrepreneurship competitions and innovation ability cultivation in electronic information majors.

## 2     Problems

The introduction and promotion of case-based teaching methods can help students understand the background of the case and the way of raising questions, innovative ideas and entrepreneurial passion, key problems and their solutions, and the way of presenting results through specific cases. In addition, students can also learn about the entrepreneurial process, market opportunity analysis, risk assessment methods, etc., laying a solid foundation for future entrepreneurial practice. However, in practical applications, case-based teaching also faces the following specific problems.

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**Lack of case Resources and Lagging Updates.** At present, the case resources of innovation and entrepreneurship education are relatively scarce, and some of the cases are outdated, which cannot reflect the latest market trends and technological developments. Students find it difficult to learn the latest knowledge and skills through case studies, which affects teaching effectiveness.

**Improper Selection of Cases.** Some teachers fail to fully consider students' professional backgrounds, learning needs, and interest when selecting cases, resulting in a disconnect between cases and students' actual situations. It is difficult for students to empathize, affecting learning enthusiasm and participation.

**Insufficient Depth of Case Analysis.** In the process of case analysis, some teachers only stay at the interpretation of superficial phenomena, lacking in-depth analysis and exploration. Students find it difficult to obtain valuable information and inspiration from case studies, which affects their learning outcomes.

**Dull and Passive Case Teaching Mode.** Some teachers use traditional lecture based teaching methods for case studies. As a result, students are in a state of passive acceptance, and it is difficult to give full play to their subjective initiative, which affects the learning effect and the cultivation of innovation ability.

# 3    Principles for Building a Case Library

Student centered case-based teaching combines theory with practice by presenting case scenarios, guiding students to discover, analyze, and solve problems, thereby achieving the effect of cultivating students' comprehensive abilities such as innovative thinking, entrepreneurial spirit, practical ability, teamwork ability, social responsibility, and mission. The following principles need to be followed.

**Choose Cases that are Close to Students' Lives.** Choose cases closely related to students' lives, interests, or future career plans. Such cases are more likely to resonate with students, making them feel that the content they are learning has practical significance and value. In addition, it is necessary to ensure that the case content is novel and reflects current hot issues in social, economic, or technological development. This can stimulate students' curiosity and thirst for knowledge, and encourage them to actively understand and learn relevant knowledge.

**Adopting Diverse Teaching Methods.** Using multimedia methods such as video, audio, and images to showcase case content, making abstract knowledge vivid and concrete. Multimedia assisted teaching can attract students' attention, stimulate their learning interest and imagination.

**Emphasize Practicality and Applicability.** In the process of case analysis, guide students to apply the knowledge they have learned to solve practical problems [5]. By simulating entrepreneurial projects, conducting market research, and other activities, students can personally experience the process of entrepreneurship and feel the charm and challenges of entrepreneurship. This practical teaching method can stimulate students' interest and motivation in learning. Encourage students to reflect and summarize after case analysis, and extract valuable experiences and lessons. By writing case analysis reports, sharing sessions, and other forms, students can showcase their learning outcomes and thinking processes. This applied teaching method can enhance students' sense of achievement and confidence, further stimulating their interest in learning.

**Classification Based Construction of Case Library.** The construction of the case library should comprehensively consider the characteristics of our university's electronic information majors, talent training needs and goals, knowledge systems of related majors, industry needs and development directions, key issues and development directions in disciplinary fields, etc., and adopt the principle of classified construction of the case

library. The design and construction of the case library are approached from three perspectives: communication, electronics, and their integration with artificial intelligence.

# 4      Construction of Competition Case Library

## 4.1      Overall Design of Case Library

According to the requirements of the innovation and entrepreneurship competition for electronic information majors, the construction of students' knowledge system and the cultivation of their innovation ability, in addition to the two outstanding work of the National Undergraduate Electronics Design Contest and China International College Students' 'Internet+' Innovation and Entrepreneurship Competition over the years, we have designed the innovation and entrepreneurship competition case library based on our own discipline and professional electric power characteristics.

The overall framework of the case library is divided into three parts, that is, communication [6,7], electronics [8,9], and artificial intelligence plus [10,11]. The communication category mainly includes 10 specific cases, including the 'Fenghuo Tongda' 5G micro base station intelligent inspection system, 'Fenghuo Tongda' 5G micro base station tidal scene intelligent shutdown energy-saving system, small base station detection system based on Beidou Navigation Satellite System, tunnel distribution equipment monitoring system based on hybrid communication network, 5G smart grid simulation based on HTML5+JS, and intelligent building positioning system based on visible light communication and power line communication. The electronic category mainly includes 10 specific cases, including insulator fault detection equipment based on acoustic spectrum analysis, structural innovation and parameter optimization based on commercial unmanned aerial vehicles, 'Xundian intelligent inspection' - integrated device for cable crimping detection, control system design and research based on resonant cavity steam humidity measurement, submarine cable vortex induced vibration detection system based on distributed fiber optic vibration sensing, and intelligent perception system for three-dimensional shape of power cables based on distributed fiber optic strain sensing. The artificial intelligence plus category mainly includes 10 specific cases, such as the improved YOLOv7 substation intelligent inspection system, Nova Helmet intelligent safety helmet, deep learning based garbage classification system, intelligent recognition system for substation violation actions, and development of Tang poetry generation system based on semantic RNN and LSTM.

The outstanding cases are presented in the form of pictures+audios+videos+text descriptions. The word count of the case study should be limited within 3000-5000 words, with a focus on highlighting the technical features and innovations of the project, as well as the experience and lessons learned during the preparation process. We can provide relevant pictures or videos of the competition team, hardware, software, and application effects to better illustrate the case. The referenced outline for the case is as follows:

(1) Title. The title is required to be concise and concise, and can reflect the distinctive features and key technologies of the case.

(2) Brief information about project team members. Introduce the college, major, grade, etc.

(3) Introduction to the case project. The relevant background significance, objectives, overall ideas, and effectiveness of the case are presented.

(4) Case project demand analysis. The current situation of the industry and pain points, functional needs, technical needs, non-functional needs, etc. is investigated and analyzed.

(5) Technical scheme of the case project. It focuses on the technical roadmap, feasibility analysis, and key technologies adopted by the project.

(6) Characteristics and innovations of the case project. It focuses on the technical level, innovation, advancement and uniqueness of the case, and the competitive advantage compared with similar projects.

(7) The implementation effect of the case project. It focuses on the process, results, economic benefits, social benefits, and prospects for promotion and application of case projects.

(8) Conclusion. The summary of the case project and the perceptions, experiences and lessons in the process of promoting the implementation are given, so as to enlighten students' thinking, cultivate students' ability to flexibly use relevant knowledge to solve similar problems, critical and creative thinking, and stimulate innovation and entrepreneurship inspiration.

## 4.2    Collection of Case Materials

Electronic information majors involve multiple fields, such as electronic technology, communication technology, computer technology, artificial intelligence, and control, and have the characteristics of strong comprehensiveness, practicality, technicality, fast update speed, and interdisciplinary intersection. From micro electronic technology, optoelectronic technology, integrated circuit technology, nano electromechanical devices, molecular electronic devices, quantum electronic technology, flexible electronic technology, liquid electronic technology at micro-scale, to analog and digital or hybrid electronic systems at macro-scale, as well as spaceships, satellites, radars, computers, the Internet, cars/electric vehicles, robots, medical equipment, power secondary systems relying on electronic systems, it is very difficult to select cases.

In addition to being typical, timely, innovative, and applicable [12], the selection of outstanding cases in innovation and entrepreneurship competitions should also combine the characteristics of disciplines and specialties, have distinctive industry characteristics, and take into account both versatility and industry characteristics. North China Electric Power University is a national key university directly under the Ministry of Education. At present, the Council composed of 12 super large power enterprises, including the State Grid Corporation of China, China Southern Power Grid Corporation, and the China Power Enterprise Confederation, has jointly established with the Ministry of Education. [13]. In each of the communication, electronics, and artificial intelligence plus categories, 60% to 80% of cases with characteristics of the energy and power industry are closely integrated with the research projects of relevant teachers, fully lev-

eraging the advantages of deep integration of industry, academia, research, and education. The scope of case material collection includes outstanding discipline competition works from relevant departments, excellent dissertations of graduate students, scientific research project practices, academic papers, etc.

## 4.3    Technologies Used in the Case Library

The case library involves a wide and diverse range of technologies, mainly including the following aspects.

Communication technology, such as 5G micro base station intelligent inspection system, tidal scene intelligent shutdown energy-saving system, hybrid communication network monitoring system, etc. It demonstrates the applications in 5G, IoT, and communication network monitoring and management.

Electronic technology, covering insulator fault detection equipment, drone structural innovation and parameter optimization, integrated cable crimping detection device, etc. It reflects the in-depth application and technological innovation in several industries of electronic equipment and technology.

Artificial intelligence and machine learning technologies, including improved YOLOv7 substation intelligent inspection scheme, intelligent safety helmet, and deep learning based garbage classification research, etc. It demonstrates the potential of AI in improving industry efficiency and intelligence level [14].

Fiber optic sensing and monitoring technology, solutions such as distributed fiber optic online monitoring systems, smart grids, smart oil and gas, etc. It reflects the widespread application and deep penetration of fiber optic sensing and monitoring technology in multiple industries.

These technologies have jointly promoted the construction of smart cities, the digital transformation of industries, and the improvement of intelligence levels. Especially in key areas such as 5G micro base station inspection energy-saving smart solutions, distributed fiber optic online monitoring systems, and 5G network equipment, the trend of perception communication integration is fully reflected.

5G micro base station inspection energy-saving smart solution, by integrating advanced communication technology and intelligent management platform, efficient inspection and energy-saving management of 5G micro base stations can be achieved. This may include using drones for base station inspections, remote monitoring of base station status, intelligent adjustment of base station energy consumption, etc., to improve operation and maintenance efficiency and energy conservation and emission reduction.

Distributed fiber optic online monitoring system, integrates sensing fiber optic, monitoring host, and disposal platform, providing multi scenario, high-precision, and long-term sensing monitoring. It uses optical fibers as sensing media to achieve real-time, efficient, and holographic problem perception, warning, and disposal for industries such as power, security, and oil and gas by monitoring parameters such as acoustic vibration, strain, and temperature in the optical fibers [15].

5G network equipment, the transmission equipment and solutions such as PTN/OTN/IPRAN support the ultra large capacity and ultra high speed data transmission of 5G networks. These equipments play an important role in 5G networks, ensuring stable and high-speed data transmission.

### 4.4    Case Application Effectiveness

The typical case library of innovation and entrepreneurship has been widely applied in the electronic information major of several university in recent years, and students' enthusiasm, awareness, self-confidence, and ability to participate in innovation have significantly improved. From 2020 to 2022, our department has completed a total of 120 innovation and entrepreneurship projects for college students, including 23 at the national level and 8 at the provincial level. We have won the Outstanding Organization Award in National College Student Electronic Design Competition, 'Datang Cup' National College Students Mobile Communication Technology Competition, 'Blue Bridge Cup' National Software and Information Technology Professional Talent Competition and other competitions, and more than 20 teachers won the Excellent Guidance Teacher Award. We obtain 135 competition awards at the provincial and ministerial level or above, including over 30 national level awards. In 2023, we wan 231 awards in provincial and ministerial level and above discipline competitions. Among them, the '5G Smart Grid Simulation Based on HTML5+JS' project won the national special prize in the 'Unveiling and Leading' special competition at the 18th 'Challenge Cup' National College Students' Extracurricular Academic and Technological Works Competition, becoming the first such award in Hebei Province. It also makes outstanding contributions to our university winning the "Winning Cup" of the competition and obtaining the qualification of "Initiating University" of the competition.

## 5    Conclusion

This paper introduces the construction and application effects of a case library for innovation and entrepreneurship competitions in electronic information majors. The case library includes three categories: communication, electronics, and artificial intelligence plus, with distinct characteristics of the energy and power information and communication industry. The case library effectively stimulates students' interest in learning and enthusiasm for participating in competitions, inspires their thinking, cultivates their ability to flexibly use relevant knowledge to solve similar problems, cultivates their critical and creative thinking, inspires innovation and entrepreneurship inspiration, and achieves good application results.

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## References

1. Xinping Zhang, Xiaomin Feng: Building Pedagogy-oriented Case Study Databases for Professional Degree Programs: Rationales, Significance and Approaches. Modern University Education 36(4), 100-104+112 (2020).
2. Xiaoji He, Yonggui Yang: Case Situational Teaching Model: Student-centered Entrepreneurship Education Model and the Implementation Path. Journal of Higher Education 21(10), 81-84+90 (2024).
3. Ministry of Education of the People's Republic of China homepage, http://www.moe.gov.cn/srcsite/A22/moe_826/201505/t20150511_189480.html, last accessed 2015/5/11.
4. Jinrong Cui, Qiong Huang, Xin Liu, Wei Cao, Meiyan Xiao: How to lmplement the "Integration of Teaching and Research"---The Discussion on the Model of Digital lmage Processing Course. The Theory and Practice of Innovation and Entrepreneurship 4 (8) 52-53+64 (2021).
5. Kai Xu, Zhouyang He, Wenxuan Xu, Haoxuan Yuan: 2019. Construction and practice of teaching case database of Artificial Intelligence course for rail transit. Experimental Technology and Management 36(5), 15-20 (2019).
6. Zhixiong Chen, Leixin Zhi, Xiongwen Zhao, Yincheng Qi: Parallel Access Scheme for Wireless and Power Line Dual-Connection Communication. 2022. IEEE Transactions on Vehicular Technology 71(7), 7997-8001 (2022).
7. Yapeng Chen, Zhenyu Zhou, Dongsheng Han, Xiongwen Zhao, Yincheng Qi, Yong Wei: TSN-Integrated Flow Scheduling Method in Power+5GFronthaul Network. Acta Electronica Sinica 51(05), 1141-1147 (2023).
8. Anqiang Lv, Chongwu Huang, Yanjie Le, jing Li: Research on morphology reconstruction algorithm of three-core fiber based on distributed strain. Journal of Optoelectronics·Laser 32(07), 784-790 (2021).
9. Xiangyu Zhang, Li Sun, Zhaotong Huang: Design of Intelligent Inspection Robot System for Substation. Electric Power Information and Communication Technology 17(12), 37-42 (2019).
10. Jingdong Guo: Hierarchical Detection of Transmission Line Environment and Component Anomaly Based on Improved YOLOX. Electric Power Information and Communication Technology 20(11), 27-36 (2022).

11. Yincheng Qi, Baoli Wang, Boqiang Shi, Ke Zhang: Human action recognition model incorporating multi-scale temporal convolutional network and spatio-temporal excitation network. Journal of Electronic Imaging 32(3), 033003,1-16 (2023).
12. Yuanfa Dong, Zifan Fang, Xuan Du, Yang Yang, Wei Peng, Ronghua Meng: Construction and Application of Teaching Case Base of Artificial Intelligence Technology for Mechanical Engineering Postgraduates. The Science Education Article Collects, 18, 99-100 (2021).
13. North China Electric Power University homepage, https://net.ncepu.edu.cn/xxgk/xxjj/ index.htm, last accessed 2024/8/3.
14. Ke Zhang, Ruiheng. Zhou, Jiacun Wang, Yangjie Xiao, Xiwang Guo, Chaojun Shi: Transmission Line Component Defect Detection Based on UAV Patrol Images: A Self-Supervised HC-ViT Method. IEEE Transactions on Systems, Man, and Cybernetics: Systems, 1-12 (2024).
15. Qiufeng Shang, Da Huang, Biao Gong: Submarine cable vibration signal identification method based on VMD and AdaBoost-SCN. Journal of Vibration and Shock 42(19), 231-239 (2023).