

Interdisciplinary Integration Paths for Specialized General Education in Applied Colleges and Universities—Chengdu College of University of Electronic Science And Technology of China as an Example

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Abstract. Under the background of the "Four New" (new engineering, new medical, new agricultural, new liberal arts) construction initiative, general education serves as a critical approach for cultivating versatile talents. In response to the issue that general education in local applied colleges and universities has become merely formalistic, Chengdu College of University of Electronic Science And Technology of China (CDUESTC) has proposed the "specialized general education" model. This model achieves interdisciplinary education by constructing a knowledge and competency framework that integrates engineering, business, and art, developing PBL (Problem-Based Learning) course clusters and corresponding textbooks, and establishing a CIPP-based quality evaluation system. Practical implementation demonstrates that this model significantly enhances students' interdisciplinary innovation capabilities and elevates teachers' teaching and research standards. This study offers a replicable pathway for reforming general education in applied colleges and universities.

Keywords: Applied colleges and universities, Specialized general education, Application scenarios, Interdisciplinary integration, PBL teaching

1. Background and Significance of the Construction of Specialized General Education

1.1 Current Status of General Education

China has entered a period of rapid development of the scientific and technological revolution and industrial change, which has placed new demands on the knowledge, ability and quality structure of new talents, and the Ministry of Education has put forward the opinion of "Four New" construction of "new engineering, new medical science, new agricultural science and new liberal arts" to cultivate a thick foundation. The Ministry of Education has put forward the opinion of "Four New" construction, cultivating general and specialized talents with thick foundation, wide caliber, specialization and innovation is an important exploration, and general education is a must. Modern liberal education originated at the beginning of the 20th century, European and American colleges and universities gradually established a teaching system aimed at comprehensive quality training[1]. In 2001, Peking University organized "Yuan Pei" experimental class opened the road of China's modern higher education and liberal education, followed by Beijing Normal University, Fudan University, Tsinghua University, Zhejiang University and other famous universities, general education has been pushed to a climax[2].

Unlike research-oriented colleges and universities, local applied colleges and universities, although following the wave of general education, tend to be formalized and credit-oriented[3]. First, the students of such colleges and universities are employment-oriented, and in the case of not being able to integrate the general education courses with their majors, the endogenous motivation for learning is insufficient; second, it is difficult for such colleges and universities to offer high-quality offline general education courses such as humanistic literacy and natural sciences, and they adopt a large number of on-line learning modes, which have greatly reduced the learning effect;

third, they do not pay enough attention to it, and they lack the school's top-level design and an organizational system that promotes the landing of the general education courses.

1.2 Problems in General Education

In traditional general education, three major issues have been identified: first, the misalignment between general education courses and real-world application scenarios leads to insufficient intrinsic motivation among students for learning; second, the integration of disciplines in general education often results in a superficial "platter-like" approach, failing to effectively synthesize and coherently integrate knowledge across disciplines; third, imbalance exists between theoretical knowledge in general education and the development of practical skills, which hinders the effective cultivation of students' abilities to solve complex interdisciplinary problems[4]. Given the varying levels of students and the availability of institutional resources, how to design a general education curriculum system that genuinely fosters the development of complex applied talents, significantly enhances students' intrinsic motivation for learning, and supports the construction of the "Four New" initiatives has become a critical challenge for general education in local applied colleges and universities.

1.3 Significance of Constructing a Specialized General Education System

In response to the aforementioned challenges, CDUESTC initiated the construction of a specialized general education system in 2020. Leveraging the school's existing golden triangle of engineering, business, and art, an interdisciplinary teaching team was established. This team aims to develop a specialized general education system grounded in application scenarios, promoting interdisciplinary cross-fertilization and fostering cross-border thinking and composite abilities. The system is designed to cultivate students' capabilities in solving cross-field problems, address the issue of intrinsic learning motivation, and provide a replicable model for local applied colleges and universities in constructing their general education systems.

2. Paths of Interdisciplinary Integration for Specialized General Education

2.1 Positioning and Philosophy of Specialized General Education

Based on theories such as constructivism learning theory and T-shaped talent model[5], we position specialized general education as an interdisciplinary knowledge system bridging traditional general education and professional education. It serves as a methodology for training students to integrate interdisciplinary knowledge and skills to address complex engineering problems.

The traditional general education program is based on the national high-quality open courses (online resources), aiming to improve students' cultural literacy, comprehensive quality and sound personality. In contrast, the specialized general education system is tailored to specific disciplines and specialties, with application scenarios serving as its starting point. By interweaving knowledge and skills from two additional disciplines or specialties, it aims to cultivate students' ability to identify, integrate, and apply professional knowledge, tools, and methods relevant to specific tasks. This enables students to transcend professional perspectives, solve problems using interdisciplinary thinking and methodologies, and make informed decisions from a broader perspective.

2.2 Integration Paths of Specialized General Education

Specialized general education emphasizes the organic integration of disciplines. Taking CDUESTC as an example, it promotes the cross-fertilization of knowledge, tools, and methods from engineering, business, and art. Through the collaboration of an interdisciplinary teaching team, it evolves systematic thinking and integrates these elements into a new knowledge system. This approach achieves the synergistic effect of " $1+1+1 > 3$ " between disciplines and specialties, thereby realizing the organic integration of quality education and professional education. As

illustrated in Figure 1, the integration of the three disciplines enables a big leap in competency through the complementary use of tools.

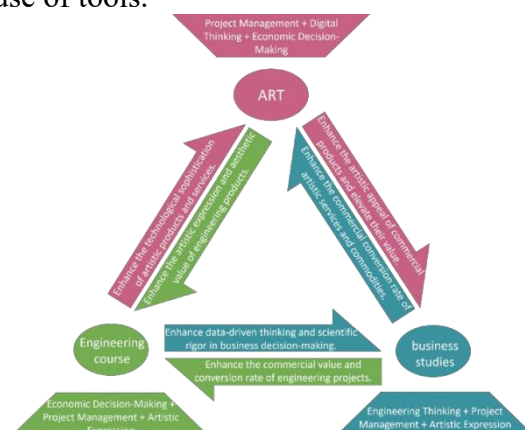


Figure1. “Engineering + Business + Arts” Golden Triangle

Engineering: By integrating the development tools (including hardware and software technologies, products, etc.) and scientifically rational thinking methods of engineering, we can provide business with data-driven decision-making support and bring more scientifically advanced products and services for arts.

Business: By leveraging the application tools, management methodologies, and decision-making capabilities from the business domain, we can introduce empirical non-engineering perspectives to engineering disciplines, enhancing the commercialization value of engineering projects and bringing commercially viable products and services to the arts.

Arts: By incorporating the creative concepts and perceptual thinking approaches from the field of arts, we can add artistic expression forms and aesthetic values to engineering projects within engineering disciplines and infuse artistic aesthetics into commercial products, management methods, and means in business disciplines, thereby elevating product value.

3. Specific Implementation Paths of Specialized General Education

3.1 Developing a Series of Textbooks to Lay the Foundation for Specialized General Education

We established an interdisciplinary teaching team with specialized general knowledge. Guided by the principles of "scenarios-focused" "problem-oriented" and "application-focused", this team aims to construct application scenarios for various majors within the context of the new economy and emerging industries. By adhering to these guiding principles, we have developed application scenarios for different majors in the new economic and industrial landscape, extracted an interdisciplinary knowledge system, refined composite practical abilities, constructed a new systematic thinking framework, and designed and developed a series of "specialized general education textbooks". These textbooks are oriented toward real-world projects and emphasize the organic integration of quality education and professional education, serving as the foundation for specialized general education. The construction concept for each textbook is presented in Table 1.

Table 1. The construction concept of the specialized general education textbooks

Name	Introduction
Project Management for Engineering Students	Guide students to form project teams, with the development process of a complete project serving as the main thread, and introduce the PMBOK knowledge system (the 10 knowledge areas of project management).
Artistic Expression for Engineering Students	Taking art as a guiding thread, explore the intersection of art and engineering, identify their common fields, and introduce each field in detail.

Domain Knowledge Engineering	Taking the specific processes of human economic and social activities in the information society as the research object, it specifically studies and designs solutions for the particular problems faced by these tasks, along with their implementation modes of automation, collaboration, and knowledge-based engineering.
Business Decisions for Art Students	Guided by the application scenario, the knowledge point of business decision-making is integrated with the art scene, primarily encompassing the innovation and entrepreneurship module, the enterprise management module, the marketing module, the finance module, and the law module.
Python Programming for Business Students	Help business students establish foundational computational thinking and data thinking, master Python grammar rules, data types, program control structures, composite data types, commonly used functions, and other knowledge and skills, and cultivate students' basic data analysis literacy in work scenarios.
Digital Technology for Business Students	Based on the four-tier architecture of the digital economy, introduce the relevant theories and technical tools associated with each layer.
Project Management for Business Students	Develop systematic thinking and enhance planning, organizational, coordination, control, and decision-making skills among business students, and introduce the PMBOK knowledge system (the 10 knowledge areas of project management) in economics and management.
Business Decisions for College Students	Based on the application scenarios of college students during their studies and early employment, understand the core essentials of business decision-making, master effective decision-making methods and tools, conduct practical decision-making according to typical scenarios, cultivate business awareness, and enhance students' core competitiveness in solving complex problems.
Financial Literacy of College Students	Guided by the scenarios of college students' study life and career development, chapters like the investment and finance based on economic life scenarios, the career finance based on career development scenarios, and the entrepreneurial finance based on entrepreneurial decision-making scenarios enable students to deeply understand the nature and structure of finance while cultivating their financial literacy.

3.2 Designing PBL Courses to Enhance the Effectiveness of Specialized General Education

In order to promote the organic integration of quality education and professional education, we adopt the PBL model for instructional design and classroom organization. This involves establishing a results-oriented working mechanism between teachers and students, while reinforcing capacity building[6].

Under the PBL teaching mode, templates for teacher manuals, student manuals, and activity materials are designed. Each course team under the framework of specialized general education is required to conduct teaching through authentic projects and group discussions, guiding students to independently analyze problems, collect information, and propose solutions around real-world issues. This approach aims to cultivate students' abilities in identifying complex problems, engaging in self-directed learning, and fostering creativity.

Teacher manuals are used by instructors to clarify teaching methods, behaviors, and key concerns during the teaching process. Student manuals are distributed to students before class, enabling them to understand learning objectives, prepare adequately through pre-class study, and support supplementary review of classroom content. Activity materials are provided during class sessions, with classroom activities being carefully designed in advance to align closely with course content and serve as an extension of it.

3.3 Constructing a CIPP Evaluation System to Ensure the Quality of Specialized General Education

We establish a CIPP-based quality evaluation system tailored for specialized general education, clarify teaching objectives and quality requirements, provide a foundation for the construction, assessment, selection, and evaluation of specialized general studies courses, and achieve the closed loop of "selection-evaluation- improvement" [7].

The quality evaluation system for specialized general education comprises both evaluation methods and an indicator system. The evaluation methods consist of four parallel dimensions: "Students' Evaluation + Course Experience Research + Supervisors' Evaluation + Special Inspection of Teaching Resources", each with specific requirements and corresponding evaluation indicators established.

Students' Evaluation, with a focus on input and outcome evaluations, is conducted by students based on 6 primary indicators (such as moral integrity, teaching design, teaching methodology, learning acquisition, etc.) and 17 secondary indicators. A percentage system is adopted to intuitively reflect the teaching quality and effectiveness from the perspective of students.

Course Experience Research emphasizes contextual and outcome evaluations. It primarily investigates the necessity of offering specialized general education courses, differences among various courses, students' sense of learning acquisition and their concern for other areas. This research serves as a basis for optimizing and updating specialized general education textbooks and curriculum systems.

Supervisors' Evaluation involves supervisors' specialized listening and evaluation activities, focusing on input and process evaluations. Evaluations are scored by supervisors based on 24 secondary indicators under six dimensions, including student-centered teaching, the teacher's in-class scheduling and control capabilities, and teaching modes. This mechanism enables timely identification of issues and effective feedback, which facilitates process supervision of specialized general education courses and enhances the teaching proficiency of the specialized general education teaching team.

Special Inspection of Teaching Resources entails organizing experts to conduct specialized inspections of syllabuses, courseware, teacher manuals, student manuals, and other materials for specialized general education courses. The inspection focuses on background and process evaluations, ensuring that teaching content aligns with the objectives of specialized general education courses and provides adequate support for cultivating students' interdisciplinary knowledge, skills, and qualities. This process contributes to the optimization of the specialized general knowledge framework and PBL teaching design.

3.4 Building a Multi-level Linkage Organizational Structure to Ensure the Effectiveness of Specialized General Education

Through top-level design, a three-tier linkage working mechanism of "University-level Planning + Faculty Front-line Management + Course Team Implementation" has been established. This mechanism promotes the organic integration of the specialized general education system with cross-disciplinary elements in terms of operational mechanisms.

A teaching and research office has been established, responsible for collective lesson preparation, regular lesson research, peer observation, and systematic optimization and updating of teaching materials such as syllabuses, PPTs, case libraries, and teacher manuals on a semester basis. These teaching materials are centrally managed and archived by the specialized general education working group under the Office of Academic Affairs at CDUESTC. Additionally, the specialized general education course leverages the smart teaching platform to establish online resources, facilitating flipped classroom practices and extending learning opportunities.

Specialized general education courses have been incorporated into our 3-year programs and undergraduate programs, with credit-based management implemented. A series of management

documents and quality assessment indicators have been released to ensure the effective implementation and outcomes of the specialized general education system.

4. Implementation Effect of Specialized General Education

Since the initiation of the specialized general education system in 2020, we have found the competencies of both teachers and students have been significantly enhanced.

The interdisciplinary research and teaching capabilities of the course group instructors have markedly improved. Compared to pre-2020 levels, the number of interdisciplinary vertical and horizontal projects has increased by 313%. Additionally, two provincial education reform projects and two provincial "Four New" projects related to this field have been successfully completed, with nine papers on educational reform published.

Under the guidance of this system, students' interdisciplinary abilities, knowledge reserves, and innovative thinking have greatly improved. Notable achievements include over 20 published papers, more than 30 authorized patents, over 100 innovative works, six realized business plans generating profits exceeding 500,000 yuan, and over 160 awards won at or above the provincial level in interdisciplinary competitions.

5. Conclusion

General education is a critical component of modern higher education. However, local applied colleges and universities face numerous challenges in implementing general education. Through its exploration and practice of innovative models such as specialized general education, CDUESTC has provided a replicable model for addressing these challenges. Moving forward, local applied colleges and universities should further emphasize the significance of general education by aligning it with their institutional contexts, continuously refining the general education curriculum system, enhancing course quality, stimulating students' learning interest and intrinsic motivation, and striving to cultivate more well-rounded and applied talents to meet the demands of contemporary development. Besides, additional research and practice are necessary to continually improve and promote the specialized general education system, thereby advancing the comprehensive development of general education within China's higher education landscape.

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