Curriculum and Teaching Methodology (2025)
Clausius Scientific Press, Canada

DOI: 10.23977/curtm.2025.080121
ISSN 2616-2261 Vol. 8 Num. 1

# Innovation and Practice of "Outcome-Based Education" Model for Electronic Information Majors from the Perspective of "New Engineering"

**Guiyu Zhou*, Qing Li, Linghua Wen**

*School of Electronic Information Engineering, Yibin University, Yibin, China*
**Corresponding Author: zhouguiyu@yibinu.edu.cn*

***Keywords:*** Integration of production and education; New engineering construction; Outcome-Based Education (OBE); Reverse derivation; Stepwise decomposition

***Abstract:*** In response to the demands of industrial development and guided by the new engineering construction concept of "integration of production and education, interdisciplinary innovation," this paper explores and implements the "Outcome-Based Education" (OBE) model for the Electronic Information program within the context of new engineering education. Focusing on cultivating innovative, application-oriented talent, the paper introduces a results-driven approach to course design, teaching methods, and competition training. This model emphasizes goal orientation and applies reverse engineering and step-by-step decomposition to the educational process. The integration of the OBE model in teaching reforms and practices, not only enhances the quality of classroom instruction and the efficiency of discipline-related competitions but also enables students to gain a deeper understanding and mastery of professional knowledge. Moreover, it stimulates students' initiative in extracurricular learning. Ultimately, this approach aims to jointly nurture new, interdisciplinary engineering professionals with strong practical and innovative capabilities to meet the evolving needs of emerging industries and the new economy.

## 1. Introduction

Under the background of new engineering, the trend of modern education integration is becoming increasingly evident, the research on educational theory is deepening, and the integration of multiple teaching modes has gradually become the mainstream approach [1-2]. Especially for electronic information majors, due to their strong application focus and rapid technological changes, the diversification and flexibility of teaching modes are particularly crucial [3]. The new engineering concept emphasizes interdisciplinary, collaborative innovation, and practice-oriented approaches, which makes the teaching of electronic information majors no longer limited to the traditional single-discipline framework, but instead focuses more on the integration of multiple disciplines, innovative practice, and outcome-oriented training modes. In this context, the concept of "Outcome-Based Education" (OBE) is particularly important, especially its principle of reverse design. OBE is not merely a teaching method; it represents a profound shift in the educational model for electronic information majors [4]. The core of the reverse design is to begin with the needs, clarify the training goals for students, and then design the curriculum system around these goals [5]. In contrast to the "positive design" of traditional education, the biggest difference is that reverse design starts from demand, with the curriculum system, graduation requirements, and other elements structured around the development of student's skills and the alignment with industry needs, ensuring the consistency between educational objectives and teaching outcomes.

The trend of modern education integration is becoming increasingly pronounced, the research on educational theory is deepening, and the integration of multiple teaching modes has gradually become the mainstream approach [6-7]. Especially for electronic information majors, due to their strong application focus and rapid technological changes, the diversification and flexibility of teaching modes are particularly critical [8-9]. The new engineering concept emphasizes interdisciplinary, collaborative innovation, and practice-oriented approaches, which makes the teaching of electronic information majors no longer limited to the traditional single-discipline framework [10-11]. Instead, it places greater emphasis on the integration of multiple disciplines, innovative practice, and outcome-oriented training models [12-13]. In this context, the concept of OBE becomes particularly significant, especially its principle of reverse design. OBE is not just a teaching method; it represents a profound transformation in the educational model for electronic information majors. The core of the reverse design is to begin with the needs, clarify the training goals for students, and then design the curriculum system around these goals. In contrast to the "positive design" of traditional education, the key difference is that reverse design starts from demand, with the curriculum system, graduation requirements, and other elements structured around the development of student's abilities and the alignment with industry needs. This ensures the consistency between educational objectives and teaching outcomes.

## 2. Definition and analysis of the current situation of OBE

OBE is a model of education that is oriented towards the final learning outcomes of students [13]. It focuses on goal definition, ability cultivation, and achievement evaluation throughout the teaching process, and emphasizes the specific abilities and qualities that students should attain through course learning. The core idea is that the design, implementation, and evaluation of educational activities should be closely aligned with the learning results that students can achieve, ensuring that students possess practical application abilities upon completing their studies [14]. OBE takes "results" as the core, follows the educational design concept from results to process, and emphasizes the reverse design of the curriculum system, teaching methods, and evaluation methods from the perspective of students' learning outcomes. Its purpose is to ensure that students can master specific knowledge, skills, and attitudes through learning to meet the actual needs of society, industry, or academia, emphasizing clear teaching objectives, an accurate evaluation system, and a continuous feedback mechanism to help students achieve a dual improvement of both knowledge and ability. By focusing on the final learning outcomes, OBE ensures that teaching is aligned with the needs of society and industry, and cultivates high-quality talents with innovative thinking, practical problem-solving abilities, and teamwork skills. Its connotation includes demand-oriented curriculum design, student-centered teaching methods, continuous evaluation and feedback mechanisms, and strengthening the cultivation of application and practical abilities.

With the change in educational philosophy, more and more colleges and universities are beginning to pay attention to the actual achievement of students' learning outcomes, rather than just the transfer of knowledge [15]. Through clear learning objectives and evaluation criteria, OBE ensures that students are equipped with the necessary knowledge, skills, and qualities by the end of the course. This mode of education not only focuses on students' academic performance but also emphasizes the cultivation of their comprehensive abilities, especially in practical application, innovative thinking, teamwork, and interdisciplinary capabilities. Many education systems have adopted OBE as an important means to ensure the quality of education and have promoted the close integration of curriculum design with social needs and industry development [16-17].

However, although OBE is being implemented in many educational institutions, its implementation still faces some challenges. First of all, the transformation of educational concepts requires time, and many teachers and administrators remain strongly dependent on traditional teaching models, making it difficult to quickly adapt to a teaching model with student learning outcomes at its core. Second, the curriculum design and evaluation system of OBE often requires high levels of input and professional support, especially when it involves interdisciplinary, practice-oriented courses, and lacks adequate teaching resources and support mechanisms. In addition, how to effectively evaluate students' learning outcomes and how to ensure the consistency of education quality under different contexts are also urgent problems that must be addressed in the process of implementing OBE. Nevertheless, with the continuous advancement of technology and the evolving development of educational concepts, OBE is expected to become a more common and mature teaching model.

## 3. The practice path of OBE in the teaching process

Aiming to address the training needs of electronic information professionals, and leveraging the educational characteristics and advantages of electronic information majors at local universities in Yibin, this study focuses on the construction and practice of new engineering programs that integrate interdisciplinary approaches and industry-education collaboration and innovation. The goal is to cultivate innovative, application-oriented talents for the electronic information industry, with a focus on the "coordinated development of knowledge, quality, and skills." In this context, the innovative development model of OBE in the teaching process is explored. The project construction plan and technical approach are illustrated in Figure 1.

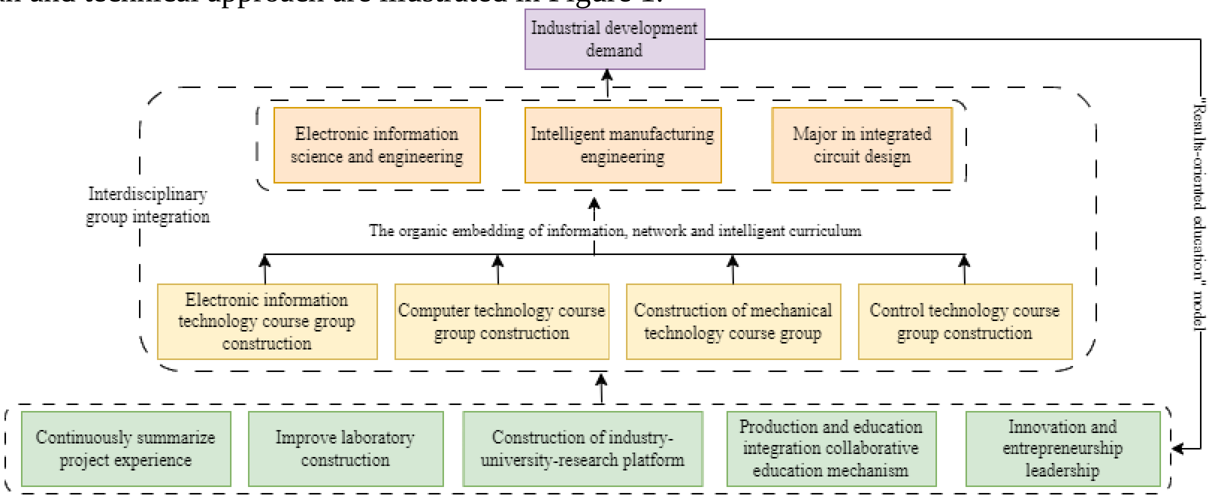


Figure 1 The project construction scheme and technical route

Guided by industrial development, a series of "golden courses" have been built through provincial and university-level applied demonstration courses, excellent courses, resource-sharing courses, and characteristic textbooks. These measures aim to construct an innovative practical curriculum system for electronic information majors based on the teaching model of "outcome-oriented education". The process of system formation, a discipline teaching team is established based on the course group. With the four major course groups, namely, the Electrical and Electronic Course Group, the Information and Control Course Group, the Embedded Application Technology Course Group, and the Applied Innovation Course Group, as the basic construction unit, the corresponding three major innovative teaching practice platform systems are built. Combined with the accumulation of professional school running, the talent demand of the electronic information industry, and the close integration of electronic information and science, especially the new requirements of Yibin City's intelligent terminal industry and digital economy for electronic information industry talents, the ability to cultivate students' circuit design,, programming, and debugging, is continuously strengthened. At the same time, intelligent science theory and practice courses are offered to lay a foundation for students' image, machine learning, neural networks, and other artificial intelligence basics. The practical approach for specific applications in course design, teaching, and competitions is outlined as follows.

### 3.1 Application of OBE in curriculum design

In course design, OBE places students at the center, enhances teaching methods, and improves both students' learning efficiency and the quality of their learning. At the same time, it emphasizes the use of various effective teaching methods, focuses on improving the quality of classroom instruction, and works to enhance students' comprehensive abilities. Students are encouraged to progress toward their goals based on their own learning experiences, characteristics, status, and progress. Taking the core course "Principle and Application of Single Chip Microcomputer" in the electronic information major as an example, the traditional course design method is usually arranged in a sequential structure. In contrast, the OBE model follows a reverse design approach and promotes learning in layers, aiming to stimulate students' interest, significantly improve learning efficiency, and encourage extracurricular independent learning and practice. In terms of results-oriented curriculum design reform, the specific course design process can be realized through the following steps: First, a demonstration is conducted to show functional requirements, followed by group discussions to achieve these functions, clarifying the division of hardware and software modules, and determining the subject knowledge involved. Then, the course shifts back to the MCU system, where students analyze which control pins are required and write the corresponding program code to achieve the necessary functions. Teams work collaboratively to complete the project development and physical production, ultimately submitting their work. In this process, the results-oriented teaching model capitalizes on students' strengths, stimulates their problem-solving abilities, encourages creative program design, and cultivates divergent thinking. This model not only enhances students' learning outcomes but also boosts their practical abilities and innovative mindset.

### 3.2 Application of OBE in classroom teaching

The classroom is the primary form of teaching implementation, and a well-designed classroom teaching method serves as a bridge to help students achieve training goals efficiently. The introduction of OBE into the classroom is mainly reflected in the following two aspects: the shift from a knowledge-centered classroom to an ability-centered classroom. In the teaching process, teachers move away from the traditional curriculum system, which emphasizes theory and neglects practice, and instead focus on cultivating employability and entrepreneurial skills, emphasizing "relevance" and "application" [18]. Through the demonstration of physical products or direct internships at various training bases, students gain a deeper understanding of how theoretical knowledge can be applied in practical production settings. Teachers will organically combine professional knowledge with practical skills, thereby significantly improving students' professional abilities. This approach helps students smoothly transition into the workforce and become high-quality talents who not only possess solid professional knowledge but can also effectively apply it in actual production processes—talents who understand both technology and business.

From the emphasis on learning and limited thinking to the combination of learning and critical thinking, independent thinking becomes the core of learning. Only through critical thinking can students truly understand, moving from phenomenon to essence, and from disorder to law. The OBE model emphasizes that teaching is not merely the transfer of knowledge but also "teaching students to think about learning"—that is, teaching students how to "enjoy learning," "learn how to learn," and "learn to think" [13]. Students should learn to think critically during their learning process and find solutions through their thinking. Taking the application innovation course "Smart Fish Model Robot" for electronic information majors as an example, students can manually build machinery and install sensor components, and then use PLC and single-chip microcomputer interface boards for programming control. In the traditional teaching model, teachers strictly control the entire assembly and control process, guiding students to complete specific functions, such as the expansion and contraction of mechanical arms, color classification, and the construction of three-dimensional garages. Under the OBE model, teachers gradually liberate their minds, providing relevant model materials for students to observe and think. Students are encouraged to combine their knowledge of mechanical principles and mechanical transmission design to assemble and program control. After realizing the basic functions, students can further modify the system to achieve additional functions, encouraging them to continually transform inspiration into practical results and stimulating innovative thinking.

### 3.3 Application of OBE in discipline competition training

Through rich disciplinary competitions and numerous practical experiences, students are able to integrate the theoretical knowledge from multiple professional courses, deeply understanding and verifying the validity of the theories. In this process, students' initial perceptual understanding evolves into rational comprehension, which is further developed through continuous practice and reflection, gradually leading to a new theoretical level. Through the repeated cycle of practice-know-re-practice-re-understanding, students move toward a deep, conceptual grasp of new theories. The practical nature of these discipline competitions fully embodies dialectical materialism and the unity of knowledge and action, effectively enhancing students' ability to solve complex engineering problems. Disciplinary competitions can spark students' strong interest in electronic information majors and result in professional achievement. This not only encourages students to reflect on what they have learned in class but also fosters the development of their independent learning, innovation, and hands-on skills. At the same time, these competitions strengthen students' sense of teamwork, promote the construction of a positive teaching style and learning atmosphere, and highlight the role of "promoting teaching through competition." To apply the results-oriented teaching model in disciplinary competitions, students are required to clarify the final goals of the competition. Taking the Freescale Smart Car Competition as an example, by integrating the OBE concept into the competition training, students can practice skills like mechanical structure identification and assembly while combining electronic technology with mechanical principles. By using the main controller to collect information from sensors such as angle sensors, camera gray values, and ultrasonic sensors, students can enable automatic curve recognition, obstacle avoidance, and automatic acceleration and deceleration on ramps. In the competition, students first define the final function they aim to achieve and then, through reverse derivation, gradually identify the core courses needed to realize the control system, including mechanical principles, mechanical and electrical transmission control, system design, computer fundamentals, electronic technology, C language programming, the principles and applications of single-chip microcomputers, and control engineering fundamentals. Additionally, students must master relevant software tools like Proteus, Altium Designer, and IAR. This process not only stimulates students' interest in professional knowledge but also enhances their independent learning abilities, thus achieving the dual goals of "promoting learning through competition" and "promoting teaching through competition."

### 3.4 Serve local economic industries and promote the development of the OBE model

Adhering to the service of regional economic development, the focus is on highlighting the unique training characteristics of electronic information professionals to better support local economic construction. As society develops and technology advances, higher demands are placed on multidisciplinary talents, and the cultivation of students' comprehensive qualities should be closely aligned with the needs of enterprises—particularly in areas such as professional competence, social adaptability, practical and innovative abilities, and a strong sense of social responsibility [19-20]. The electronic information major at Yibin local universities is characterized by the "integration of production and education" and "school-enterprise collaboration". Its primary goal is to enhance students' ability to integrate professional skills with practical application. Through a talent training model based on deep collaboration between schools and enterprises, more than 20 enterprises and research institutes have been engaged in school-enterprise partnerships. Together, they have established over 40 student practice bases. Additionally, school-enterprise joint project declarations are part of this collaborative effort, which, under the OBE model, facilitates the deep integration of production and education, fostering a practical, technology-driven talent development pathway through strong school-enterprise cooperation.

## 4. Conclusion and prospect

Through the integration of multiple resources within the OBE framework and in alignment with the new engineering background, the construction of electronic information majors is further strengthened, with a clear focus on cultivating innovative application talents, particularly those with a foundation in artificial intelligence. In this training process, a combination of strategies—such as "innovative thinking", "general education", "core professional curriculum", "application innovation", and "intelligent science"—has been adopted. These efforts have gradually shaped a talent training system characterized by "a solid foundation, strong application, and innovation". The system also promotes a comprehensive "teacher construction mechanism" that integrates the stages of "introduction," "training", "sending", and "mentoring", ensuring the continuous improvement of teaching quality and fostering innovation capabilities. By closely aligning with industry development needs and emerging technological trends, the curriculum design emphasizes interdisciplinary and cross-disciplinary integration, offering students well-rounded training in both knowledge and skills. This approach enhances their abilities in engineering practice and innovative application, ensuring they are prepared for the demands of the future. This innovative talent training model serves as an effective reference for the development of new engineering professionals, meeting the industry's growing demand for high-quality applied talents and responding to the emerging needs of frontier technologies like artificial intelligence and big data in the field of electronic information.

## Acknowledgments

This study was supported by Yibin College Curriculum Ideological and political series project (Project number: XJGY2024013); Application-oriented Brand Courses of Undergraduate universities in Sichuan Province "Principle and Application of Single-Chip Microcomputer";

Development of the National First-Class Undergraduate Program in "Electronic Information Science and Technology" (Project No. 409-GYLZY202402);

## References

*[1] Wals AE, Blewitt J (2010) Third-wave sustainability in higher education: Some (inter) national trends and developments. In: Sustainability education. Routledge, pp 55-74.*
*[2] Wei Z, Yuan M (2023) Research on the current situation and future development trend of immersive virtual reality in the field of education. Sustainability 15:7531.*
*[3] Liu M, Zhou R, Dai J, Feng X (2022) Analysis and practice of using modern information technology for classroom teaching mode reform. Mobile Information Systems 2022:2565735.*
*[4] Yuan X, Wan J, An D, Lu J, Yuan P (2024) Multi-method integrated experimental teaching reform of a programming course based on the OBE-CDIO model under the background of engineering education. Scientific Reports 14:16623.*
*[5] Purzer Ş, Quintana‐Cifuentes J, Menekse M (2022) The honeycomb of engineering framework: Philosophy of engineering guiding precollege engineering education. Journal of Engineering Education 111:19-39.*
*[6] Rof A, Bikfalvi A, Marques P (2022) Pandemic-accelerated digital transformation of a born digital higher education institution. Educational Technology & Society 25:124-141.*
*[7] Li C (2023) Research on the Construction of Educational Practice Curriculum Integrating Ideology and Politics Under the New Situation. Journal of Education and Educational Research 5:59-69.*
*[8] Hashim MAM, Tlemsani I, Matthews R, Mason-Jones R, Ndrecaj V (2022) Emergent strategy in higher education: postmodern digital and the future? Administrative Sciences 12:196.*
*[9] Quy VK, Thanh BT, Chehri A, Linh DM, Tuan DA (2023) AI and digital transformation in higher education: Vision and approach of a specific university in Vietnam. Sustainability 15:11093.*
*[10] Crosthwaite C (2021) Engineering futures 2035 engineering education programs, priorities & pedagogies. Australian Council of Engineering Deans, Report.*
*[11] Zhan D, Li X, Nie L, Gu S, Zhang L (2024) Joint Construction of Virtual Teaching and Research Section Across Universities: Creating a New Model for Collaborative Teaching and Research. Frontiers of Digital Education 1:254-266.*
*[12] Li L, Farias Herrera L, Liang L, Law N (2022) An outcome-oriented pattern-based model to support teaching as a design science. Instructional Science:1-32.*
*[13] Asbari M, Novitasari D (2024) Outcome-Based Education Model: Its Impact and Implications for Lecturer Creativity and Innovation in Higher Education. International Journal of Social and Management Studies 5:22-31.*
*[14] Hailikari T, Virtanen V, Vesalainen M, Postareff L (2022) Student perspectives on how different elements of constructive alignment support active learning. Active Learning in Higher Education 23:217-231.*
*[15] Xin X, Shu-Jiang Y, Nan P, ChenXu D, Dan L (2022) Review on A big data-based innovative knowledge teaching evaluation system in universities. Journal of innovation & knowledge 7:100197.*
*[16] Kumar V, Rewari M (2022) A responsible approach to higher education curriculum design. International Journal of Educational Reform 31:422-441.*
*[17] Srivastava SK, Agnihotri K (2022) A study on modern teaching pedagogy with special reference to outcome-based education system. International Journal of Business Excellence 26:95-114.*
*[18] Okolie UC, Nwajiuba CA, Eneje B, Binuomote MO, Ehiobuche C, Hack-Polay D (2021) A critical perspective on industry involvement in higher education learning: Enhancing graduates' knowledge and skills for job creation in Nigeria. Industry and Higher Education 35:61-72.*
*[19] Aithal P, Maiya AK (2023) Innovations in Higher Education Industry–Shaping the Future. International Journal of Case Studies in Business, IT, and Education (IJCSBE) 7:283-311.*
*[20] Li L (2024) The Construction of Educational Technology Major and Talent Cultivation in China. Journal of Educational Technology Development and Exchange (JETDE) 17:30-62.*