Practical Research on the New RADIR Teaching Mode in the Training of Electronic Information Professionals

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Abstract: Focusing on the construction of new engineering and the industrial development trend in the new era, this study aims to create a new teaching mode of RADIR (Release Analyst Design Implementation Reflection) suitable for the training of electronic information talents, explore a new path of coupling reality with reality, and build a π model integrating theory with practice to solve the existing problems in the current talent training, providing a new paradigm for the training of electronic information talents and providing replicable experience for the teaching reform of other engineering majors.
***Keywords*:** RADIR; Virtual and real coupling; π model

1. Introduction

As a critical field within modern engineering, electronic information disciplines face new challenges and opportunities amid the rapid advancement of information technology. To cultivate talents capable of meeting the demands of the new era, reforming teaching models has become a key direction in educational innovation within this discipline. Emerging engineering education (New Engineering) emphasizes the development of comprehensive, interdisciplinary engineering talents with global perspectives, cross-boundary integration capabilities, technical innovation capacity, and applied practical skills [1–3]. Given the swift pace of technological iteration in the electronic information field, traditional teaching models struggle to align with industry needs, making novel, diversified integration models a breakthrough point for reform. Current teaching model reforms [4–7] are driven by four major contextual factors: (1) Rapid Technological Advancement: With the rise of 5G, artificial intelligence (AI), the Internet of Things (IoT), cloud computing, and other emerging technologies, the curricular content and technical frameworks of electronic information programs are continuously updating. Traditional theory-centric approaches are insufficient to meet industry demands for practical skills, innovative thinking, and interdisciplinary literacy; (2) Changing Industry Demands: Enterprise requirements for electronic information professionals are increasingly diverse, placing greater emphasis on practical ability, innovation, and teamwork. Graduates often experience a "theory–practice gap," and companies must invest substantial resources in retraining. This compels higher education institutions to shift from teacher-centered instruction to student-centered innovative teaching models; (3) Educational Reform Policies: Global strategies such as China's "New Engineering" initiative and Germany's "Industry 4.0" emphasize the integration of industry, academia, and research. Educational authorities have introduced policies advocating for enhanced innovation and practical skills, promoting alignment between higher education and industrial needs;(4) Digital and Information Transformation: The construction of smart courses—integrating teaching resources, online assessment, and interactive platforms—enables the intelligent, information-based, and modernized development of curricula, offering new opportunities for educational model innovation in electronic information specialties.

2. Domestic and International Research Status

In recent years, domestic universities and research institutions have conducted extensive explorations in the cultivation of electronic information talents [8–9]. Some institutions have begun to experiment with interdisciplinary curricula and introduce project-driven and case-based teaching methods. For instance, Tsinghua University and Zhejiang University have adopted "New Engineering" concepts in their electronic information engineering programs, emphasizing interdisciplinary integration and hands-on skills. The Ministry of Education has also launched the "Excellent Engineer Education and Training Program" to foster high-quality engineering talents with innovation and practical capabilities through school–enterprise cooperation. Moreover, the Ministry advocates teaching innovation competitions and national first-class course construction under the "Four New" initiatives (New Engineering, New Medical Science, New Agricultural Science, and New Liberal Arts). These efforts aim to solve teaching challenges by refining teaching objectives under appropriate pedagogical philosophies and redesigning teaching materials, content, models, environments, and assessment mechanisms.

Domestic institutions are increasingly adopting Project-Based Learning (PBL) [9–12] to strengthen students' practical

and collaborative skills through real project implementation. For example, Huawei's "Intelligent Base" program collaborates with universities to offer AI and chip design courses; Southeast University's "School–Enterprise Joint Laboratory" supports FPGA project-based training. The flipped classroom model is also widely used, allowing students to learn foundational knowledge via pre-class videos and use class time for discussion, practice, and problem-solving. In addition, some universities integrate STEAM (Science, Technology, Engineering, Arts, and Mathematics) concepts to foster interdisciplinary talent. Zhejiang University uses machine learning to analyze student lab data and dynamically adjust teaching difficulty, while Tsinghua University has built an "Integrated Circuit Virtual Simulation Experiment Platform" to support remote full-process chip design. Nevertheless, significant disparities exist in teaching resources and outcomes across regions. To address this, cross-institutional collaborative communities can be formed to share and build quality resources, enabling innovative teaching models tailored to local student characteristics.

Internationally, several mature teaching models have been established. For instance, the Massachusetts Institute of Technology pioneered the CDIO (Conceive–Design–Implement–Operate) framework, emphasizing full-process cultivation of practical and innovative capabilities. Universities generally prioritize collaboration with industry through internships and joint projects to enhance employability. Student-centered pedagogies, emphasizing active and inquiry-based learning, are widely adopted. Stanford's "Silicon Valley-style teaching" encourages technology commercialization through startup incubators. Coursera has introduced "AI teaching assistants" that recommend personalized learning paths based on programming assignment data.Virtual simulation technologies are also leveraged to improve experimental skills while reducing costs. Purdue University uses VR to simulate high-frequency circuit design, avoiding expensive physical equipment. International institutions promote interdisciplinary curricula—MIT's EECS program, for example, integrates hardware and algorithm development to cultivate systems-level thinking.Global collaboration platforms, such as the EU's Erasmus+ program, facilitate cross-national joint degree offerings—e.g., TU Delft and KTH Royal Institute of Technology co-offering an IoT joint degree—enriching resources and fostering autonomous learning.

3. Problems and Countermeasures

3.1 Existing Problems

The electronic information industry is experiencing rapid growth, with increasing market size and technological sophistication. Talent demand concentrates in semiconductors, AI, IoT, cybersecurity, and quantum computing, with hardware and software engineers accounting for 30% and 35%, respectively. By 2026, the industry will face a new wave of technological revolution and industrial upgrading, driving sustained demand for highly skilled, interdisciplinary, and innovative talents. Future professionals must possess solid technical knowledge, cross-disciplinary expertise, and strong learning and innovation capabilities to cope with rapid industry changes.

However, the curriculum often lags behind technological updates, failing to keep pace with industry demands. Under the new engineering and innovation-entrepreneurship context, it is necessary to cultivate comprehensive engineering talents in electronic information education. Key problems include: (1) Outdated teaching models: Software and hardware courses are taught in isolation, overemphasizing virtual simulation without sufficient project-based practical teaching. Fragmented knowledge cannot effectively address complex engineering problems; (2) Industry alignment gaps: The curriculum emphasizes application design but lacks integration with real enterprise needs; school–enterprise collaboration remains insufficient; (3) Lack of context-driven design: Course content is detached from real application scenarios; teaching environments are monotonous, and students' circuit debugging abilities are weak.

3.2 Specific Measures

3.2.1 Establishing the RADIR Teaching Model

To address these challenges, the course team proposes the RADIR teaching model (Figure 1). Under this framework, teaching content is restructured, the learning environment rebuilt, the educational model reshaped, and assessment mechanisms redesigned.

Pre-class: Teachers release tasks via smart course platforms (AI practice + circuit simulation), integrate resources, analyze AI-based learning analytics, and design instruction. In-class: Using portable experiment kits, pocket instruments, and xMuse EEG devices, the team implements a seven-step process: guide–learn–discuss–practice–present–evaluate–extend. Post-class: Based on in-class issues, iterative improvements are made to continuously refine teaching methods with an outcome-oriented approach.

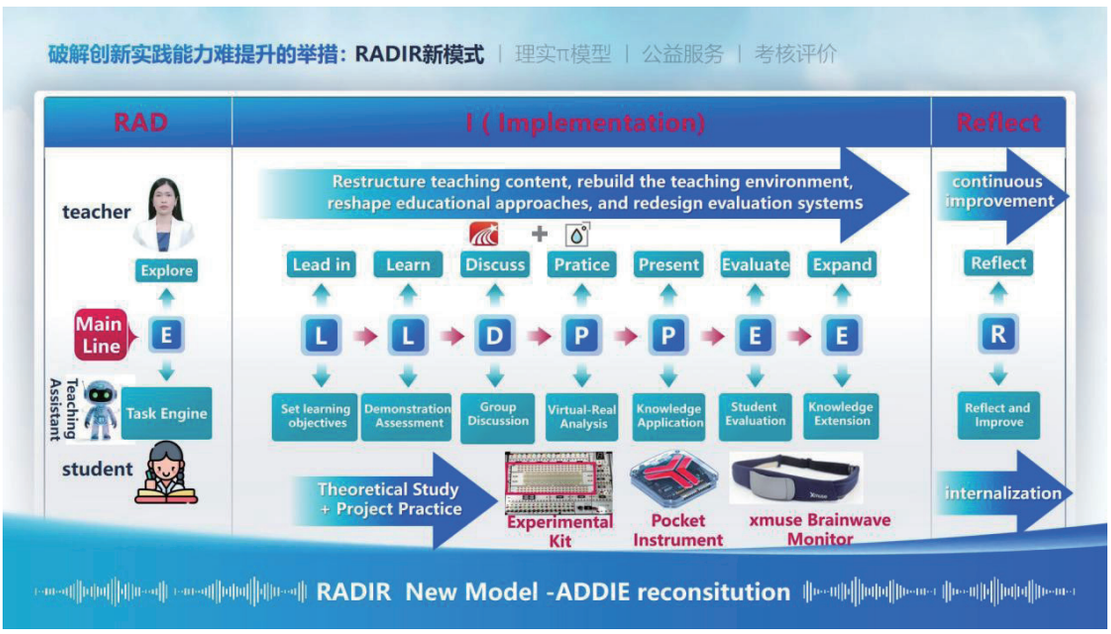

Figure 1. The RADIR Teaching Model

3.2.2 Exploring a New Virtual–Real Coupling Pathway

Adhering to a student-centered, outcome-oriented, and continuously improving philosophy, we construct a virtual–real coupling pathway across five dimensions: teaching environment, content, assessment, practice, and ideological–political education. By combining "four classrooms" and "five software tools" in the teaching environment, dual-pathway dual-device interface content, multi-dimensional evaluation, authentic practice, and integrated ideologyal–political education, grounding learning in tangible outcomes .Taking Digital Electronic Technology as an example, we developed a new teaching environment using Rain Classroom and Rain Lab platforms for task distribution, integrating pocket instruments and simulation software, alongside curriculum development tools from the University of Victoria. This virtual–real environment enables anytime, anywhere learning, accommodating personalized needs.Curricular content follows the principle of "application as the main thread, capability as the core,"adjusting structure, updating content, and tracking advanced technological trajectories. In-class chapter knowledge serves as the tangible foundation, enriched by literature discussion, interdisciplinary integration, and multi-course synthesis to achieve knowledge goals while enhancing abilities and professional qualities.The integration of virtual and real assessment cultivates students' learning, critical thinking, reasoning, communication, analytical, and practical skills. To improve hands-on abilities, we have independently developed teaching instruments that, combined with software platforms, support challenging comprehensive design experiments.

3.2.3 Constructing the Theory–Practice Integration π-Model

We propose a multi-interactive theory–practice integration π-model (Figure 2). Through the Electronic Information Industry College, we integrate new industry technologies, industrial culture, and developmental needs into teaching while also bringing students to enterprises for real projects, cultivating practical and innovative capabilities, and achieving notable results in competitions and patents. Theory reform includes six aspects: (1) Problem-driven methods to stimulate active thinking; (2) Improved pedagogical approaches to enhance teaching effectiveness; (3) Establishing connections across circuit courses via project-based cases; (4) OBE (Outcome-Based Education) principles for student-centered, outcome-oriented teaching; (5) Establishing evaluation and improvement mechanisms for continuous refinement; (6) Multi-course and interdisciplinary knowledge integration. Experimental course reform includes six aspects: (1) Increasing innovative experiments while eliminating purely verification-based ones; (2) Project case mining and group discussion-based learning; (3) Guiding students to participate in professional competitions and transforming award-winning works into teaching resources; (4) Supervising student innovation and entrepreneurship projects; (5) Strengthening school–enterprise cooperation and solving practical engineering problems with theoretical knowledge; (6) Diversifying course design topics and effectively integrating coursework with practice to optimize teaching structure and model.

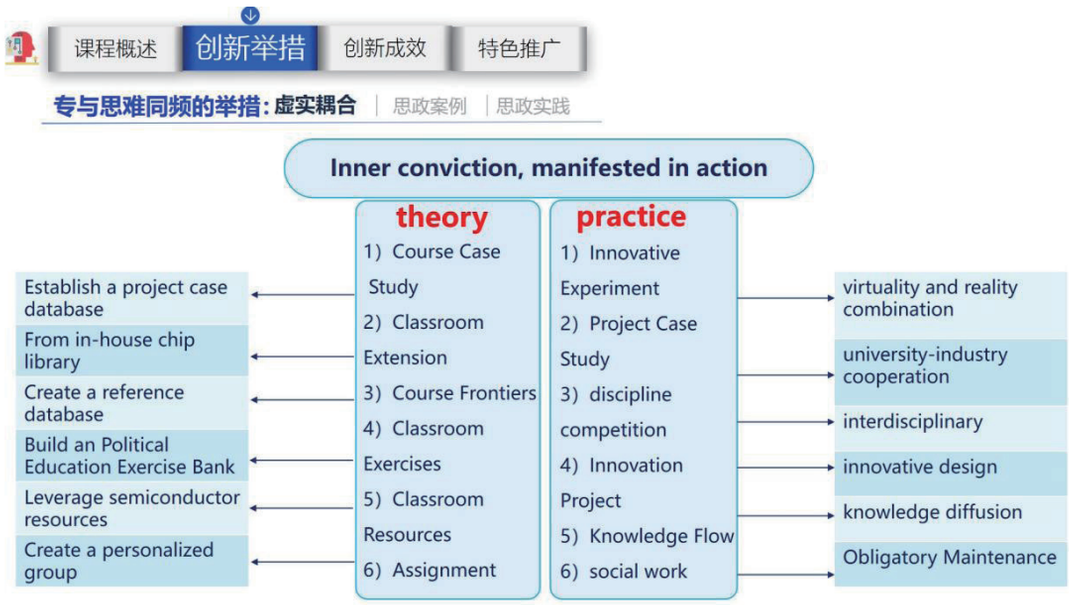

Figure 2. Theory–Practice Integration π-Model

4. Conclusion

The teaching model for electronic information programs is being driven by rapid technological updates, evolving industry demands, and educational policy reforms. Innovative teaching models not only enhance student engagement and initiative but also effectively improve their overall competencies. In the face of rapid digital transformation and changing student demographics, teaching methods must continuously evolve. It is essential to build a collaborative research community for foundational electrical and electronic courses in local universities, integrate cutting-edge industry technologies, and persistently refine teaching approaches to cultivate knowledgeable, capable, and responsible innovative talents.

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References

[1] Lü Xiaofeng, Han Xiaolong, Feng Yuan, et al. (2024). Innovation and practice analysis of electronic information teaching model based on industry-education integration[J]. Electronics Technology, 53(02), 256–257.
[2] Yan Xuxiu. (2024). Research on the construction of smart laboratories integrating online and offline under the New Engineering context[J]. University, (16), 34–37.
[3] Yang Junfeng, Ye Jingjing, Ma Tao, et al. (2024). Discussion on the construction of Digital Electronic Technology courses under the New Engineering background[J]. Educational Informationization Forum, (04), 60–62.
[4] Jiang Huali, Lin Jieben, Zhang Ronghui. (2019). Exploration of innovation and entrepreneurship education reform in electronic information engineering[J]. Experimental Technology and Management, 36(04), 31–34+50.
[5] Le Liqin, Li Hongxia. (2024). Research and practice on innovative course construction based on New Engineering: A case study of Digital Electronic Technology[J]. Journal of Innovation and Entrepreneurship Theory and Practice, 7(08), 45–47.
[6] Zhou Huaxiang, Tao Jing, Hua Wenlin, Yuan Huan. (2022). Reform and practice of mechanical talent cultivation under the New Engineering background[J]. Journal of Hubei Institute of Technology, 38(05), 69–72.
[7] Tian Yanan. (2022). Exploration and practice of electronic information program development under the New Engineering background: A case study of communication engineering[J]. IoT Technology, 12(08), 139–141.
[8] Wang, M., & Li, M. (2023). A hybrid teaching model for electronic information courses based on virtual simulation[J].

China Educational Technology, 42(5), 89–95.
[9] Zhang, M., et al. (2022). Exploration of "AI + project-driven" teaching reform for electronic information majors under the New Engineering background[J]. Research in Higher Education of Engineering, 30(3), 112–117.
[10] Chen, M., & Liu, M. (2021). Innovation of integrated circuit talent cultivation models from the perspective of industry-education collaboration[J]. Research and Exploration in Laboratory, 40(8), 210–214.
[11] Smith, J., & Lee, K. (2023). Integrating VR-based labs into electronics engineering education: A case study of high-frequency circuit design[J]. IEEE Transactions on Education, 66(2), 145–153.
[12] Gupta, R., et al. (2022). Adaptive learning systems for FPGA programming: An AI-driven approach[J]. Journal of Engineering Education, 111(4), 789–805.