Article

Exploration and Practice of Reforming the Curriculum-Based Ideological and Political Education Model in Recent Advances in Information and Communication Engineering

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Abstract: This article examines how ideological and political education can be integrated into Frontiers in Information and Communication Engineering, a graduate course characterized by rapidly changing technologies and interdisciplinary content. Drawing on the course's instructional design and reported teaching practices, it identifies three related objectives: understanding research frontiers, developing research competence, and exercising professional responsibility. The proposed framework combines research-led thematic teaching, engineering case studies, seminar discussion, team-based technical reports, and digital learning resources. Cases drawn from 5G/6G communications, quantum technology, satellite navigation, artificial intelligence, and cybersecurity connect technical analysis with research integrity, national development needs, and engineering ethics. The discussion outlines how students can evaluate technological options, justify their decisions, and reflect on their wider consequences. Multi-instructor collaboration and formative feedback provide means of coordinating and refining the curriculum. This practice-based account offers a transferable approach to graduate engineering teaching, although its impact on learning outcomes remains to be assessed through systematic empirical evidence.

Keywords: curriculum-integrated ideological and political education; information and communication engineering; postgraduate teaching reform; engineering ethics

1. Introduction

Graduate courses on emerging technologies must do more than introduce new theories, algorithms, and systems. As students approach independent research and engineering practice, they also encounter questions about data protection, information security, academic integrity, and the consequences of technical decisions. In Chinese higher education, curriculum-integrated ideological and political education seeks to address such questions within disciplinary learning rather than through a separate body of general material. The Ministry of Education's 2020 guidelines establish the policy basis for integrating value formation with knowledge acquisition and the development of professional abilities [1].

Effective integration depends on how closely the chosen issues relate to what students actually study and do. In a university English linguistics course, Mei reported that carefully planned activities could connect subject knowledge with civic and ethical reflection [2]. Shen et al. likewise described the use of clinical cases to integrate professional learning and value-oriented education in undergraduate otolaryngology teaching [3]. Neither setting is directly comparable with a graduate engineering course, but both suggest that disciplinary concepts, authentic cases, and opportunities for reflection should be designed together rather than treated as separate teaching tasks.

Digital transformation has also altered the resources available to instructors and the responsibilities faced by engineering students. Yang et al. proposed a model of teachers' competence that includes identifying relevant educational elements, employing digital

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tools, organizing instruction, collaborating with colleagues, and using feedback for improvement [4]. In science and engineering education, Usher and Barak examined how online case-based activities can support students' engagement with AI-related ethical questions [5]. A later study by Usher et al. explored graduate students' expectations of universities in preparing them to address such questions [6]. Nevertheless, Wiese et al.'s systematic review found that teaching interventions in AI ethics often lack sufficiently rigorous assessment methods [7]. These findings support explicit ethical inquiry within technical teaching, while also cautioning against equating a proposed curriculum with demonstrated learning gains.

The graduate course Frontiers in Information and Communication Engineering provides a relevant setting for this approach. Its topics include 5G/6G networks, quantum communication, the BeiDou navigation system, artificial intelligence, and cybersecurity. Each introduces technical choices that also concern public infrastructure, scientific collaboration, information governance, or social responsibility. Hardebolle et al. argue that engineering ethics education should address fairness, safety, transparency, human agency, sustainability, and governance in the development and use of AI [8]. Cañavate et al. similarly discuss how engineering curricula can connect generative AI with broader technological and sustainability concerns [9]. Building on the existing course, this article asks two practical questions: how can such issues be embedded in frontier-oriented teaching without diluting disciplinary depth, and which activities can connect knowledge, research practice, and responsible decision-making? The analysis describes curriculum design and teaching practice rather than a controlled evaluation of educational effectiveness.

1.1. Rationale, Priorities and Learning Objectives

1.1.1. Why the Integration Is Necessary

Information and communication engineering underpins digital infrastructure, technological innovation, and a wide range of public and industrial services. Decisions about network architecture, intelligent processing, or navigation systems therefore have implications beyond laboratory performance. Graduate students need to understand not only whether a technical solution can be implemented, but also what conditions govern its responsible use and whose interests it may affect. These concerns make research competence and professional responsibility complementary aims of the course.

Graduate education places particular weight on independent inquiry. Students must evaluate literature, frame research questions, compare technical options, report results accurately, and acknowledge the work of others. Research integrity is therefore a condition of sound engineering practice, not an addition to it. By examining scientists' contributions, the responsibilities associated with key technologies, and the requirements of academic communication, the course connects personal research choices with wider scientific and societal obligations.

1.1.2. Curricular Priorities and Intended Outcomes

Three priorities guide the reform. The first is to relate technological advances to national strategic needs while retaining a critical, evidence-based view of international research. The second is to make links among optoelectronic sensing, communication engineering, and information processing visible across course topics. The third is to update scientific cases and instructional resources regularly, so that expectations concerning research integrity and engineering ethics remain relevant as the discipline evolves. These priorities reflect a frontier course whose coverage is broad and whose content changes quickly.

The intended outcomes fall into three domains. In the knowledge domain, students should be able to identify emerging research directions and explain the strengths and limitations of alternative technologies. In the capability domain, they should synthesize interdisciplinary evidence, develop technically defensible proposals, and communicate their reasoning. In the value domain, they should recognize questions of integrity, security, public responsibility, and scientific purpose arising from engineering work.

Cases concerning Huawei's 5G development, the Micius quantum satellite, and the BeiDou navigation system are used to relate these aims to recognizable research and engineering contexts (Figure 1).

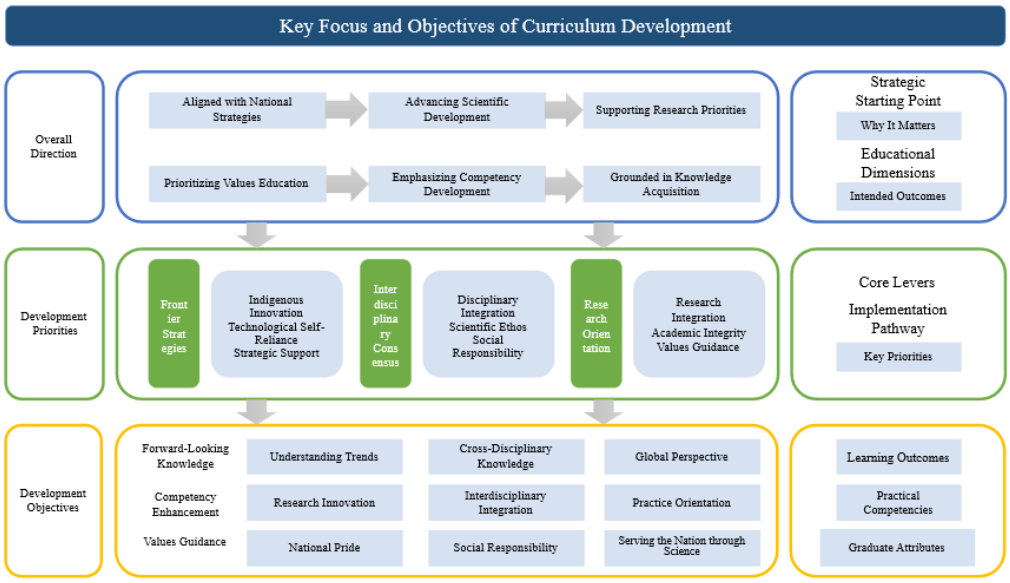

Figure 1. Directions, Priorities, and Objectives of Curriculum-Integrated Education.

1.2. Pathways for Integrating Disciplinary and Civic Learning

The instructional pathway has five connected elements: thematic teaching, case analysis, reflective discussion, research-based assignments, and digital support. Each begins with a disciplinary problem rather than an abstract value statement. Instructors introduce the technical concepts, select a case that raises an identifiable decision, and guide students in examining both the engineering evidence and the responsibilities attached to that decision. Students then apply the same reasoning in discussions and written research tasks.

Thematic modules draw on the expertise of instructors working in different research areas. A session on next-generation communication networks, for example, may address system architecture and performance before considering infrastructure reliability and security. Cases involving 5G development, quantum communication, or satellite navigation provide a basis for asking why a technical route was chosen, what alternatives were available, and what limitations or uncertainties remain. The aim is to make value-oriented inquiry part of the technical analysis rather than an unrelated addition to it.

Structured discussion gives students an opportunity to defend their judgments against competing interpretations. Short statements, group debate, and case reviews require them to cite evidence and explain trade-offs among performance, feasibility, safety, and broader consequences. Research-oriented assignments extend this process to a proposal or literature review, where accurate citation and the identification of ethical risks become part of the expected work. Online course platforms, virtual simulation, academic databases, and international conference recordings support the updating of examples and teaching resources. Figure 2 summarizes the connections among curricular inputs, learning activities, and intended outcomes.

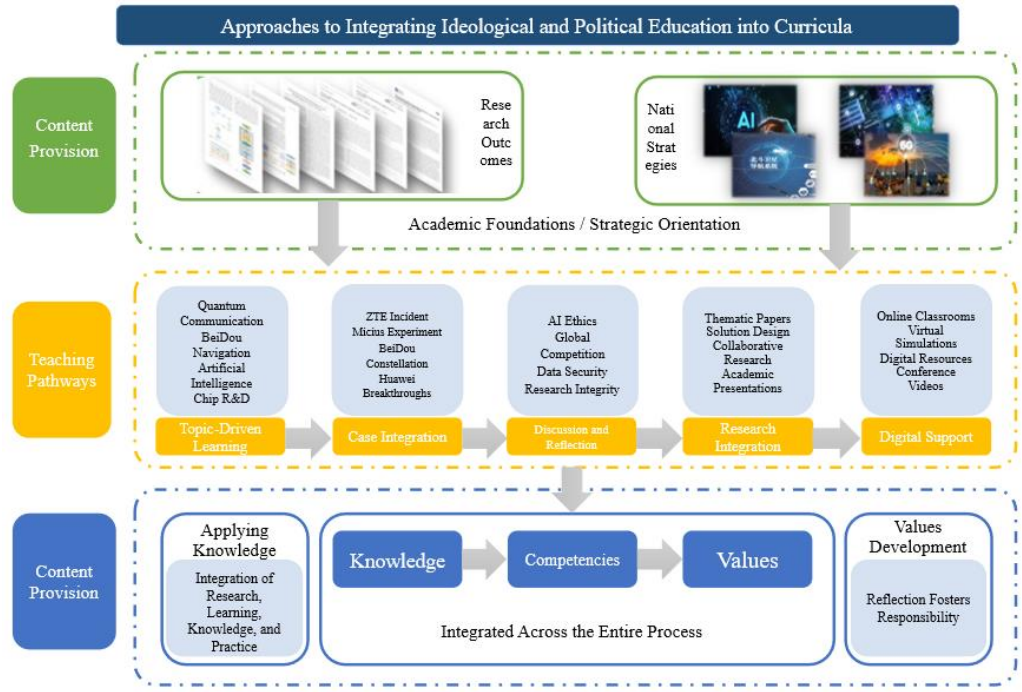

Figure 2. Pathways for Integrating Ideological and Political Education into the Course Content.

2. Construction of the Integrated Curriculum Model

The course reform is organized through collaboration among instructors, engineering cases derived from research and industrial practice, and digitally supported learning activities. It is consistent with the university's emphasis on national strategic needs and regional development, but retains the course's central function of introducing advanced scientific developments. Four themes recur across modules: scientific and technological service, innovation, research integrity, and ethical responsibility. The instructional task is to translate these themes into questions that students can investigate using technical knowledge.

The integrated model operates at three levels. The content level brings together recent work on 5G/6G communication, intelligent information processing, cybersecurity, quantum information, and navigation technologies. The instructional level combines focused lectures, case inquiries, seminars, laboratory exploration, and project work. At the learning level, technical understanding, research capability, and responsible judgment are considered jointly in students' explanations and submitted work. Coordination among instructors is essential: without shared expectations, a sequence of specialist lectures can leave students with fragmented messages about scientific conduct and social responsibility.

Implementation follows an iterative sequence. Instructors select technical topics and cases; students analyze the associated problems through discussion and written assignments; and the teaching team reviews the work and feedback to revise later sessions. This arrangement makes the justification of engineering choices a recurring learning activity. It also offers a practical means of connecting disciplinary understanding with questions of research conduct and ethical responsibility. The relationship among the three levels is illustrated in Figure 3.

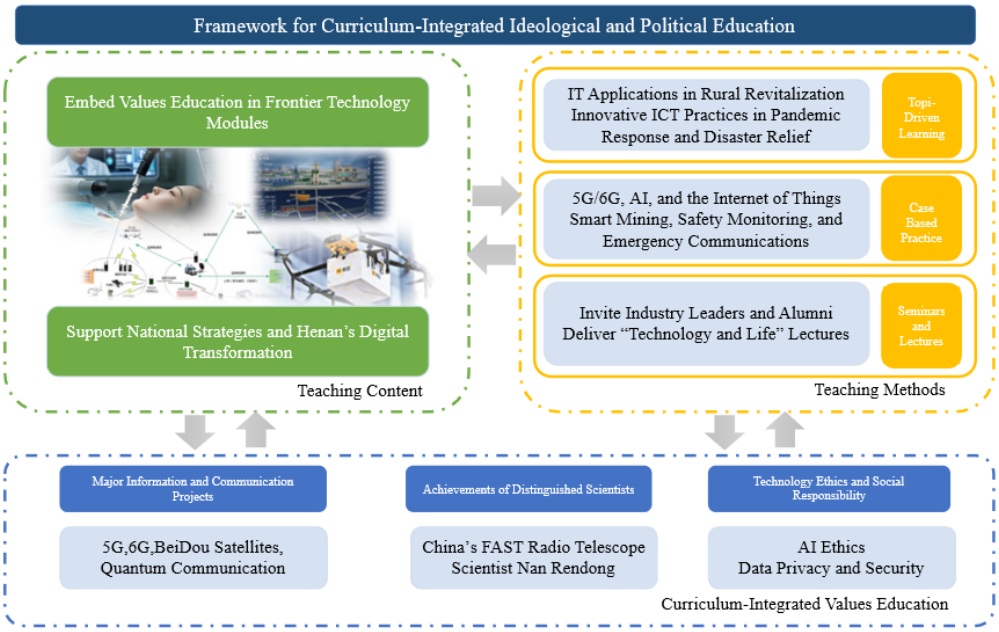

Figure 3. Integrated Curriculum Development Model.

3. Teaching Practice and Methodological Innovation

3.1. Integrating Strategic Context and Technological Ethics into Classroom Practice

Classroom implementation links frontier technologies to their research contexts and practical implications. Seminars on artificial intelligence, quantum information, communications, and related topics first establish the scientific principles and engineering constraints, then introduce relevant questions of strategic importance and technological responsibility. Examples from the work of scientists and engineers provide opportunities to discuss perseverance, accuracy, and accountability. Rather than presenting these qualities as general slogans, instructors relate them to decisions such as reporting unexpected findings, protecting confidential information, and explaining methodological limitations.

Discussion activities require students to make and defend a technical choice. In one format, groups compare two development routes and prepare a recommendation addressing performance, feasibility, reliability, and risk. During the presentation, other students question the evidence and assumptions behind each proposal. A further activity invites reflection on the relationship among personal research ambitions, family responsibilities, national development needs, and professional standards. Brief written statements and round-table discussion are used to make these considerations explicit and open to reasoned examination.

3.2. Research Assignments, Evaluation, and Feedback

Course assignments carry the same expectations into independent work. At midterm and at the end of the course, groups of three to five students undertake an innovation-oriented task and prepare a technical development report. Each report addresses three questions: what technical approach is proposed and where its contribution lies; how the work relates to strategic or societal needs; and what ethical risks and safeguards require consideration. Selected reports may be developed further through university innovation activities or research ethics workshops. In this way, social and ethical appraisal becomes part of the proposed engineering solution rather than a separate concluding statement.

Students' reports are assessed primarily on the strength of their technical reasoning and the depth of their reflection. They should distinguish claims supported by evidence from assumptions, draw on reliable sources, acknowledge uncertainty, and consider the possible implications of their proposals. After teaching activities, instructors collect

anonymous feedback and use students' comments to reconsider the cases, seminar questions, and assignment formats. The course records available for this account do not specify the number of respondents, the response rate, a common assessment rubric, or comparable pre- and post-course results. Accordingly, this paper describes the instructional arrangements and the purposes they are intended to serve; it does not present them as evidence of a measured improvement in students' knowledge or ethical reasoning (As shown in Figure 4).

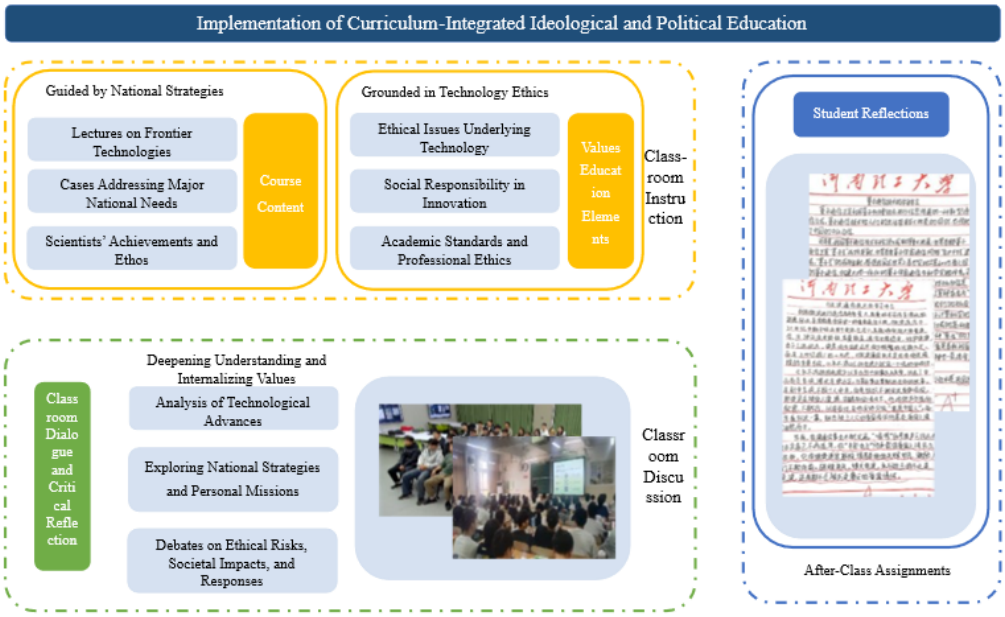

Figure 4. Teaching Practices for Curriculum-Integrated Ideological and Political Education.

3.3. A Three-Setting Pedagogy for Engineering Frontiers

Three teaching formats are used in this course: thematic instruction, engineering-case analysis, and seminars. The thematic sessions introduce the scientific principles and recent work in intelligent communications, network security, and satellite navigation. Engineering cases include the ZTE sanctions episode, the Micius quantum satellite, and the BeiDou system. Students return to these cases with research papers and technical documentation, examining the reasons for particular technical choices and the alternatives available. Discussion also addresses cooperation in research, dependence on critical technologies, the reliability of engineered systems, and responsibility to the wider public.

The teaching activities extend beyond the lecture room into two further settings. The first, centred on theoretical instruction and guided discussion, establishes the basis for subsequent work. The second involves laboratories and research exploration, while the third is devoted to applying knowledge in projects. Laboratory visits and interdisciplinary tasks allow students to consider constraints that may receive little attention in published studies. Project reports bring together conceptual understanding, technical assessment, and ethical reflection, rather than treating these as separate exercises. Figure 5 depicts the relationship among the three settings. An assessment of their educational effects would require evidence of participation and learning outcomes in each setting.

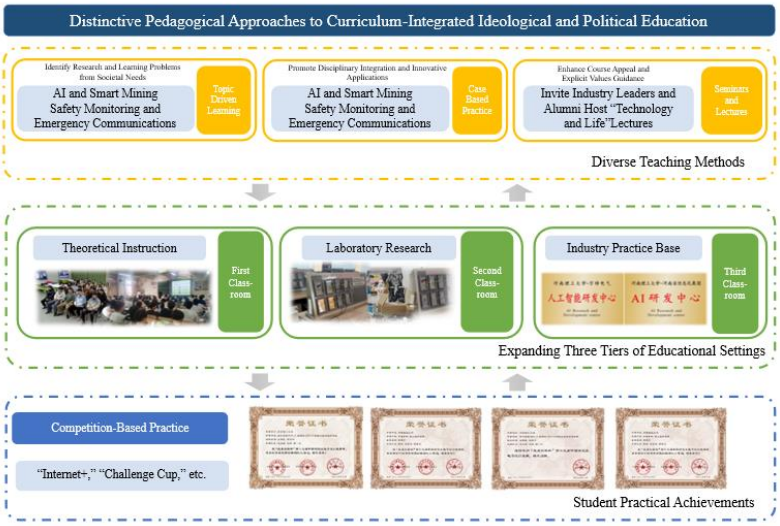

Figure 5. Distinctive Teaching Methods for Curriculum-Integrated Education.

4. Distinctive Features and Continuous Refinement

The course has three distinctive features. First, instructors from different research specializations coordinate their sessions and identify recurring questions that students can revisit across topics. This helps prevent value-oriented teaching from becoming a series of disconnected examples. Second, digital resources support continuous curricular renewal. Research databases, recordings of international conferences, and blended learning platforms allow the teaching team to update technical cases while retaining a consistent focus on academic conduct and societal implications.

Finally, case-based inquiry continues after the initial lecture rather than ending with the first presentation of an example. Students revisit each case in seminar discussions, technical proposals, and reflective assignments. As they do so, they are asked to examine the evidence again and refine their judgments in light of the issues raised. This sequence connects initial learning with discussion, written work, and feedback. Together with collaboration among instructors and the regular updating of digital resources, it provides the basis for the improvement process illustrated in Figure 6.

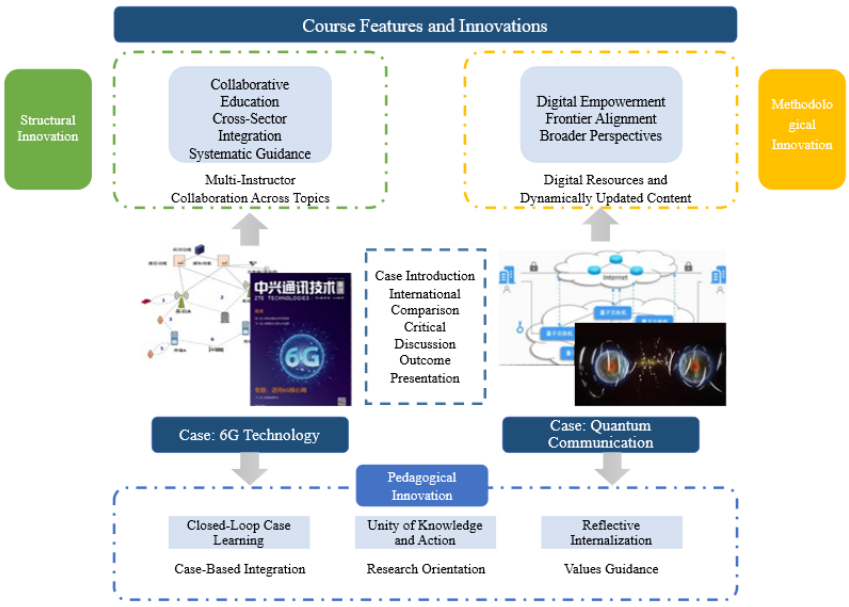

Figure 6. Key Features of the Course and Its Innovations.

5. Conclusion

The reform discussed in this paper concerns the integration of ideological and political education into the graduate course Frontiers in Information and Communication Engineering. Its teaching arrangements combine research-oriented thematic instruction with engineering cases, seminars, group technical reports, and digital resources. Questions of academic integrity and engineering responsibility are considered while students examine the evidence for emerging technologies and the choices involved in their application. Such an approach requires coordination among instructors working in different specialisms. This is particularly important in a frontier course, where the subject matter spans several fields and changes rapidly.

The course provides a practice-based account of how intended learning outcomes can be addressed through teaching activities and reviewed through feedback. Instead of adding general value statements after a technical lecture, instructors ask students to consider the responsibilities associated with a particular engineering decision and to explain the evidence behind their judgment. The approach may be useful to those designing other courses on emerging engineering topics, although its applicability outside this setting has not been established. The teaching account refers to positive experiences, but it does not report reliable quantitative measures of learning gains. Consequently, the material presented here cannot establish a causal improvement attributable to the reform. A subsequent evaluation should use explicit scoring criteria, gather evidence before and after instruction, and examine students' written work over time. Comparisons across cohorts or disciplines would also help determine whether technical understanding, research integrity, and responsible engineering judgment develop as intended.

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References

1. Ministry of Education of the People's Republic of China, "Notice on Issuing the Guidelines for Curriculum-Based Ideological and Political Education in Higher Education (Jiao Gao [2020] No. 3)," 2020. [Online]. Available: https://www.moe.gov.cn/srcsite/A08/s7056/202006/t20200603_462437.html. [Accessed: Nov. 16, 2026].
2. Z. Mei, "Integration of curriculum ideology and politics in higher education: a case study of English linguistics in China," *Frontiers in Education*, vol. 9, p. 1389469, 2024, doi: 10.3389/feduc.2024.1389469.
3. Y. Shen, S. Zhang, and G. Chang, "Integrating case-based learning with curriculum-based ideological and political education: enhancing undergraduate otolaryngology education," *Frontiers in Education*, vol. 10, p. 1521548, 2025, doi: 10.3389/feduc.2025.1521548.
4. X. Yang, W. Ye, J. Wei, and H. Yu, "Construction and empirical analysis of the ideological and political teaching ability inspection model of professional teachers in universities empowered by digital intelligence," *Frontiers in Psychology*, vol. 16, p. 1550797, 2025, doi: 10.3389/fpsyg.2025.1550797.
5. M. Usher and M. Barak, "Unpacking the role of AI ethics online education for science and engineering students," *International Journal of STEM Education*, vol. 11, p. 35, 2024, doi: 10.1186/s40594-024-00493-4.
6. M. Usher, M. Barak, and S. Erduran, "What role should higher education institutions play in fostering AI ethics? Insights from science and engineering graduate students," *International Journal of STEM Education*, vol. 12, p. 51, 2025, doi: 10.1186/s40594-025-00567-x.
7. L. J. Wiese, I. Patil, D. S. Schiff, and A. J. Magana, "AI ethics education: a systematic literature review," *Computers and Education: Artificial Intelligence*, vol. 8, p. 100405, 2025, doi: 10.1016/j.caeai.2025.100405.
8. C. Hardebolle, M. Héder, and V. Ramachandran, "Engineering ethics education and artificial intelligence," in *The Routledge International Handbook of Engineering Ethics Education*, S. Chance, T. Børsen, D. A. Martin, R. Tormey, T. T. Lennerfors, and G. Bombaerts, Eds. London: Routledge, 2025, pp. 125–141, doi: 10.4324/9781003464259-9.
9. J. Cañavate, E. Martínez-Marroquín, and X. Colom, "Engineering a sustainable future through the integration of generative AI in engineering education," *Sustainability*, vol. 17, no. 7, p. 3201, 2025, doi: 10.3390/su17073201.

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