



Research Paper

Integrating Moral Education into Engineering Education: An Internal–External Approach from Marxist–Leninist Philosophy

MA. Nguyen Nam Hung

MA. Truong Vu Long

MA. Tong Thi Phuong Thao

University of Technology – Thai Nguyen University¹

Abstract

In the context of rapid advancements in science and technology, artificial intelligence, and digital transformation, engineering education today is required not only to equip learners with specialized knowledge but also to cultivate their capacity for action and enhance their sense of responsibility. This paper aims to clarify the theoretical foundations and propose a model for integrating moral education into engineering education from the perspective of Marxist–Leninist philosophy. The study employs a qualitative approach, combining theoretical analysis, a systems perspective, and a case study at the University of Technology – Thai Nguyen University. The findings indicate that moral education has established a certain foundation through political theory courses and the institutional educational environment. However, its integration with specialized courses, learning outcomes, and specific professional situations remains somewhat limited. Based on these findings, the paper proposes an integration model structured around input–process–output, aiming to connect professional knowledge with professional responsibility. This study contributes to enriching the scientific basis for innovating engineering education in the current context.

Keywords: *engineering education; moral education; integration; Marxist–Leninist philosophy; systems approach; digital transformation; Vietnam*

I. Introduction

In the context of the Fourth Industrial Revolution, along with the rapid development of artificial intelligence, automation, and digital transformation, engineering education is facing the imperative of comprehensive innovation. Beyond specialized knowledge and professional skills, educational programs must also aim to cultivate learners' capacity for responsible action. This requirement is reflected in international learning outcome standards, where ethical competence and social responsibility are considered essential components of engineering education, as evidenced by the expectation that learners demonstrate the “ability to recognize ethical and professional responsibilities in engineering situations” [8, p. 5].

However, the challenges confronting engineering education today stem not only from the need to reform its internal elements, but also from external pressures arising from the technological environment and the rapid transformation of society. From an external (exogenous) perspective, the advancement of artificial intelligence, digital data, and the demand for sustainable development have made ethical issues in engineering practice increasingly urgent and complex. Meanwhile, from an internal (endogenous) perspective, educational practice continues to reveal a gap between the provision of specialized knowledge and moral education; these domains often remain relatively separate and insufficiently integrated into disciplinary courses.

From the perspective of Marxist–Leninist philosophy, morality is understood as a form of social consciousness that reflects social being and is intrinsically linked to specific relations of interest. As Karl Marx and Friedrich Engels asserted, “social consciousness reflects social being” [1, p. 25]. Accordingly, moral

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education is not merely the transmission of normative standards, but a process of transformation from cognition to belief and behavior. Nevertheless, the application of this approach to engineering education—particularly in the form of an integrated model—remains limited.

Against this background, this paper seeks to clarify the theoretical foundations and propose a model for integrating moral education into engineering education through a case study at the University of Technology – Thai Nguyen University, thereby contributing to enhancing the effectiveness of moral education in the current context.

II. Theoretical Framework and Research Methodology

2.1. Theoretical Framework

2.1.1. Conceptions of Human Beings, Morality, and Social Responsibility in Marxist–Leninist Philosophy

In Marxist–Leninist philosophy, morality is understood as a form of social consciousness that reflects social being and is conditioned by specific socio-economic circumstances. Karl Marx and Friedrich Engels pointed out that “social consciousness reflects social being” [1, p. 25]. This perspective emphasizes that morality is not merely an internal system of individual norms but is also shaped by external social conditions; as socio-economic contexts change, both individual and social value systems inevitably undergo corresponding transformations.

In this regard, Marxist–Leninist philosophy conceives human beings as “the ensemble of social relations” [1, p. 11]. From this standpoint, individual behavior is always embedded in a social context and in concrete relations of interest; the development of the individual is inseparable from that of the community. Therefore, orienting behavior toward socially grounded values is not only a moral imperative but also a condition for sustainable development.

On this basis, morality plays a guiding role in shaping behavior through the unity of cognition and practice. Vladimir Ilyich Lenin emphasized that “from practice, humans not only come to understand the world but also transform it” [2, p. 194]. This indicates that morality does not remain at the level of theoretical norms but directly participates in the formation of beliefs, ideals, and motivations for human action.

In the field of engineering, professional decisions made by engineers—given their wide-ranging impact—can profoundly affect various aspects of social life. Therefore, social responsibility cannot be confined merely to legal compliance; it must become an intrinsic component of professional ethics. In the context of digital technologies and artificial intelligence, engineering education must place even greater emphasis on ethical competence and regard it as a core element of professional capability.

2.1.2. The Nature of Moral Education and Its Integration into Engineering Education

From the perspective of Marxist–Leninist philosophy, moral education is not simply the transmission of ethical knowledge and behavioral norms, but a process of transformation from cognition to belief and action. This process reflects the dialectical relationship between the learner’s internal (endogenous) factors and the external (exogenous) practical environment. As Vladimir Ilyich Lenin argued, “the path from cognition to practice is the dialectical path of truth” [2, p. 179]. Accordingly, the effectiveness of moral education does not emerge instantaneously but is cultivated through internalization, practice, and lived experience.

This suggests that moral education can only be truly effective when it is closely connected to real-life contexts in which learners are required to confront concrete choices and value conflicts. In engineering education, this entails incorporating issues such as technological safety, social responsibility, data security, and environmental impact into the learning process, thereby transforming knowledge into actionable competence. This requirement is also emphasized in international engineering learning outcome standards [8, p. 5].

In the context of educational reform, integration represents an appropriate approach to overcoming the separation between theory and practice. Integrating moral education into engineering education is not merely about embedding ethical content into disciplinary courses, but about reorganizing curricula and pedagogical methods to establish meaningful connections between professional knowledge and ethical values. This can be implemented through various approaches, such as case-based learning, group discussions, problem-based learning, and simulations of engineering decision-making [10], [11].

In essence, this is a systemic process in which internal institutional elements—such as objectives, content, and teaching methods—are interconnected with external demands arising from the professional and social environment. Thus, integrating moral education into engineering education is not only a pedagogical requirement but also a necessity rooted in the social nature of contemporary engineering practice.

2.2. Research Methodology

This study adopts a qualitative approach, combining theoretical analysis, a systems perspective, and a case study to clarify the scientific foundations and practical applicability of a model for integrating moral education into engineering education.

The method of theoretical analysis is employed to systematize key concepts and arguments on moral education from the perspective of Marxist–Leninist philosophy, thereby constructing the analytical framework for the study. The systems approach enables engineering education to be examined as a holistic structure comprising input–process–output components with interactive relationships, while also explaining the connection between the internal (endogenous) structure of the institution and the external (exogenous) demands of the professional and social environment. Accordingly, moral education is understood as an integral component of the overall educational system.

In addition, a case study at the University of Technology – Thai Nguyen University is conducted to assess the feasibility of the proposed model. Data are collected through curriculum analysis, classroom observation, and exploratory student surveys, providing a basis for comparing theoretical perspectives with practical implementation.

The combination of these methods ensures consistency between theoretical analysis and empirical evidence, aligning with the objective of proposing an integration model applicable to engineering education.

III. A Case Study at the University of Technology – Thai Nguyen University

3.1. Educational Characteristics

The University of Technology – Thai Nguyen University is an application-oriented engineering institution, with the mission of training high-quality human resources associated with scientific research, consultancy, application, and technology transfer, in response to the requirements of sustainable development and international integration [5]. This orientation indicates that education is not limited to imparting specialized knowledge but also aims to develop learners’ capacity for action within modern industrial environments.

The disciplinary structure focuses on fields such as electrical and electronic engineering, control and automation, information technology, mechanical engineering, automotive engineering, construction, and environmental engineering, while expanding into areas such as artificial intelligence, the Internet of Things (IoT), and intelligent systems [7]. This reflects the external influence of emerging technological trends on academic development, situating students in a learning context closely linked to data, technological safety, and sustainable development.

From an internal perspective, the curriculum is structured into general education, foundational, and specialized components in accordance with current standards [3]. Political theory courses play a foundational role in shaping learners’ worldview and value orientation [4]. However, given the applied nature of engineering education, students’ professional competence depends not only on specialized knowledge but also on their ability to make decisions in real-world situations involving ethical considerations.

From the perspective of Marxist–Leninist philosophy, technical activity is inherently embedded in social relations; therefore, professional decisions simultaneously constitute social actions with far-reaching consequences. This suggests that if the training structure emphasizes technical skills while neglecting value-oriented competencies, it will be difficult to fully meet the demands of modern professional practice. In this context, moral education needs to be directly integrated into the training process, closely linked to learning outcomes and professional competencies. This orientation is also consistent with the institution’s ongoing efforts in quality assurance and accreditation [14], [15].

3.2. Current State of Moral Education

Within the current training structure at the University of Technology – Thai Nguyen University, moral education is primarily delivered through political theory courses such as Marxist–Leninist Philosophy, Marxist–Leninist Political Economy, Scientific Socialism, and the History of the Communist Party of Vietnam [4]. This indicates that moral education is currently organized in an integrated manner within the general education curriculum, associated with the formation of worldview and value orientation for learners.

This approach has a certain theoretical foundation, as Marxist–Leninist philosophy holds that “morality is associated with social relations and the process of human consciousness formation” [1, p. 25]. Accordingly, moral education through political theory courses plays an important role in fostering political awareness, social responsibility, and a foundational value system for students.

From the perspective of educational organization, the university has undertaken innovations toward digital transformation, gradually adopting learning management systems (LMS), digital learning resources, and online teaching and learning platforms [12], [13]. In addition, the activities of Party organizations, the Youth Union, and the Student Association continue to contribute to the cultivation of students’ qualities through collective movements, community engagement, and campaigns promoting academic integrity, responsibility in data use, and digital citizenship awareness [16], [17].

Overall, moral education at the university is currently implemented through three main channels: the formal curriculum, the student activity environment, and digital learning support platforms. As a result, this domain has established a certain foundation within the training process and has contributed to shaping learners’

value awareness. In the context of modern engineering education, this serves as an important basis for further developing forms of moral education closely linked to professional competence and emerging technological practices.

Table 1. Students’ perceptions of the role of moral education (n = 80)

Survey items	Agree / Strongly agree
Moral education is necessary for engineering students	86.3%
Marxist–Leninist Philosophy plays a role in value orientation	78.8%
Professional ethics is as important as professional competence	82.5%

Source: Authors’ survey results.

The results in Table 1 indicate that students have a relatively clear awareness of the importance of moral education in engineering training. The majority consider ethics a necessary requirement and acknowledge the value-orienting role of political theory courses. These findings suggest that students demonstrate a certain level of interest in moral education throughout their learning process.

However, when examined at the level of behavior and application, the survey results reveal variations in the degree to which awareness is translated into practice among different groups of students. This is reflected in the frequency with which ethical considerations are taken into account when addressing learning situations, as well as in students’ evaluation of the connection between course content and professional practice.

Table 2. The transformation from awareness to ethical behavior (n = 80)

Survey items	Frequent / High agreement
Proactively consider ethical factors in handling learning situations	46.8%
Course content is closely linked to professional practice	18.8%
Desire for increased discussion of professional ethical situations	72.5%

Source: Authors’ survey results.

The results in Table 2 show that the manifestation of moral education at the level of behavior and application varies among students. Specifically, 46.8% of students frequently consider ethical factors when addressing learning situations; 18.8% believe that course content is closely connected to professional practice; while 72.5% express a desire for more discussion of professional ethical scenarios. These figures reflect students’ interest in educational forms that emphasize practical relevance and interactive engagement.

In addition, the activities of Party organizations, the Youth Union, and the Student Association continue to provide experiential environments for students to develop a sense of community responsibility and collective awareness [16], [17]. Together with the existing curriculum, these constitute the primary channels currently contributing to moral education at the university.

3.3. Major Limitations (An Internal–External Approach)

Based on survey findings, curriculum analysis, and a comparison with the requirements of moral education in the context of digital technology, the major limitations in implementation at the University of Technology – Thai Nguyen University can be identified across two dimensions: internal (endogenous) and external (exogenous). This approach highlights the relationship between the internal structure of training and the pressures for innovation arising from the external environment.

From the internal perspective, first, the level of integration between moral education and specialized training remains insufficiently clear. Moral education is currently delivered mainly through political theory courses, while its presence in disciplinary courses is still limited. As a result, learners tend to separate value awareness from professional practice; only 18.8% of students report that course content is closely linked to professional practice.

Second, the modernization of tools does not necessarily imply innovation in pedagogy. The adoption of LMS platforms, digital learning materials, and online assessment reflects the institution’s efforts to adapt; however, if technology merely supports traditional teaching methods, the effectiveness of moral education is unlikely to improve significantly. The fact that 72.5% of students express a desire for more discussion of professional ethical situations indicates a demand for dialogical and experiential learning approaches.

Third, moral education has not yet been closely aligned with learning outcomes and assessment mechanisms. Without being translated into concrete indicators—such as professional responsibility, safety compliance, or responsible decision-making—this component risks remaining largely formalistic.

From the external perspective, the most significant challenge arises from the rapid transformation of the technological and social environment. The development of artificial intelligence, big data, and automation has

generated new ethical issues, including data privacy, algorithmic bias, system safety, and environmental impact, requiring continuous updates in the content of moral education.

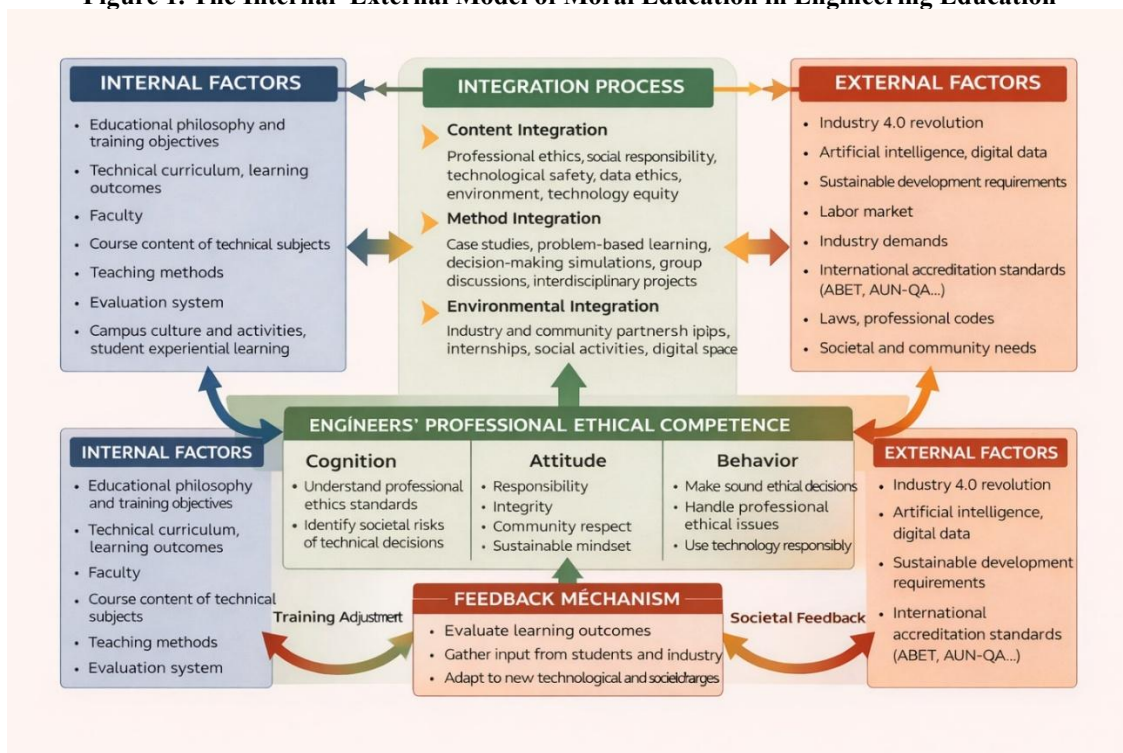
In addition, the demands of the labor market have changed considerably. Employers now require not only technically competent engineers but also professionals with a strong sense of responsibility, collaborative skills, and technological ethics. If training continues to prioritize technical knowledge alone, the gap between educational standards and professional expectations will widen.

Overall, the current limitation does not lie in a lack of awareness regarding the role of moral education, but rather in the lag of internal institutional mechanisms in responding to external pressures for change. Therefore, developing an integrated model of moral education in engineering education is an inevitable requirement for innovation in contemporary higher education.

IV. An Integrated Model of Moral Education in Engineering Education Based on Internal–External Linkages

Based on a systems approach, the integrated model of moral education in engineering education is proposed as follows:

Figure 1. The Internal–External Model of Moral Education in Engineering Education



As illustrated in Figure 1, the model is structured according to an input–process–output logic, combined with a feedback mechanism to ensure the system’s operation and continuous development. Accordingly, moral education is not treated as a separate component but as an integral part of the entire educational process, aimed at transforming values into professional competencies. A key feature of the model lies in conceptualizing educational effectiveness as the result of interaction between the institution’s internal (endogenous) factors and the external (exogenous) demands of the technological, social, and labor market environment.

At the input level, the model is shaped by two fundamental groups of factors. The internal group includes educational philosophy, curriculum design, teaching staff, instructional methods, and assessment mechanisms. Within this framework, Marxist–Leninist philosophy provides the worldview and methodological foundation guiding the educational process. The external group encompasses the contemporary techno-social context, including artificial intelligence, digital data, automation, sustainable development requirements, quality assurance standards, and labor market demands. These two groups of factors jointly determine the objectives and content of integration.

At the process level, integration is implemented across three main dimensions. First, content integration is achieved by incorporating issues such as professional ethics, social responsibility, technological safety, data ethics, and environmental concerns into disciplinary courses. Second, methodological integration is realized through approaches such as case studies, problem-based learning, critical discussions, and other forms of active

learning. Third, environmental integration is carried out through classroom activities, Youth Union and student association activities, industry internships, and experiential learning contexts. This constitutes the central stage of the model, where the institution’s internal resources are mobilized and transformed to meet external professional requirements.

At the output level, the model aims to develop students’ professional ethical competence, comprising three core components: awareness of ethical norms, value-based attitudes and beliefs, and the capacity to act appropriately in professional contexts. In other words, the intended outcome is not merely technically competent graduates, but individuals capable of applying their knowledge responsibly in relation to society.

The feedback mechanism plays a crucial role in refining the system. Through the assessment of learning outcomes, feedback from learners, employer input, accreditation requirements, and labor market dynamics, the curriculum, teaching methods, and integrated content are continuously adjusted. This demonstrates that the model operates not as a closed system but as one that dynamically adapts to external conditions.

In sum, the proposed model is grounded in solid theoretical foundations while also demonstrating practical applicability. Its core lies in establishing coherence between internal and external dimensions, between theory and practice, and between professional training and moral education—thereby contributing to the development of engineers capable of meeting the demands of the digital age.

V. Discussion

5.1. Comparison with International Models

5.1.1. Western Approaches to Engineering Ethics

In Western engineering education systems, engineering ethics has developed as a relatively independent field, focusing on establishing professional standards and decision-making competencies in specific situations. A typical manifestation is the development of professional codes of ethics, which emphasize principles such as public safety, professional integrity, and professional responsibility. For example, the National Society of Professional Engineers asserts that “engineers shall hold paramount the safety, health, and welfare of the public” [9].

At the systemic level, accreditation bodies such as ABET have integrated ethical requirements into program learning outcomes. Accordingly, graduates are expected to demonstrate “an ability to recognize ethical and professional responsibilities in engineering situations and make informed judgments considering global, economic, environmental, and societal contexts” [8, p. 5]. This indicates that Western approaches tend to emphasize the internal dimension of the subject—namely, individual judgment, personal responsibility, and norm-compliant behavior.

In terms of pedagogy, these models commonly employ case analysis, problem-based learning, and ethical debate to develop decision-making competencies. Michael Davis argues that professional ethics can be effectively taught through the analysis of real-world cases [10], while Caroline Whitbeck emphasizes that ethical issues in engineering should be approached as practical problems requiring reasoning and choice [11].

Overall, the Western approach highlights the standardization of professional norms and the development of individual decision-making capacity, thereby forming a highly practice-oriented model of moral education.

5.1.2. Distinctiveness of the Marxist–Leninist Approach

From the perspective of Marxist–Leninist philosophy, however, the above approach remains largely normative, focusing primarily on determining right and wrong behavior in specific situations based on predefined principles. While this approach offers clarity and practical applicability, it raises questions regarding the deeper origins of moral values.

In contrast, Marxist–Leninist philosophy conceives morality as a socio-historical phenomenon, closely linked to economic conditions and concrete relations of interest. As Karl Marx and Friedrich Engels noted, “social consciousness reflects social being” [1, p. 25]. This perspective allows ethical issues to be understood not only at the level of individual consciousness but also in relation to the broader structures of society, historical conditions, and technological environments.

At the same time, Marxist–Leninist philosophy emphasizes the dialectical relationship between the individual and society in professional conduct. Karl Marx argued that “the essence of human beings is the ensemble of social relations” [1, p. 11]. Accordingly, the responsibility of engineers is defined not only by individual obligations but also by the social, environmental, and collective impacts of technical decisions.

Another important distinction lies in the conception of the educational process. While Western models focus on analytical and decision-making skills, Marxist–Leninist philosophy emphasizes the transformation from cognition to action. Vladimir Ilyich Lenin pointed out that “the path from cognition to practice is the dialectical path of truth” [2, p. 179]. Thus, moral education is not only about helping learners “know what is right” but also about fostering the capacity for sustained ethical action in professional practice.

In essence, the fundamental difference between these two approaches lies not only in methodology but also in how they conceptualize the origin of moral behavior—whether it is primarily grounded in individual subjectivity or in broader social structures. These approaches are not mutually exclusive but complementary. While Western models provide practical tools for analyzing and addressing specific situations, Marxist–Leninist philosophy offers a theoretical foundation for explaining and orienting values. Their integration opens up the possibility of constructing a model of moral education that is both standardized and theoretically grounded, suitable for contemporary engineering education.

5.2. Practical Significance and Implications

In the context of higher education reform and digital transformation in Vietnam, integrating moral education into engineering training has significant implications at both the systemic and institutional levels.

At the general level, the Ministry of Education and Training emphasizes the comprehensive development of learners, in which moral qualities, social responsibility, and professional competence are essential components of learning outcomes [3], [4]. However, in practice, these requirements are still primarily implemented within political theory courses, while their integration into specialized training remains limited. This indicates that the internal structure of curricula has not yet kept pace with external demands from the labor market and digital society. Therefore, the proposed model contributes to repositioning moral education from a supplementary element to a core component of the entire training process. This approach is significant in developing engineers who are not only technically competent but also capable of making responsible decisions in complex technological contexts.

At the institutional level, the case of the University of Technology – Thai Nguyen University demonstrates the feasibility of the integrated model. First, the model allows for leveraging the existing foundation of political theory courses while extending ethical content into specialized engineering subjects. This is consistent with the university’s application-oriented training approach, where learning activities are closely linked to industrial practice [5], [7].

Moreover, the application of methods such as case studies, problem-based learning, and critical discussion can contribute to pedagogical innovation, enhance learners’ active roles, and reduce the gap between awareness and behavior identified in the survey findings [10], [11]. Given that the university has already implemented LMS platforms and digital learning resources, this approach is practically feasible [12], [13]. This suggests that when internal conditions are appropriately organized, external demands for innovation can be effectively transformed into substantive training capacity.

More importantly, the model can be integrated into quality assurance systems by incorporating criteria such as professional responsibility, data ethics, community awareness, and digital citizenship into learning outcomes and assessment tools. In this way, moral education moves beyond value dissemination and becomes a set of competencies that can be observed, measured, and evaluated throughout the training process [14], [15]. This also creates alignment between institutional objectives and external societal and labor market expectations.

VI. Conclusion

In the context of rapid scientific and technological development and digital transformation, engineering education can no longer be limited to the transmission of specialized knowledge but must aim to cultivate learners’ capacity for responsible action. Issues such as technological safety, data security, and environmental impact demonstrate that moral education is no longer supplementary but an essential requirement of modern engineering practice. From the perspective of Marxist–Leninist philosophy, separating moral education from professional training would limit the transformation of knowledge into responsible professional behavior.

On this basis, the study has clarified the theoretical foundations and proposed an integrated model of moral education based on a systems approach encompassing input–process–output. The model emphasizes the linkage between the institution’s internal factors and the external demands of society and the labor market. The case of the University of Technology – Thai Nguyen University shows that this approach is feasible, particularly in connecting political theory courses with specialized training and promoting pedagogical innovation.

Based on the research findings, higher education institutions need to shift from a “supplementary” to an “integrative” approach, embedding moral education as a core component of curricula and learning outcomes. At the same time, it is necessary to strengthen practice-oriented teaching methods such as ethical case studies, problem-based learning, and experiential learning. More broadly, integrating moral education into engineering education contributes to the development of high-quality human resources capable of meeting the demands of the knowledge economy and digital society.

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