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Professional Ethics in Computing Education: A Qualitative Inquiry into Students' Ethical Reasoning Development

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Abstract: The increasing societal impact of computing technologies has intensified the need for robust ethics education within computing disciplines. This study investigates the development of ethical reasoning among students through a qualitative inquiry based on secondary data, including scholarly literature, institutional frameworks, and policy documents. Grounded in Kohlberg's theory of moral development, Rest's Four-Component Model, and constructivist learning theory, the research examines how ethical reasoning is conceptualised, taught, and developed in computing education. The findings reveal that ethical reasoning is a multidimensional construct encompassing cognitive, affective, and behavioural dimensions, shaped by pedagogical practices such as case-based learning, experiential engagement, and reflective activities. Furthermore, curriculum integration, institutional support, and cultural context significantly influence students' ethical development. Despite progress, persistent challenges include fragmented curricula, limited assessment mechanisms, and insufficient practical exposure. The study underscores the importance of adopting interdisciplinary and context-sensitive approaches to ethics education, emphasising the need for sustained curricular reform and innovative pedagogical strategies. These insights contribute to advancing professional ethics education and preparing socially responsible computing graduates.

Keywords: Computing ethics; ethical reasoning; higher education; qualitative research; moral development; ICT education; professional responsibility

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1. Introduction

The unprecedented expansion of digital technologies in the 21st century has profoundly reshaped human interaction, governance, economic systems, and knowledge production. Computing technologies, ranging from artificial intelligence (AI) and big data analytics to cybersecurity infrastructures and cloud computing, have become deeply embedded in nearly every domain of modern life. While these technologies offer transformative benefits, they also generate complex ethical challenges that demand critical reflection and responsible decision-making from computing professionals (Floridi et al., 2018). As a result, the cultivation of professional ethics in computing education has emerged as a central concern for educators, policymakers, and professional bodies worldwide.

Professional ethics in computing education refers to the systematic integration of ethical principles, values, and decision-making frameworks within computing curricula to prepare students for responsible professional practice. These ethical principles encompass issues such as data privacy, algorithmic bias, intellectual property, digital surveillance, environmental sustainability, and social justice (Johnson, 2015). The ethical implications of computing are no longer confined to technical domains; rather, they intersect with broader societal concerns, including human rights, democratic governance, and global equity (Brey, 2012). Consequently, computing education must move beyond purely technical instruction to foster ethically informed and socially responsible graduates.

The importance of ethics in computing is underscored by numerous real-world incidents involving misuse or unintended consequences of technology. Cases of data breaches, algorithmic discrimination, and misinformation campaigns illustrate how inadequate ethical awareness among computing professionals can lead to significant harm (Martin et al., 2019). For example, biased AI systems have been shown to perpetuate racial and gender inequalities, raising questions about accountability and fairness in algorithmic decision-making (Nissenbaum, 2010). These challenges highlight the need for educational interventions that equip students with the ability to critically evaluate the ethical dimensions of their work.

Despite growing recognition of its importance, the integration of ethics into computing education remains uneven and fragmented. Some institutions offer dedicated ethics courses, while others incorporate ethical discussions into technical modules. However, there is limited consensus on the most effective pedagogical approaches for fostering ethical reasoning among students (Fiesler et al., 2020). Traditional lecture-based methods often fail to engage students in meaningful ethical reflection, whereas more interactive approaches, such as case-based learning and experiential projects, have shown greater promise in promoting ethical understanding (Herkert, 2005).

Ethical reasoning, a core component of professional ethics, involves the ability to

identify ethical issues, evaluate alternative courses of action, and make decisions based on moral principles. It is a complex cognitive and affective process that develops over time through education, experience, and social interaction (Rest, 1986). The development of ethical reasoning in computing students is particularly challenging due to the abstract and rapidly evolving nature of technological systems. Students must learn to anticipate the societal impacts of technologies that may not yet be fully realised, requiring both critical thinking and moral imagination (Floridi et al., 2018).

Theoretical perspectives on moral development provide valuable insights into how ethical reasoning evolves. Kohlberg's (1981) stage theory suggests that individuals progress from rule-based reasoning to principled moral judgment, while Rest's (1986) Four-Component Model emphasises the interplay of moral sensitivity, judgment, motivation, and character. These frameworks highlight that ethical competence is not merely about knowing ethical rules but involves the ability to apply them in contextually complex situations.

In addition to individual cognitive development, social and cultural factors play a significant role in shaping ethical reasoning. Constructivist learning theory posits that knowledge is constructed through interaction with others and engagement with real-world experiences (Vygotsky, 1978). In computing education, this implies that students develop ethical understanding through collaborative learning, discussion of case studies, and reflection on practical experiences. Furthermore, cultural context influences ethical perceptions and decision-making processes, necessitating a more inclusive and globally aware approach to ethics education (Ess, 2006).

This study seeks to explore the development of ethical reasoning among computing students through a qualitative inquiry based on secondary data. By synthesising existing literature, policy documents, and curricular frameworks, the research aims to provide a comprehensive understanding of how ethics is conceptualised and taught in computing education. The study addresses the following research questions:

- How is ethical reasoning conceptualised in computing education literature?
- What pedagogical approaches are employed to foster ethical reasoning among students?
- What factors influence the development of ethical reasoning in computing students?
- What gaps and challenges exist in current ethics education practices?

The significance of this study lies in its potential to inform curriculum design, teaching strategies, and policy development in computing education. By identifying effective practices and existing gaps, the research contributes to the advancement of ethics education and supports the development of ethically responsible computing professionals.

2. Literature Review

Professional ethics in computing is grounded in normative ethical theories, including

deontology, utilitarianism, and virtue ethics, which provide frameworks for evaluating moral actions (Johnson, 2015). Deontological approaches emphasise adherence to rules and duties, while utilitarian perspectives focus on maximising overall benefits. Virtue ethics, on the other hand, highlights the importance of moral character and integrity.

In the context of computing, these theoretical perspectives are operationalised through professional codes of conduct, such as the ACM Code of Ethics (ACM, 2018). These codes articulate principles such as honesty, fairness, respect for privacy, and responsibility to society. However, critics argue that codes alone are insufficient to guide ethical behaviour, as they may not adequately address complex and context-specific dilemmas (Gotterbarn et al., 2017).

Floridi et al. (2018) propose an information ethics framework that conceptualises ethical issues in terms of information flows and the moral value of information entities. This approach is particularly relevant in the digital age, where data-driven technologies play a central role in decision-making processes. Similarly, Nissenbaum's (2010) theory of contextual integrity emphasises the importance of maintaining appropriate information flows within specific social contexts, providing a nuanced understanding of privacy and data ethics.

2.1 Ethical Reasoning and Moral Development Theories

Ethical reasoning is a central construct in ethics education, encompassing the ability to analyse moral dilemmas and justify decisions based on ethical principles. Kohlberg's (1981) theory of moral development remains one of the most influential frameworks in this area. According to Kohlberg, individuals progress through six stages of moral reasoning, ranging from obedience to authority (Stage 1) to adherence to universal ethical principles (Stage 6).

While Kohlberg's model has been widely applied in educational research, it has also been critiqued for its emphasis on justice-based reasoning and its limited consideration of cultural diversity (Gilligan, 1982). Gilligan's ethics of care framework offers an alternative perspective, emphasising relationships, empathy, and responsibility for others.

Rest (1986) expanded on Kohlberg's work by introducing the Four-Component Model, which includes moral sensitivity, moral judgment, moral motivation, and moral character. This model provides a more comprehensive understanding of ethical behaviour, highlighting that reasoning alone is insufficient without the motivation to act ethically.

Empirical studies have shown that ethical reasoning can be developed through targeted educational interventions. For example, Bebeau and Thoma (2003) demonstrated that structured ethics education programs can significantly enhance students' moral judgment. However, the extent of this development varies depending on pedagogical approaches and contextual factors.

2.2 Pedagogical Approaches in Computing Ethics Education

The literature identifies several pedagogical strategies for teaching ethics in computing, each with varying degrees of effectiveness.

2.3.1 Case-Based Learning

Case-based learning is one of the most widely used approaches in ethics education. It involves presenting students with real or hypothetical scenarios that require ethical analysis and decision-making. This method encourages critical thinking and allows students to explore multiple perspectives (Herkert, 2005).

Fiesler et al. (2020) found that case studies related to current technological issues, such as social media algorithms and data privacy, are particularly effective in engaging students. By situating ethical dilemmas in real-world contexts, case-based learning enhances students' ability to apply ethical principles in practice.

2.3.2 Experiential and Project-Based Learning

Experiential learning approaches, including project-based learning and service learning, provide students with opportunities to engage with ethical issues in real-world settings. These methods align with constructivist principles, emphasising active participation and reflection (Kolb, 1984).

Studies indicate that experiential learning fosters deeper ethical understanding by connecting theoretical knowledge with practical application (Brey, 2012). For example, students working on software development projects may encounter ethical issues related to user privacy and data security, prompting reflection and discussion.

2.3.3 Interdisciplinary and Integrated Approaches

Integrating ethics across the curriculum rather than confining it to a single course has been advocated as a more effective approach. Interdisciplinary teaching, combining computing with fields such as philosophy, law, and sociology, provides a broader perspective on ethical issues (Martin et al., 2019).

This approach reflects the complex and multifaceted nature of ethical challenges in computing, which often require knowledge beyond technical expertise. However, implementing interdisciplinary curricula can be challenging due to institutional constraints and limited faculty expertise.

2.3.4 Reflective Practices

Reflective writing and discussion are essential components of ethics education, enabling students to internalise ethical principles and examine their own values. Reflection encourages metacognition and supports the development of moral identity (Moon, 2004).

2.4 Factors Influencing Ethical Reasoning Development

The development of ethical reasoning is influenced by a range of individual, educational, and contextual factors.

2.4.1 Curriculum Design and Institutional Support

Curriculum structure plays a critical role in shaping ethical learning outcomes. Programs

that integrate ethics throughout the curriculum tend to produce higher levels of ethical reasoning compared to those with isolated ethics courses (Fiesler et al., 2020).

Institutional support, including faculty training and resource allocation, is also essential for effective ethics education.

2.4.2 Cultural and Social Context

Ethical reasoning is not culturally neutral; it is shaped by social norms, values, and experiences. Cross-cultural studies highlight differences in ethical perspectives, emphasising the need for culturally responsive pedagogy (Ess, 2006).

2.4.3 Technological Context

The rapidly evolving nature of technology introduces new ethical challenges, requiring continuous adaptation of curricula. Emerging fields such as AI ethics and data governance demand updated educational frameworks (Floridi et al., 2018).

2.5 Challenges and Gaps in Existing Literature

Despite extensive research, several gaps remain:

- Lack of standardised assessment tools for ethical reasoning
- Limited empirical studies in diverse cultural contexts
- Insufficient integration of ethics in technical courses
- Need for longitudinal studies on ethical development

Addressing these gaps is essential for advancing ethics education in computing.

3. Theoretical Framework

The development of ethical reasoning in computing education is a complex, multidimensional process that cannot be adequately explained by a single theoretical lens. This study adopts an integrative theoretical framework combining Kohlberg's Theory of Moral Development, Rest's Four-Component Model, and Constructivist Learning Theory. Together, these frameworks provide a comprehensive understanding of how students acquire, interpret, and apply ethical principles within computing contexts.

3.1 Kohlberg's Theory of Moral Development

Kohlberg's (1981) theory of moral development remains one of the most influential frameworks for understanding ethical reasoning. According to Kohlberg, individuals progress through three levels of moral development,pre-conventional, conventional, and post-conventional, each consisting of two stages. At the pre-conventional level, moral reasoning is guided by obedience to authority and avoidance of punishment. The conventional level is characterised by conformity to social norms and the desire to maintain social order. At the post-conventional level, individuals develop the capacity for abstract reasoning based on universal ethical principles such as justice, fairness, and human rights.

In the context of computing education, Kohlberg's framework is particularly useful for analysing how students transition from rule-based thinking (e.g., adhering to institutional policies or codes of conduct) to principled reasoning (e.g., critically

evaluating the societal implications of technology). For example, a student operating at a conventional level may follow data privacy regulations because they are required, whereas a student at a post-conventional level may question whether those regulations adequately protect vulnerable populations.

However, Kohlberg's model has been subject to criticism, particularly for its emphasis on justice-oriented reasoning and its limited consideration of cultural and contextual diversity (Gilligan, 1982). In computing ethics, where dilemmas often involve competing values such as privacy, security, and innovation, a more nuanced understanding of moral reasoning is required. Nevertheless, Kohlberg's framework provides a valuable foundation for examining the progression of ethical reasoning among students.

3.2 Rest's Four-Component Model

To address some of the limitations of Kohlberg's theory, Rest (1986) proposed the Four-Component Model of moral behaviour, which expands the focus beyond moral judgment to include additional psychological processes. According to this model, ethical action is the result of four interrelated components:

- **Moral Sensitivity** - the ability to recognise the presence of an ethical issue and understand its implications for others.
- **Moral Judgment** - the capacity to determine the most ethically justifiable course of action.
- **Moral Motivation** - the prioritisation of ethical values over competing interests such as personal gain or convenience.
- **Moral Character** - the ability to implement ethical decisions through perseverance and integrity.

This model is particularly relevant in computing education, where students must not only identify ethical issues (e.g., algorithmic bias or data misuse) but also make decisions and act upon them in professional settings. For instance, a student may recognise that a machine learning model is biased (moral sensitivity) and understand that it should be corrected (moral judgment), but may lack the motivation or courage to challenge organisational practices (moral motivation and character).

Empirical research supports the applicability of Rest's model in educational contexts, demonstrating that ethics instruction can enhance different components of moral development (Bebeau & Thoma, 2003). In computing education, this suggests the need for pedagogical approaches that address all four components, rather than focusing solely on cognitive reasoning.

3.3 Constructivist Learning Theory

Constructivist learning theory provides a pedagogical perspective on how ethical reasoning is developed through educational experiences. Rooted in the work of Piaget (1972) and Vygotsky (1978), constructivism posits that learners actively construct knowledge through interaction with their environment, rather than passively receiving information.

In the context of ethics education, constructivism emphasises the importance of experiential learning, social interaction, and reflection. Students develop ethical understanding by engaging with real-world problems, discussing diverse perspectives, and reflecting on their own values and assumptions. For example, case-based learning and group discussions allow students to explore ethical dilemmas collaboratively, thereby deepening their understanding of complex issues (Kolb, 1984).

Vygotsky's concept of the Zone of Proximal Development (ZPD) is particularly relevant, as it highlights the role of social interaction and guidance in learning. Instructors and peers can facilitate ethical reasoning by providing scaffolding, prompting critical thinking, and encouraging dialogue. This aligns with the notion that ethical reasoning is not only an individual cognitive process but also a socially mediated activity.

Constructivist approaches are especially important in computing education due to the rapidly evolving nature of technology. Students must learn to adapt ethical principles to new and unforeseen situations, which requires flexibility, creativity, and critical reflection.

3.4 Integrative Theoretical Model

By integrating Kohlberg's developmental stages, Rest's psychological components, and constructivist learning principles, this study conceptualises ethical reasoning development as a dynamic, iterative, and context-dependent process. This integrative model recognises that:

- Ethical reasoning evolves through stages of cognitive development (Kohlberg, 1981).
- Ethical behaviour involves multiple psychological processes beyond reasoning (Rest, 1986).
- Ethical understanding is constructed through interaction, experience, and reflection (Vygotsky, 1978; Kolb, 1984).

This framework provides a robust foundation for analysing how computing students develop ethical competence and how educational practices can support this development. It also underscores the importance of designing curricula that address cognitive, emotional, and social dimensions of ethical learning.

4. Methodology

This study adopts a qualitative research design based on secondary data analysis to explore the development of ethical reasoning in computing education. Qualitative research is particularly suitable for investigating complex, context-dependent phenomena such as ethical reasoning, which involves subjective interpretations, values, and experiences (Creswell & Poth, 2018). By focusing on secondary data, the study synthesises existing knowledge to generate new insights and identify patterns across diverse contexts.

Secondary qualitative analysis involves the systematic examination of existing data sources, including published research, policy documents, and institutional reports (Johnston, 2017). This approach allows for a

comprehensive exploration of the topic without the constraints of primary data collection, while also enabling the integration of findings from multiple studies.

4.1 Data Sources and Selection Criteria

The study draws on a wide range of secondary data sources, including:

- Peer-reviewed journal articles
- Academic books and book chapters
- Conference proceedings
- Institutional and policy reports (e.g., ACM/IEEE curriculum guidelines)
- Educational frameworks and teaching resources

To ensure relevance and quality, the following inclusion criteria were applied:

- Publications focused on computing ethics, ICT education, or ethical reasoning
- Studies addressing higher education contexts
- Peer-reviewed or authoritative sources published within the last two decades (with seminal works included regardless of date)
- English-language publications

Exclusion criteria included non-scholarly sources, opinion pieces without empirical or theoretical grounding, and studies unrelated to computing or ethics education.

4.3 Data Collection Procedure

Data were collected through systematic searches of academic databases, including Google Scholar, Scopus, and Web of Science. Keywords used in the search process included:

- "computing ethics education"
- "ethical reasoning development"
- "ICT ethics curriculum"
- "moral development in higher education"
- "professional ethics in computer science"

The search process involved iterative refinement, with initial results screened based on titles and abstracts, followed by full-text review. Reference lists of selected articles were also examined to identify additional relevant sources (snowball sampling).

4.4 Data Analysis: Thematic Analysis

The study employs thematic analysis, a widely used qualitative method for identifying, analysing, and interpreting patterns within data (Braun & Clarke, 2006). The analysis followed a six-phase process:

- **Familiarisation** - Reading and re-reading the data to gain an overall understanding
- **Initial Coding** - Identifying meaningful units of text related to ethical reasoning
- **Theme Development** - Grouping codes into broader themes (e.g., pedagogical approaches, influencing factors)
- **Reviewing Themes** - Refining themes to ensure coherence and relevance

- **Defining and Naming Themes** - Clearly articulating the scope and meaning of each theme
- **Interpretation** - Linking themes to the theoretical framework and research questions

This systematic approach ensures that the analysis is both rigorous and transparent.

4.5 Trustworthiness and Rigour

To enhance the credibility and reliability of the study, several strategies were employed:

- **Triangulation**: Using multiple data sources to validate findings (Creswell & Poth, 2018)
- **Transparency**: documentation of data collection and analysis
- **Peer-reviewed sources**: Ensuring the quality and validity of data
- **Reflexivity**: Acknowledging potential biases in interpretation

These measures contribute to the trustworthiness of the research and strengthen the validity of its conclusions.

4.6 Ethical Considerations

As the study relies exclusively on secondary data, it does not involve direct interaction with human participants and therefore does not require formal ethical approval. However, ethical considerations remain important in terms of:

- Proper citation and acknowledgement of original authors
- Accurate representation of findings (Mannan & Farhana, 2026)
- Avoidance of plagiarism

The study adheres to academic integrity standards and follows APA (7th ed.) guidelines for referencing.

4.6 Limitations of the Study

While secondary data analysis offers several advantages, it also has limitations:

- Dependence on the scope and quality of existing literature
- Lack of direct engagement with participants
- Potential bias in source selection

These limitations are acknowledged, and the findings are interpreted within the context of these constraints.

5. Findings and Analysis

The thematic analysis of secondary data reveals that the development of ethical reasoning in computing education is a multifaceted, iterative, and context-sensitive process. The findings are organised into four major thematic domains: conceptualisation of ethical reasoning, pedagogical practices, influencing factors, and structural and pedagogical gaps. Each theme is critically analysed in light of the theoretical framework adopted in this study.

5.1 Ethical Reasoning as a Multidimensional Construct

The literature consistently conceptualises ethical reasoning as a multidimensional construct encompassing cognitive, affective, and behavioural components. It is not merely the ability to identify ethical rules but involves the capacity to interpret complex scenarios, evaluate competing values, and act

in accordance with ethical principles (Rest, 1986). This aligns with Rest's Four-Component Model, which emphasises that ethical competence includes moral sensitivity, judgment, motivation, and character.

From a cognitive perspective, ethical reasoning requires critical thinking and analytical skills to assess the implications of technological decisions. Students must engage in abstract reasoning, particularly when dealing with emerging technologies such as artificial intelligence and data analytics, where ethical consequences may not be immediately visible (Floridi et al., 2018). This corresponds with the higher stages of Kohlberg's (1981) moral development, where individuals apply universal ethical principles rather than merely adhering to rules.

The affective dimension of ethical reasoning involves empathy, moral concern, and emotional engagement with ethical issues. Studies indicate that students who demonstrate higher levels of empathy are more likely to consider the social impact of their technological decisions (Gilligan, 1982). This highlights the importance of integrating affective learning into computing education, which has traditionally focused on technical skills.

The behavioural dimension involves the translation of ethical reasoning into action. This aspect is particularly challenging, as students may recognise ethical issues but fail to act due to external pressures or lack of confidence. This gap between knowledge and action underscores the importance of moral motivation and character, as emphasised by Rest (1986).

Overall, the findings suggest that ethical reasoning development requires a holistic approach that addresses cognitive, emotional, and behavioural dimensions simultaneously.

5.2 Pedagogical Approaches to Ethics Education

5.2.1 Case-Based Learning as a Core Strategy

Case-based learning emerges as one of the most effective pedagogical approaches for fostering ethical reasoning in computing education. By presenting students with realistic scenarios, case studies enable them to engage with complex ethical dilemmas and explore multiple perspectives (Herkert, 2005).

The analysis indicates that contemporary case studies often focus on issues such as data privacy, algorithmic bias, and social media ethics, which are highly relevant to students' experiences (Fiesler et al., 2020). These cases encourage students to move beyond theoretical knowledge and apply ethical principles in practical contexts, thereby facilitating deeper learning.

From a constructivist perspective, case-based learning supports knowledge construction through active engagement and social interaction. Students collaboratively analyse scenarios, debate alternative solutions, and reflect on their reasoning processes. This aligns with Vygotsky's (1978) emphasis on social learning and the co-construction of knowledge.

5.2.2 Experiential and Project-Based Learning

Experiential learning approaches, including project-based learning and service learning, play a critical role in ethical reasoning development. These approaches provide students with opportunities to encounter ethical issues in real-world contexts, thereby bridging the gap between theory and practice (Kolb, 1984).

For example, students working on software development projects may face ethical decisions related to user privacy, data security, and system transparency. Such experiences require them to apply ethical principles in dynamic and uncertain environments, enhancing their problem-solving and decision-making skills (Brey, 2012).

The findings suggest that experiential learning not only enhances cognitive understanding but also strengthens moral motivation and character by fostering a sense of responsibility and accountability.

5.2.3 Interdisciplinary and Integrated Curriculum Approaches

The integration of ethics across the computing curriculum is identified as a key factor in effective ethics education. Rather than confining ethics to a standalone course, interdisciplinary approaches embed ethical considerations within technical subjects, enabling students to see the relevance of ethics in their field (Martin et al., 2019).

For instance, discussions of algorithmic fairness can be incorporated into machine learning courses, while issues of cybersecurity ethics can be addressed in network security modules. This integrated approach reinforces the idea that ethics is an integral part of professional practice, rather than an optional add-on.

However, the implementation of interdisciplinary curricula faces challenges, including limited faculty expertise and institutional constraints. Despite these challenges, the literature suggests that integrated approaches are more effective in promoting sustained ethical engagement.

5.2.4 Reflective Practices and Moral Identity Formation

Reflective practices, such as journaling and group discussions, are essential for developing ethical awareness and moral identity. Reflection allows students to examine their values, question assumptions, and internalise ethical principles (Moon, 2004).

The analysis indicates that reflective practices are particularly effective when combined with experiential learning, as they enable students to process their experiences and derive meaningful insights. This aligns with constructivist theories, which emphasise the role of reflection in knowledge construction.

5.3 Factors Influencing Ethical Reasoning Development

5.3.1 Curriculum Design and Institutional Support

Curriculum design plays a central role in shaping ethical reasoning outcomes. Programs that integrate ethics throughout the

curriculum tend to produce higher levels of ethical competence compared to those with isolated ethics courses (Fiesler et al., 2020).

Institutional support, including faculty training and resource allocation, is also critical. Educators must be equipped with the knowledge and skills to teach ethics effectively, which requires ongoing professional development.

5.3.2 Cultural and Contextual Influences

Ethical reasoning is influenced by cultural and social contexts, which shape individuals' values and perspectives. Cross-cultural studies highlight differences in ethical priorities, such as the emphasis on individual rights versus collective welfare (Ess, 2006).

In computing education, this implies the need for culturally responsive pedagogy that acknowledges diverse perspectives and promotes inclusive ethical discussions. Students must be encouraged to consider the global implications of technology, particularly in an increasingly interconnected world.

5.3.3 Technological Complexity and Uncertainty

The rapid pace of technological change presents significant challenges for ethics education. Emerging technologies such as AI and big data introduce new ethical dilemmas that may not be adequately addressed by existing frameworks (Floridi et al., 2018).

Students must develop the ability to anticipate and respond to unforeseen ethical issues, which requires flexibility, creativity, and critical thinking. This highlights the importance of teaching ethical reasoning as a dynamic and adaptive process.

5.4 Gaps and Limitations in Current Practices

Despite advancements in ethics education, several gaps persist:

- **Lack of standardised assessment tools:** Measuring ethical reasoning remains a challenge, as existing tools may not capture the complexity of ethical decision-making.
- **Limited practical exposure:** Many programs lack opportunities for students to engage with real-world ethical issues.
- **Insufficient integration:** Ethics is often treated as a peripheral subject rather than a core component of computing education.
- **Neglect of cultural diversity:** Ethical frameworks are often based on Western perspectives, limiting their applicability in diverse contexts.

These gaps highlight the need for more comprehensive and inclusive approaches to ethics education.

6. Discussion

The findings of this study provide important insights into the development of ethical reasoning in computing education, highlighting both strengths and limitations of current practices. This section interprets the findings in relation to the theoretical framework and broader literature, offering critical reflections and implications.

6.1 Ethical Reasoning as a Developmental and Contextual Process

The findings support the view that ethical reasoning is a developmental process that evolves, consistent with Kohlberg's (1981) theory. Students progress from rule-based thinking to more sophisticated forms of reasoning that involve abstract principles and critical evaluation.

However, the development of ethical reasoning is not linear or uniform. It is influenced by a range of factors, including educational experiences, social interactions, and cultural contexts. This aligns with constructivist perspectives, which emphasise the role of context and interaction in learning (Vygotsky, 1978).

Rest's (1986) Four-Component Model provides a useful framework for understanding the multidimensional nature of ethical reasoning. The findings suggest that effective ethics education must address all four components, sensitivity, judgment, motivation, and character, rather than focusing solely on cognitive aspects.

6.2 The Role of Pedagogy in Ethical Development

The analysis highlights the importance of pedagogical approaches in shaping ethical reasoning outcomes. Interactive and experiential methods, such as case-based and project-based learning, are more effective than traditional lecture-based approaches.

These findings are consistent with previous research, which emphasises the value of active learning in ethics education (Herkert, 2005). By engaging students in real-world scenarios, these methods promote deeper understanding and facilitate the application of ethical principles.

However, the effectiveness of these approaches depends on their implementation. Poorly designed case studies or a lack of guidance can limit their impact. Therefore, educators must carefully design and facilitate learning activities to maximise their effectiveness.

6.3 Integration of Ethics in Computing Curricula

The integration of ethics across the curriculum emerges as a key factor in promoting ethical reasoning. This approach aligns with the interdisciplinary nature of computing ethics, which requires knowledge from multiple domains.

Despite its benefits, integration remains a challenge due to institutional constraints and disciplinary silos. Addressing this challenge requires collaboration among faculty members and support from institutional leadership.

6.4 Cultural and Global Dimensions of Ethics Education

The findings underscore the importance of cultural context in ethical reasoning. In a globalised world, computing professionals must navigate diverse ethical frameworks and values.

This highlights the need for culturally responsive pedagogy that incorporates diverse perspectives and promotes intercultural understanding (Ess, 2006). Ethics education should not be limited to

Western frameworks but should reflect the global nature of computing.

6.5 Implications for Policy and Practice

The study has several implications:

- **Curriculum reform:** Ethics should be integrated across all levels of computing education.
- **Faculty development:** Educators need training in ethics pedagogy.
- **Assessment innovation:** New tools are needed to measure ethical reasoning effectively.
- **Global perspective:** Ethics education should incorporate diverse cultural perspectives.

6.6 Future Research Directions

Future research should focus on empirical studies involving students to validate these findings. Longitudinal studies are particularly needed to examine the development of ethical reasoning over time.

7. Conclusion

This study has examined the development of ethical reasoning in computing education through a qualitative analysis of secondary data, offering a comprehensive synthesis of theoretical perspectives, pedagogical practices, and contextual influences. The findings affirm that ethical reasoning is not a static or purely cognitive ability but a dynamic, multidimensional process shaped by intellectual growth, emotional engagement, and social interaction. Drawing on Kohlberg's (1981) theory, Rest's (1986) Four-Component Model, and constructivist learning principles, the study demonstrates that effective ethics education must address not only moral judgment but also moral sensitivity, motivation, and character.

A key conclusion emerging from this study is the critical importance of integrating ethics throughout the computing curriculum. Isolated ethics courses, while valuable, are insufficient to foster sustained ethical awareness and application. Instead, embedding ethical considerations within technical subjects enables students to recognise the relevance of ethics in real-world computing practices. Pedagogical strategies such as case-based learning, experiential projects, and reflective exercises have proven particularly effective in promoting deeper engagement and critical thinking.

The study also highlights the influence of broader contextual factors, including institutional support, cultural diversity, and the evolving technological landscape. Ethical reasoning is shaped by cultural values and social norms, underscoring the need for globally inclusive and context-sensitive approaches to ethics education. Moreover, the rapid advancement of technologies such as artificial intelligence and big data necessitates continuous adaptation of ethical frameworks and teaching methodologies.

Despite these insights, significant challenges remain. The lack of standardised assessment tools limits the ability to measure ethical development effectively, while insufficient practical exposure reduces opportunities for students to apply ethical principles in authentic contexts. Addressing these gaps

requires coordinated efforts among educators, institutions, and policymakers.

In conclusion, the study underscores the imperative of rethinking ethics education in computing as a holistic, integrated, and evolving process. By adopting interdisciplinary approaches, enhancing pedagogical innovation, and fostering a culture of ethical responsibility, educational institutions can better prepare students to navigate the complex moral challenges of the digital age. Future research should build on these findings through empirical and longitudinal studies to further advance the field of computing ethics education.

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