



The Ethics and Moral Values in Digital Education: A Cluster-Based Exploration of Student Perspectives

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ABSTRACT

As digital education continues to expand, ethical concerns such as data privacy, academic integrity, accessibility, ethical awareness, and moral values have become increasingly important. This study aims to examine students' perceptions of these ethical dimensions in digital learning environments using a quantitative research design with a cross-sectional survey methodology. Data were collected from 193 students at two educational institutions in Kazakhstan. An online survey, administered via Google Forms, allowed students to participate voluntarily and anonymously. Using cluster analysis with the Hartigan-Wong k-means algorithm, three distinct student groups were identified based on their ethical awareness and moral values. Cluster 1 showed moderate-to-high agreement with ethical principles, Cluster 2 showed the lowest ethical awareness, particularly regarding data privacy and accessibility, and Cluster 3 showed the highest ethical agreement, reflecting strong institutional support and digital literacy. The study identifies data privacy and accessibility as the most pressing concerns, with students expressing unease about personal data management and the inclusivity of digital learning platforms. Findings reveal significant differences in ethical preparedness among students, indicating that institutional policies, digital literacy levels, and socio-economic factors play a key role in shaping ethical perspectives. The study recommends targeted ethics training, improved accessibility policies, and enhanced data protection measures to foster a more equitable and ethically aware digital learning environment.

KEYWORDS

Ethics and moral values; cluster analyses; digital education; student perspectives.

INTRODUCTION

The rapid expansion of digital education has transformed traditional learning methods, creating an ecosystem where technology and pedagogy intersect in dynamic ways. This shift has enabled broader access to education and the adoption of innovative instructional strategies (Cabezas-González et al., 2024; Hamakali & Josua, 2023; Moldagali et al., 2022; Tamimi, 2024). However, it also raises complex ethical concerns that warrant scholarly attention (Balta, 2023; Olcott et al., 2015; Regan & Jesse, 2019). Studies highlight challenges related to data privacy, emphasizing the risks of widespread data collection and the necessity for strong protection mechanisms (Regan & Jesse, 2019). Researchers have also examined academic integrity, noting that digital assessments introduce distinct vulnerabilities to dishonest practices (Dennis & Harrison, 2021; Okka, 2024; Simelane & Pillay, 2024). Accessibility remains a critical issue, with evidence showing that unequal access to technology exacerbates educational disparities (Dyantyi & Mkabile-Masebe, 2025; Mohale, 2024; Olcott et al., 2015; Pietersen et al., 2023).

This study addresses this gap by examining how university students in Kazakhstan perceive and respond to ethical challenges in digital education. The purpose is to identify key issues, analyze the factors affecting ethical awareness, and propose solutions. By focusing on learners' distinct perspectives, the research provides a comprehensive understanding of digital education. The study is structured to include a detailed examination of four primary dimensions: data privacy, academic integrity, accessibility, and ethical preparedness. Each dimension is explored through surveys to ensure alignment and comparability. The novelty of this research lies in its context-specific focus on Kazakhstan, a region where digital education is rapidly evolving but remains underexplored in global literature. By contributing empirical evidence, the study offers a unique perspective that enriches the broader discourse on ethical issues in digital education.

Digital education has transformed teaching and learning, offering unprecedented opportunities for accessibility, flexibility, and innovation. However, the rapid adoption of digital tools and platforms has also introduced substantial ethical challenges that educators and institutions must address. These include concerns related to data privacy, academic integrity, accessibility, and the equitable use of technology (Mâță & Ghiațău, 2019; Olcott et al., 2015). One pressing concern is data privacy. With the proliferation of learning management systems and AI-driven educational technologies, sensitive student data are being collected and analyzed at an unprecedented scale. Studies emphasize the need for stringent data protection measures and ethical guidelines to prevent misuse (Mouta et al., 2024). Similarly, academic integrity faces new threats in the digital age, as online assessments and plagiarism detection tools present unique challenges for ensuring fairness and honesty in student evaluations (Balida, 2023).

Accessibility and equity are also key concerns. While digital education has the potential to democratize learning, it can exacerbate inequalities if access to technology and the internet is not universally available. Research highlights the importance of designing inclusive digital platforms that address diverse learner needs (Olcott et al., 2015; Pushpanadham et al., 2023).

Moreover, educators often feel unprepared to navigate these ethical complexities, pointing to a gap in professional training and development (Clipa et al., 2022; Măță & Ghițău, 2019). Moral values such as fairness, honesty, respect, equality, and responsibility form the ethical foundation of human interaction and decision-making, including within digital education. These values guide behavior and affect how students and teachers perceive and address challenges in virtual learning environments (Dennis & Harrison, 2021; Eaton, 2020; Regan & Jesse, 2019). For example, fairness and honesty are essential for fostering trust and maintaining academic integrity in online assessments, while respect and equality are central to ensuring inclusive and equitable access to digital resources (Dennis & Harrison, 2021). The integration of moral values into digital education is critical as technological tools such as artificial intelligence (AI) and learning analytics become more prominent. While these tools enhance educational experiences, they also raise concerns about transparency and fairness, requiring a strong moral framework to address such issues (Regan & Jesse, 2019). Emphasizing moral values in digital education can help institutions foster a culture of ethical awareness and preparedness among students and educators, supporting their ability to navigate complex ethical dilemmas in a rapidly evolving educational landscape (Eaton, 2020).

While previous research has primarily focused on qualitative explorations of these challenges (Selwyn, 2020b), there is an increasing need for quantitative studies to systematically assess the prevalence and impact of ethical issues in digital education. This study aims to address that gap by employing a quantitative approach to examine the ethical challenges students encounter in digital learning environments. The following research question guided this study:

- How are students grouped based on their perceptions of ethical concerns in digital education, including data privacy, academic integrity, accessibility, ethical awareness, and moral values?"

LITERATURE REVIEW

The increasing integration of digital technologies in education has fundamentally reshaped the way knowledge is delivered and acquired. Digital education—encompassing online, blended, and hybrid learning models—offers unprecedented opportunities for accessibility, flexibility, and innovation in teaching and learning (Caetano & Zaro, 2018; Matiso, 2024; Olcott et al., 2015). However, alongside these benefits emerge substantial ethical challenges that require careful examination to ensure the integrity, equity, and inclusivity of digital learning environments (Ajani, 2024; Alhrahshah, 2023). Ethical challenges in digital education refer to dilemmas and concerns related to the responsible use of technology in teaching and learning processes. These include issues such as data privacy, academic integrity, equitable access for all learners, and the preparedness of both educators and students to navigate complex moral considerations. For instance, the collection and use of personal data by educational platforms raise critical questions about security, informed consent, and transparency (Regan & Jesse,

2019). Similarly, maintaining academic honesty is becoming increasingly challenging in digital settings, where tools can facilitate unauthorized collaboration or misuse of resources (Dennis & Harrison, 2021). Understanding these challenges is essential in the context of the global shift to digital education, accelerated by events such as the COVID-19 pandemic. The rapid adoption of online learning exposed gaps in institutional readiness to address ethical concerns, often resulting in inequities and breaches of trust (Selwyn, 2020a). Furthermore, as digital education continues to evolve with the introduction of emerging technologies such as artificial intelligence and learning analytics, new ethical questions are constantly arising.

Data Privacy in Digital Education

The widespread adoption of digital technologies in education has led to the unprecedented collection, storage, and sharing of personal data from students, educators, and institutions. Educational platforms routinely gather sensitive information such as academic records, behavioral data, and even biometric details, raising serious concerns about data privacy and security (Regan & Jesse, 2019). While these practices are integral to the functionality of many digital tools, they raise ethical questions related to consent, transparency, and the potential for data misuse. Data protection regulations, such as the General Data Protection Regulation (GDPR) in the European Union and the Family Educational Rights and Privacy Act (FERPA) in the United States, play a critical role in addressing these issues. GDPR emphasizes individual rights over personal data, requiring organizations to implement strict consent protocols and secure data storage systems (Voigt & Von dem Bussche, 2017). Similarly, FERPA protects student education records by granting students and parents greater control over their personal information.

Perceptions of data privacy vary among stakeholders. Students often express concerns about how their data is used, with research indicating that many lack awareness of their rights and the privacy policies of digital platforms (Selwyn, 2020a). Teachers frequently report feeling unprepared to address these issues due to limited institutional training and unclear policy guidance (Dennis & Harrison, 2021). Educational institutions face the complex challenge of integrating advanced technologies while maintaining ethical data practices. Instances of data breaches in the education sector underscore the vulnerabilities of current systems. For example, a 2020 breach involving ProctorU exposed the personal data of hundreds of thousands of users, including names, email addresses, and hashed passwords (Jiang et al., 2023).

Academic Integrity in Digital Education

The shift to digital education has expanded opportunities for academic misconduct, including unauthorized collaboration, plagiarism, and cheating during online exams (Brown, 2023; Newton, 2018). The absence of physical oversight in virtual settings has led to the adoption of technological solutions, but these tools introduce their ethical complexities. Plagiarism detection tools, such as Turnitin and iThenticate, have become essential for promoting academic integrity by identifying instances of unoriginal work. These tools utilize advanced algorithms to compare submitted documents with extensive databases of academic and non-

academic content (Eaton, 2020). While effective in many cases, such tools have faced criticism for generating false positives or penalizing students who are unfamiliar with proper citation practices.

Online proctoring software, another widely adopted technology, uses webcams, screen monitoring, and artificial intelligence to detect potential cheating during exams. Despite its effectiveness in preventing misconduct, the use of proctoring software raises serious ethical concerns. Many students and educators view these tools as intrusive, citing the potential misuse of recorded data and the psychological stress caused by constant surveillance (Selwyn & Jandrić, 2020). Moreover, such software may disproportionately affect students with limited access to reliable technology, further exacerbating inequities in digital education. Student and teacher attitudes toward academic integrity in the digital age vary widely. Research shows that students often perceive cheating as more feasible in online environments due to the lack of direct supervision (Newton, 2018). However, many also express a need for more straightforward guidelines and support in understanding ethical expectations in digital learning. Teachers, meanwhile, report difficulties in detecting and addressing misconduct, often feeling that institutions rely too heavily on technological solutions rather than fostering a culture of academic honesty (Eaton, 2020).

Accessibility and Equity in Digital Education

The rapid advancement of digital education has created significant opportunities to expand access to learning. However, these benefits are not equitably distributed, as the digital divide continues to cause disparities in educational access and outcomes. The digital divide refers to the gap between individuals and communities with varying access to information and communication technologies, often shaped by socioeconomic status, geographic location, and infrastructure availability (van Dijk, 2020). Barriers to accessibility in digital education arise from several factors. Socioeconomic status remains a key determinant, as students from lower-income families may lack access to devices, high-speed internet, and digital literacy training (Eubanks, 2018). Geographic disparities also contribute, with rural and remote areas frequently facing inadequate technological infrastructure. Additionally, students with disabilities often encounter challenges due to poorly designed digital tools that do not support diverse needs, such as screen readers, subtitles, or other assistive technologies (Seale, 2014).

Institutions worldwide have implemented various strategies to enhance accessibility and promote equity in digital education. For example, some universities provide students with devices, subsidized internet access, or digital literacy programs (Czerniewicz et al., 2020). Others strive to create inclusive learning environments by applying universal design principles in the development of digital platforms. Inclusivity in the design of digital tools is essential for reducing barriers and fostering equitable learning experiences. Features such as customizable text sizes, screen reader compatibility, multilingual support, and adaptive technologies can considerably improve access for students with diverse abilities and backgrounds (Burgstahler, 2020).

However, research shows that many digital tools remain insufficiently inclusive, often prioritizing functionality over accessibility during development (Seale, 2014).

Ethical Awareness and Preparedness

The increasing reliance on digital education has highlighted the importance of ethical awareness and preparedness among students and educators. Ethical awareness refers to the recognition and understanding of ethical issues, while ethical preparedness encompasses the ability to address and resolve such issues effectively. In digital education, these challenges often stem from the complexities of technology integration, cultural differences, and evolving pedagogical practices (Dennis & Harrison, 2021). Students and educators perceive ethical challenges differently, shaped by their roles and experiences. Students frequently face dilemmas related to academic integrity, such as navigating plagiarism and unauthorized collaboration, while educators contend with concerns about fairness and surveillance in online assessments (Newton, 2018). Both groups emphasize the need for clearer guidelines and institutional support to manage ethical issues effectively (Eaton, 2020).

Institutional policies and training programs play a key role in promoting ethical awareness. Policies that emphasize transparency, accountability, and respect for the rights of students and educators establish a foundation for addressing ethical dilemmas. Training programs strengthen this foundation by equipping stakeholders with the skills and knowledge needed to navigate complex ethical scenarios. Research shows that institutions investing in comprehensive ethics training report higher levels of confidence and preparedness among educators and students (Selwyn, 2021). Digital education also introduces unique ethical dilemmas, particularly in the use of artificial intelligence for teaching and learning. AI-driven tools, such as adaptive learning platforms and automated grading systems, raise concerns about bias, transparency, and accountability (Regan & Jesse, 2019). For example, algorithms used to personalize learning experiences may unintentionally reinforce stereotypes or exclude marginalized groups if not carefully designed and monitored. Cross-cultural perspectives further complicate ethical preparedness in digital education. Cultural differences shape how ethical challenges are perceived and addressed, highlighting the need for culturally sensitive approaches to ethics education. For instance, while some cultures emphasize collective responsibility, others focus on individual accountability, leading to different interpretations of ethical behavior (Dennis & Harrison, 2021).

Moral Values in Digital Education

Moral values play a critical role in shaping the ethics of digital education. Values such as fairness, honesty, respect, equality, and responsibility are not only fundamental to interpersonal relationships but also essential for fostering a supportive and equitable learning environment in digital settings. These values serve as guiding principles that affect students' and educators' behaviors, decisions, and perceptions of ethical dilemmas in online learning (Dennis & Harrison, 2021). Fairness is a key moral value that underpins the design and delivery of assessments in digital education. The use of automated grading systems and proctoring software often raises

concerns about fairness and equity, particularly when these tools unintentionally disadvantage certain student groups (Regan & Jesse, 2019). Similarly, honesty is vital for maintaining academic integrity, with challenges such as plagiarism and unauthorized collaboration becoming more prevalent in virtual environments. Research highlights the importance of fostering a culture of honesty through clear communication of ethical policies and the use of tools such as plagiarism detection software (Eaton, 2020).

Respect and equality are particularly important in ensuring inclusivity in digital education. Respect for diverse perspectives and backgrounds is essential for fostering a collaborative and supportive learning environment, while equality ensures that all students, regardless of socioeconomic status or abilities, have access to the same educational opportunities (Burgstahler, 2020). However, disparities in access to technology and digital literacy often exacerbate inequities, making it crucial for institutions to embed these moral values into their policies and practices (Seale, 2014). Responsibility, both individual and institutional, is another essential value in digital education. Students must take responsibility for their learning and ethical behavior, while educators and institutions are responsible for providing secure, accessible, and equitable digital platforms (Czerniewicz et al., 2020).

Cross-Sectional Analysis of Ethical Challenges

Ethical challenges in digital education manifest differently among various stakeholders, affected by their roles, experiences, and contexts. A cross-sectional analysis comparing the perspectives of students and educators offers valuable insight into how these groups perceive and address ethical dilemmas. While students often focus on issues such as academic integrity and data privacy, educators are more likely to emphasize the ethical implications of pedagogy, assessment fairness, and technology use (Newton, 2018; Eaton, 2020). Demographic factors such as age, teaching experience, and academic discipline considerably influence ethical perceptions. Younger students, for example, may demonstrate greater familiarity with digital tools but less awareness of privacy risks compared to older peers (Regan & Jesse, 2019). Similarly, experienced educators may approach ethical challenges with a stronger understanding of institutional policies, while less experienced teachers may struggle to implement ethical practices effectively (Dennis & Harrison, 2021). Academic disciplines also shape perspectives, as the emphasis on ethics varies across fields, with disciplines like the humanities typically integrating ethical discussions more extensively than technical fields (Becher & Trowler, 2001).

The cross-institutional and cross-national dimensions further enhance the analysis of ethical challenges in digital education. Institutions with robust training programs and clear policies tend to demonstrate more cohesive and proactive approaches to ethics compared to those with limited resources or ambiguous guidelines (Selwyn, 2020a). Cross-country comparisons show that cultural and legal contexts strongly affect ethical practices. For example, countries with strict data protection regulations, such as those governed by GDPR, exhibit higher levels of awareness and compliance regarding data privacy (Voigt & Von dem Bussche, 2017).

Despite these differences, several commonalities emerge across stakeholders and regions. Both students and educators recognize the growing complexity of ethical challenges as digital education technologies evolve. There is also broad consensus on the need for collaborative efforts to address these issues, including transparent policies, inclusive practices, and education on ethical standards (Eubanks, 2018).

Theoretical Frameworks and Models

The study of ethical challenges in digital education is deeply rooted in established ethical theories, which provide a foundation for understanding and addressing moral dilemmas. Ethical frameworks such as utilitarianism, deontology, and virtue ethics have been applied to analyze the implications of digital technologies in education. Utilitarianism emphasizes maximizing overall well-being and is often used to evaluate the benefits and harms of digital tools, such as weighing the convenience of online learning against potential privacy intrusions (Regan & Jesse, 2019). Deontological ethics, which focuses on adherence to moral duties and rules, supports discussions about institutional responsibilities to uphold data privacy and ensure fair assessment practices (Voigt & Von dem Bussche, 2017). Virtue ethics, in contrast, emphasizes the development of moral character in students and educators, promoting values such as honesty, fairness, and responsibility in digital learning environments (Dennis & Harrison, 2021).

Several models of ethical decision-making have been developed to guide stakeholders in navigating ethical dilemmas in digital education. For example, the Four-Component Model of ethical behavior, originally proposed by Rest (1986), has been adapted for educational contexts. This model includes recognizing an ethical issue, making a moral judgment, establishing moral intent, and acting ethically. In digital education, this framework can help educators and administrators systematically address challenges such as academic dishonesty or data misuse. The integration of educational theories with ethical considerations is essential for developing comprehensive strategies to tackle ethical challenges. Constructivist theories, which emphasize active and personalized learning, can inform the ethical design of digital tools by supporting inclusivity and learner autonomy (Facer & Selwyn, 2021). Likewise, critical pedagogy stresses the importance of questioning power structures and promoting equity, which is especially relevant in discussions about accessibility and the digital divide (Eubanks, 2018).

Gaps in Existing Research

Despite substantial progress in understanding ethical challenges in digital education, notable gaps persist—particularly concerning understudied regional contexts, methodological limitations, and emerging trends. First, there is a striking lack of research focused on specific regions such as Kazakhstan and other developing nations. Much of the existing literature centers on North America and Europe, leaving the experiences of educators and students in less-studied areas largely undocumented (Czerniewicz et al., 2020). Cultural, economic, and infrastructural differences profoundly influence how ethical issues—like data privacy and accessibility—are perceived and addressed. Research in these regions is vital for developing localized policies and practices that truly reflect their unique educational and technological environments.

Another serious concern is the methodological limitations present in much of the existing research. The current body of literature largely relies on qualitative methods, such as interviews and case studies, which offer rich, context-specific insights but often lack generalizability (Selwyn, 2020b). While these approaches are valuable for exploring nuanced experiences, they do not capture broader trends or provide systematic analyses. There is a clear need for quantitative research, including large-scale surveys and statistical modeling, to produce more comprehensive and representative findings on ethical challenges in digital education. Furthermore, the field lacks longitudinal studies that examine how ethical perceptions and practices evolve over time, particularly in response to rapid technological advancements. Emerging trends—such as the integration of artificial intelligence, learning analytics, and immersive technologies like virtual and augmented reality—introduce novel ethical dilemmas that are not yet fully addressed in the literature (Regan & Jesse, 2019). For instance, the use of AI-driven algorithms to personalize learning raises concerns about bias, transparency, and potential data misuse. Likewise, immersive technologies prompt critical questions about informed consent, psychological effects, and equitable access. As these technologies become increasingly embedded in educational environments, understanding their ethical implications will be essential to ensuring their responsible and equitable implementation.

METHODS

This study employed a quantitative research design to investigate the ethical dimensions of digital education among students and educators. A cross-sectional survey methodology was employed to collect data at a single point in time, enabling an analysis of participants' perceptions and attitudes toward ethical issues in digital education. The study aimed to identify key ethical concerns related to data privacy, academic integrity, accessibility, ethical awareness, and moral values.

Sample and Context

This study was conducted among students from two educational institutions in Kyzylorda, Kazakhstan: Korkyt Ata Kyzylorda University and Kyzylorda "Órkeniet" Medical College. These institutions represent different levels of education, enabling a comparative analysis of students' perceptions of digital education ethics across higher education and vocational training settings. The total sample consisted of 193 students, with 60.6% from the university and 39.4% from the college. Participants were recruited voluntarily, and responses were collected anonymously. The sample included students from various academic years to examine how perceptions of digital education ethics evolve as students' progress through their studies.

Korkyt Ata Kyzylorda University is one of the largest and most prominent higher education institutions in the region, serving nearly 10,000 students across a diverse array of academic disciplines. The university is organized into several specialized institutes, each offering focused programs designed to meet the educational and professional demands of its fields. The Institute of Natural Sciences provides programs in physics, mathematics, biology, geography,

and chemistry, fostering scientific inquiry and research. The Institute of Engineering and Technology offers a broad spectrum of technical and applied programs, including agricultural technologies, architecture and construction, water management, computer science, engineering technologies, electrical energy, technospheric safety and ecology, applied mechanics, and information modeling technologies. The Institute of Economics and Law delivers comprehensive education in economics, management, finance, accounting, law, philosophy, and the social sciences, preparing students for careers in both the public and private sectors. The Institute of Pedagogy and Traditional Arts emphasizes cultural preservation and educational innovation, with programs in traditional music, choreography, design and technology, pedagogy, psychology, and primary education methodology. The Institute of Humanities and Pedagogy offers diverse programs in history, archaeology, foreign languages, translation studies, Kazakh language and literature, journalism, and Russian language and literature, promoting linguistic and cultural fluency. Most recently, the university has established the Institute of Artificial Intelligence, which focuses on cutting-edge research and education in AI and related technologies, positioning the institution at the forefront of digital transformation in higher education.

In contrast, "Órkeniet" Medical College, located in Kyzylorda city, specializes in training professionals in nursing and general medicine. The college serves approximately 600 students, with a focus on practical healthcare education. The gender distribution of the sample included both male (39.9%) and female (60.1%) students. The age range of participants varied, with the majority between 17–24 years old. Specifically, 55.4% of the students were aged 17–19, 40.9% were 19–21, and 3.6% were 22–24. The grade level distribution showed that third-year students comprised the majority (55.4%), followed by second-year students (30.6%), first-year students (12.4%), and a smaller number in their fourth year (1.6%).

Instrument

The data collection tool used in this study was a structured survey developed specifically to assess students' perceptions of ethical issues in digital education. The instrument consisted of 25 items, distributed across five subscales, each representing a key dimension identified through the literature: Data Privacy (DP), Academic Integrity (AI), Accessibility (A), Ethical Awareness/Preparedness (EA), and Moral Values (MV). Each subscale consisted of five items, developed based on a comprehensive review of prior research (e.g., Regan & Jesse, 2019; Dennis & Harrison, 2021; Eaton, 2020) and refined through expert discussions among the authors to ensure conceptual clarity and relevance. The survey employed a 5-point Likert-type scale, ranging from 1 (Strongly disagree) to 5 (Strongly agree), allowing respondents to indicate the extent of their agreement with each statement. This format was chosen for its effectiveness in measuring attitudinal constructs and its ease of use in quantitative analysis.

The initial draft of the survey was created in English and then translated into Kazakh by the first author. To ensure linguistic accuracy and conceptual equivalence, two English language teachers fluent in Kazakh reviewed the translation. Minor revisions were made based on their

feedback to improve clarity and coherence. To further validate the comprehensibility of the translated version, three students were asked to read the survey items aloud. No issues related to wording or understanding were identified during this process. The reliability of the survey was assessed using Cronbach's alpha for each subscale, demonstrating a high level of internal consistency. The reliability coefficient for DP was 0.81, for AI was 0.76, for A was 0.88, for AEP was 0.84, and for MV was 0.88. The overall reliability of the instrument was calculated as 0.93, indicating that the survey is reliable and suitable for measuring students' perspectives on digital education ethics.

Data Collection

The data for this study were collected through an online survey conducted during the spring semester of the 2024–2025 academic year. A total of 214 respondents participated, of which 21 were excluded during the data cleaning process. The survey consisted of five sections with five questions each, resulting in 25 items overall. Data collection was conducted via Google Forms, with the survey link distributed through mobile phones. Participants were able to complete the survey at their convenience, with an average completion time of 7–9 minutes. The entire data collection process lasted two weeks, and no significant challenges were encountered.

Data Analysis

To analyze the underlying structure of participants' responses regarding digital education ethics, a cluster analysis was conducted using the Hartigan-Wong k-means algorithm in Jamovi software. The survey items, covering data privacy, academic integrity, accessibility, ethical awareness, and moral values, were used as input variables for clustering. Prior to the analysis, the dataset was cleaned and standardized to ensure consistency, and missing values were replaced with the mean of the corresponding variables. The optimal number of clusters was determined using the Gap Statistic method, which compares within-cluster dispersion with that expected under a null reference distribution; the gap statistic peaked at $k = 3$, indicating that a three-cluster solution offered the best partitioning of the data (Tibshirani et al., 2001). To interpret the clustering results, the sum of squares values, centroid means, and cluster plots were examined. Additionally, a Principal Component Analysis (PCA) was performed to validate the clustering structure and visualize the relationships between variables and clusters. PCA, a dimensionality reduction technique, transforms correlated variables into a smaller set of uncorrelated components that capture the maximum variance in the data (Jolliffe & Cadima, 2016). In the resulting biplot, both participants and variables were projected into a two-dimensional space, allowing for simultaneous visualization of groupings and variable influence. The direction and length of vectors indicated the contribution and correlation of each variable to the principal components, with vectors pointing in similar directions representing positive correlations (Abdi & Williams, 2010).

Validity of the Study

Internal validity refers to the extent to which the observed outcomes can be attributed to the study variables rather than external factors (Creswell & Creswell, 2018). In this study, internal

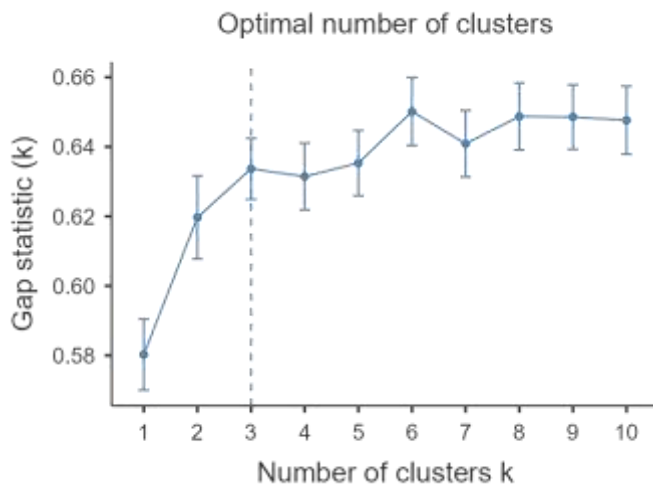
validity was reinforced by aligning the research questions, theoretical framework, and survey design. All constructs measured were grounded in established literature on digital education ethics (e.g., Eaton, 2020; Regan & Jesse, 2019). The use of a standardized, anonymous online survey minimized interviewer bias and social desirability effects, thereby enhancing the authenticity of responses. Construct validity was supported through both theoretical and empirical strategies: each of the five dimensions was operationalized based on established definitions and prior research, and the conceptual framework was empirically validated using Principal Component Analysis (PCA) and k-means cluster analysis, which revealed distinct patterns consistent with the intended constructs (Hair et al., 2019). Although the study was limited to two educational institutions in Kazakhstan, the inclusion of a heterogeneous sample—varying by academic year, gender, and disciplinary background—contributed to the transferability of the findings to comparable educational contexts. However, as acknowledged in the limitations, generalizations should be made cautiously, and further research across broader national or international samples is recommended to assess the robustness of these findings.

RESULTS

To analyze the structure of participants' responses, we conducted a cluster analysis using the Hartigan-Wong algorithm (Hartigan & Wong, 1979) in Jamovi software. This method is widely recognized for its efficiency in performing k-means clustering by minimizing within-cluster variance and maximizing separation between clusters. The analysis aimed to group respondents based on similarities in their perceptions of digital education ethics, focusing on key dimensions such as data privacy, academic integrity, accessibility, ethical awareness, and moral values.

The Gap Statistic method was used to determine the optimal number of clusters for the dataset. The plot in Figure 1 displays the gap statistic values for different numbers of clusters (k), with error bars representing variability.

The gap statistic in Figure 1 increases as the number of clusters grows from $k = 1$ to $k = 3$, indicating that adding clusters improves separation and reduces within-cluster variation. Beyond $k = 3$, the gap statistic levels off, suggesting that additional clusters do not significantly enhance the clustering structure. Table 1 presents the sum of squares values for each identified cluster, illustrating the distribution of variance within and between clusters.

Figure 1.*Optimal number of clusters***Table 1.***Sum of squares Table*

| Cluster | Value |
|------------------|---------|
| Cluster 1 | 750.52 |
| Cluster 2 | 479.67 |
| Cluster 3 | 383.11 |
| Between clusters | 784.23 |
| Total | 2397.53 |

Table 1 shows the variance within and between clusters. Cluster 1 has the highest within-cluster sum of squares (750.52), while Cluster 2 and Cluster 3 show lower within-cluster sums of squares (479.67 and 383.11, respectively). The between-cluster sum of squares (784.23) represents the variance across different clusters, contributing to the total sum of squares (2397.53). Cluster 1 is the largest group with 96 participants, followed by Cluster 3 with 55 participants, while Cluster 2 is the smallest group with 42 participants.

To further understand the characteristics of each cluster, we examined the centroid values for the three identified clusters (Table 2). The centroids represent the average scores of participants in each group across the survey items related to data privacy (DP), academic integrity (AI), accessibility (A), ethical awareness (EA), and moral values (MV). Table 2 summarizes the centroid values for each cluster. These values represent the average response for each survey item within each cluster, meaning that for each item (e.g., DP1, DP2, AI1, A1, EA1, MV1, etc.), the centroid value reflects the mean score of all respondents belonging to that cluster.

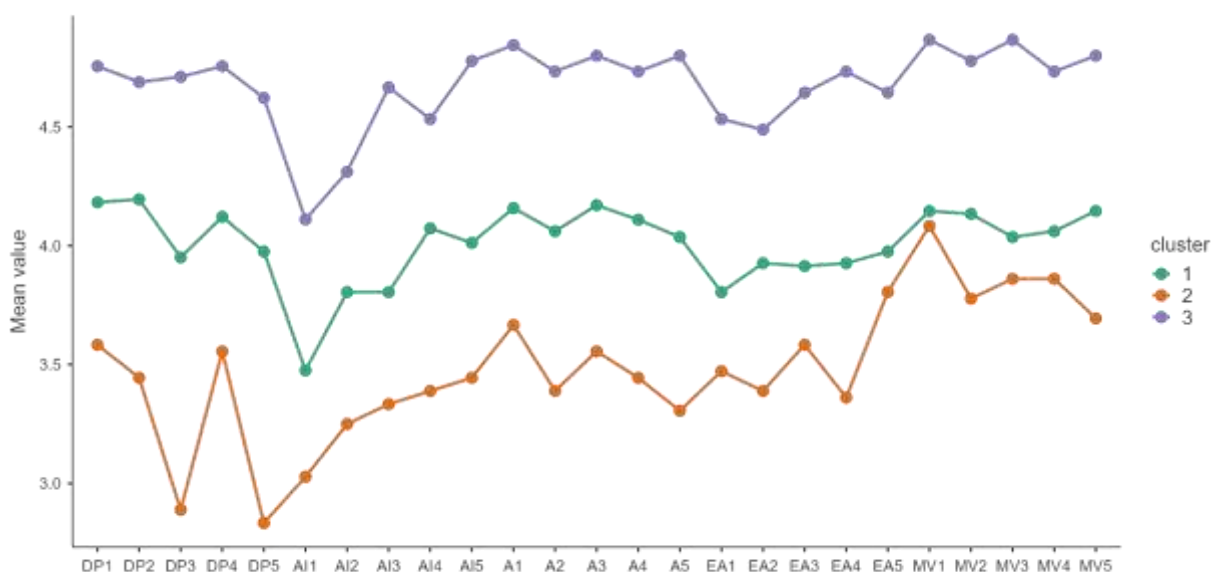
Table 2.
Centroids of Clusters Table

| Item Cluster | 1 | 2 | 3 | Item Cluster | 1 | 2 | 3 | Item Cluster | 1 | 2 | 3 |
|--------------|------|------|------|--------------|------|------|------|--------------|------|------|------|
| DP1 | 4.18 | 3.58 | 4.76 | A1 | 4.16 | 3.67 | 4.84 | MV1 | 4.15 | 4.08 | 4.87 |
| DP2 | 4.2 | 3.44 | 4.69 | A2 | 4.06 | 3.39 | 4.73 | MV2 | 4.13 | 3.78 | 4.78 |
| DP3 | 3.95 | 2.89 | 4.71 | A3 | 4.17 | 3.56 | 4.8 | MV3 | 4.04 | 3.86 | 4.87 |
| DP4 | 4.12 | 3.56 | 4.76 | A4 | 4.11 | 3.44 | 4.73 | MV4 | 4.06 | 3.86 | 4.73 |
| DP5 | 3.98 | 2.83 | 4.62 | A5 | 4.04 | 3.31 | 4.8 | MV5 | 4.15 | 3.69 | 4.8 |
| A11 | 3.48 | 3.03 | 4.11 | EA1 | 3.8 | 3.47 | 4.53 | | | | |
| A12 | 3.8 | 3.25 | 4.31 | EA2 | 3.93 | 3.39 | 4.49 | | | | |
| A13 | 3.8 | 3.33 | 4.67 | EA3 | 3.91 | 3.58 | 4.64 | | | | |
| A14 | 4.07 | 3.39 | 4.53 | EA4 | 3.93 | 3.36 | 4.73 | | | | |
| A15 | 4.01 | 3.44 | 4.78 | EA5 | 3.98 | 3.81 | 4.64 | | | | |

The centroids of clusters table reveal distinct response patterns among the three clusters. Cluster 1 represents a moderate-to-high agreement group, with scores generally ranging between 3.80 and 4.20. Cluster 2 shows the lowest overall agreement, particularly in data privacy (DP3 = 2.89, DP5 = 2.83) and accessibility (A5 = 3.31). Cluster 3 exhibits the highest agreement across all dimensions, with most scores exceeding 4.5. The Plot of Means Across Clusters in Figure 2 visually illustrates the centroid values of each survey item for the three identified clusters.

Figure 2.

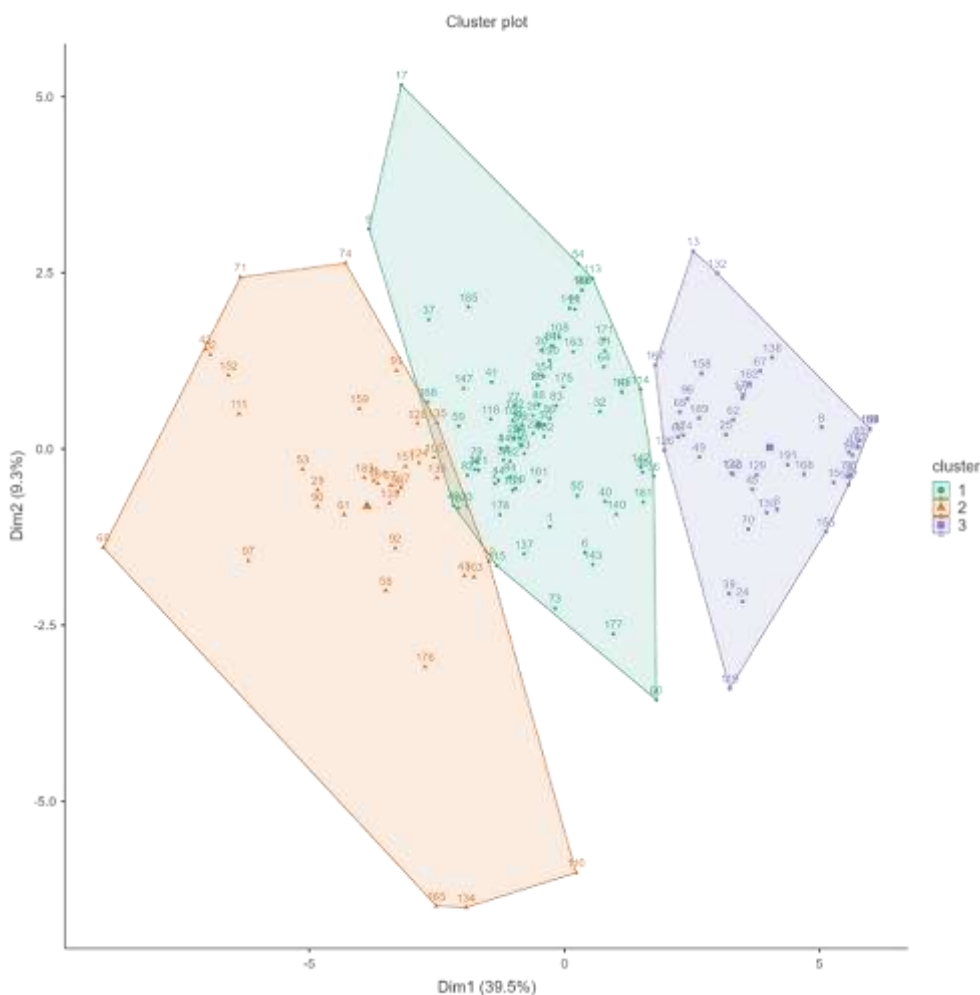
Plot of means across clusters



Cluster 3 (Purple Line) consistently shows the highest mean values across all items, indicating strong agreement with statements related to data privacy, academic integrity, accessibility, ethical awareness, and moral values. Participants in this group demonstrate the most positive perceptions of digital education ethics. Cluster 1 (Green Line) exhibits moderate scores, generally showing an upward trend in agreement across items related to accessibility and ethical awareness. While responses vary slightly, they remain positive, reflecting a balanced and moderately supportive perspective. Cluster 2 (Orange Line) has the lowest mean values, particularly in data privacy (DP3, DP5), accessibility (A5), and ethical awareness (EA1–EA5), with sharp dips in these areas suggesting greater concern or lower confidence in key aspects of digital education ethics. The cluster plot in Figure 3 visually depicts the segmentation of participants into three distinct clusters based on their survey responses. The two dimensions shown (Dim1 and Dim2) capture the variance in the dataset, with Dim1 accounting for 39.5% and Dim2 for 9.3% of the total variance. Each point represents an individual participant, while the convex hulls outline the boundaries of the three identified clusters.

Figure 3.

Cluster plot

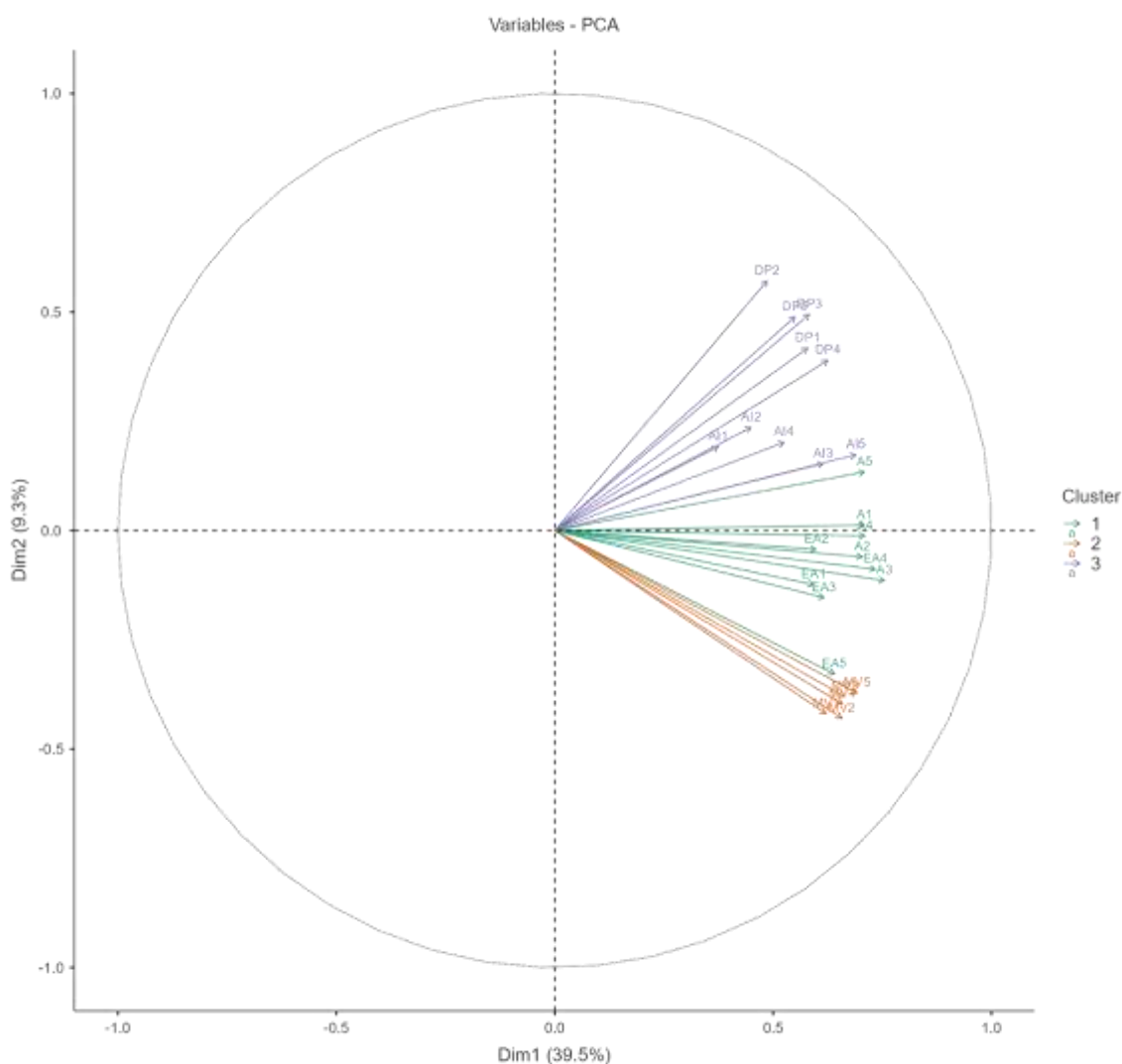


Cluster 1 (Green) is centrally located and more densely packed, indicating moderate variability in responses. Participants in this cluster share balanced perspectives across different

survey dimensions. Cluster 2 (Orange) is the most dispersed, reflecting greater variability in responses among its members and representing participants with more diverse or less consistent views on digital education ethics. Cluster 3 (Purple) is the most compact cluster, showing high consistency in responses. Participants in this group share strong and uniform opinions on digital education ethics. The PCA biplot in Figure 4 illustrates the relationships between the variables and their contributions to the clustering structure. The two principal components, Dim1 (39.5%) and Dim2 (9.3%), capture the most significant variance in the dataset and help visualize how different variables contribute to the differentiation of clusters.

Figure 4.

Variables-PCA



Items associated with Cluster 3 (Purple) (e.g., DP1–DP5, A1–A6) have strong positive correlations along Dim1, indicating that participants in Cluster 3 consistently scored high on these dimensions. Items associated with Cluster 2 (Orange) (e.g., MV1–MV5, EA5, A5) are positioned toward the lower right, showing that participants in Cluster 2 scored lower on these items, setting them apart from the other clusters. Items associated with Cluster 1 (Green) (e.g.,

EA1–EA4, AI1–AI5) cluster around the middle range, reflecting moderate variation in agreement levels among participants in this group. Items further from the center (e.g., DP1, DP2, EA5, MV1) contribute strongly to the differentiation between clusters, while variables located closer to the center have weaker contributions and do not significantly distinguish between clusters.

DISCUSSION

The study findings revealed three distinct clusters representing varying levels of ethical awareness in digital education. Cluster 1, the largest group, demonstrated moderate-to-high agreement with ethical and moral concerns, reflecting a balanced perspective across categories such as data privacy, academic integrity, accessibility, ethical awareness, and moral values. Cluster 2, the smallest and most dispersed group, exhibited the lowest overall agreement, with particularly low confidence in data privacy and accessibility, suggesting a lack of awareness or concern regarding ethical issues in digital education. Cluster 3, in contrast, displayed the strongest ethical awareness, with participants consistently scoring highest across all dimensions, indicating a strong commitment to ethical behavior in digital learning environments. Among the five ethical dimensions assessed, data privacy and accessibility emerged as the most critical concerns, particularly for Cluster 2 participants, highlighting potential gaps in institutional policies or student understanding of digital education ethics. The clear differences between these clusters point to varying levels of ethical preparedness among students and underscore the need for targeted interventions to improve ethical awareness, especially for those in Cluster 2.

The findings of this study align with and expand upon existing literature on digital education ethics and morals, particularly regarding data privacy, academic integrity, accessibility, and ethical preparedness. Prior research has highlighted growing concerns about data privacy due to the widespread collection and analysis of student data by educational platforms (Regan & Jesse, 2019; Mouta et al., 2024). Consistent with our results, previous studies have shown that students often feel uncertain about how their data is used and frequently lack awareness of privacy policies (Selwyn, 2020a). However, this study further reveals that such concerns are not evenly distributed among students, as shown by the distinct response patterns across the three identified clusters. In particular, participants in Cluster 2 exhibited the lowest confidence in data privacy protections, which supports findings by Dennis and Harrison (2021), who observed that students with lower digital literacy are more susceptible to privacy-related risks.

Academic integrity is another key ethical concern that has been widely discussed in digital education research (Balida, 2023; Newton, 2018). Previous studies have found that online learning environments present unique challenges for maintaining integrity, as students perceive cheating as more feasible due to reduced supervision (Eaton, 2020). Our study supports this notion, with participants across all clusters expressing concerns about ethical violations in digital assessments. However, our findings offer additional insight by revealing variations in ethical

awareness among different student groups. For example, Cluster 3 participants showed a strong commitment to academic integrity, consistent with prior research indicating that students who receive explicit ethics training are more likely to uphold academic honesty (Eaton, 2020). In contrast, the lower agreement scores on academic integrity observed in Cluster 2 suggest that institutional efforts to promote ethical behavior may not be equally effective for all students, raising concerns about the inclusivity and effectiveness of current integrity policies.

Accessibility has been another widely researched issue in digital education ethics, particularly concerning the digital divide and inequalities in technology access (Olcott et al., 2015; Burgstahler, 2020). Our study reinforces prior findings that students from diverse socioeconomic and educational backgrounds experience varying levels of accessibility in digital learning environments. The literature consistently shows that students from rural areas or lower-income backgrounds face greater technological barriers, which can lead to lower engagement and reduced ethical awareness (Seale, 2014; Czerniewicz et al., 2020). The response patterns in Cluster 2 align with this concern, as participants in this group reported the lowest accessibility scores. In contrast, Cluster 3 participants, who showed the highest agreement with ethical principles, may have benefited from stronger institutional support or higher levels of digital literacy. This finding suggests that accessibility challenges may have a cascading effect, influencing not only students' ability to engage with digital education but also their overall ethical awareness.

Ethical preparedness, which encompasses students' awareness of ethical dilemmas and their ability to navigate them, has been a relatively underexplored area in prior research. However, recent studies have shown that students and educators often feel ill-prepared to address ethical challenges in digital education, particularly when dealing with emerging technologies such as artificial intelligence and automated grading systems (Dennis & Harrison, 2021; Regan & Jesse, 2019). Our findings contribute to this discussion by showing that ethical awareness is not consistent among students, with Cluster 3 participants demonstrating the highest level of preparedness, while Cluster 2 revealed significant gaps in both ethical awareness and confidence. This supports Selwyn's (2020) assertion that institutions investing in structured ethics training programs tend to report higher levels of confidence and preparedness among students and educators.

While our findings align with much of the existing literature, they also highlight how students' ethical perspectives vary across different groups. The distinct response patterns identified through cluster analysis suggest that ethical concerns in digital education cannot be addressed with a one-size-fits-all approach. Instead, targeted interventions—such as customized ethics training, strengthened data privacy policies, and improved accessibility measures—may be needed to address the specific concerns of different student groups. The findings of this study reveal significant variations in ethical awareness and perceptions of digital education among students, with Cluster 2 showing the lowest ethical awareness and Cluster 3 demonstrating the highest agreement with ethical principles. These differences can be

attributed to several contextual factors, including educational background, digital literacy, socio-economic conditions, and institutional policies.

The low ethical awareness observed in Cluster 2 suggests these students may have had limited exposure to discussions on digital ethics, weaker digital literacy, or insufficient institutional support in navigating ethical dilemmas. One potential explanation is their relatively limited experience with digital education, which could result in less familiarity with challenges related to data privacy and academic integrity policies. Research shows that students who receive prior training on digital ethics or frequently engage with digital platforms tend to demonstrate stronger ethical awareness (Eaton, 2020). The lower scores in Cluster 2 may therefore reflect a lack of structured ethics education in their curriculum. Socioeconomic disparities often shape students' experiences with digital education. Those from lower-income backgrounds or under-resourced institutions may lack access to high-quality digital tools, leading to reduced engagement and awareness of ethical concerns (Czerniewicz et al., 2020). Limited access to reliable internet and technology may result in fewer opportunities to participate in discussions of digital responsibility, making ethical issues feel less relevant to their academic lives (Seale, 2014). Another contributing factor may be the absence of strong institutional policies and training. If educational institutions do not actively promote ethical dialogue or fail to integrate ethics training into digital education programs, students may not recognize the importance of academic integrity, data privacy, and accessibility (Regan & Jesse, 2019). The consistently lower agreement scores across all ethical dimensions in Cluster 2 suggest their institutions may lack effective ethical guidelines, leaving students underinformed or disengaged from digital education ethics.

In contrast, Cluster 3 participants demonstrated the highest ethical awareness, suggesting greater familiarity with digital ethics, stronger digital literacy skills, and likely exposure to institutional policies that emphasize ethical education. These students may have received prior instruction on ethical issues in digital learning through formal coursework, workshops, or institutional training sessions. Higher digital literacy enables students to navigate online learning platforms with a clearer understanding of risks such as data breaches and academic dishonesty (Regan & Jesse, 2019). The institutions attended by Cluster 3 students may enforce clear ethical guidelines, strong academic integrity policies, and structured data privacy regulations, all of which contribute to greater ethical awareness. Prior research shows that universities with well-developed digital ethics policies tend to produce students who are more engaged with ethical considerations in online education (Dennis & Harrison, 2021). Institutions that foster a culture of ethical awareness through proactive discussions, case-based learning, and ethics-focused assignments help students internalize digital ethics as a core aspect of their academic experience (Olcott et al., 2015). If Cluster 3 students have been exposed to such practices, their strong agreement with ethical principles likely reflects the influence of institutional emphasis on ethical preparedness.

Accessibility and data privacy emerged as the most serious concerns across all clusters, with Cluster 2 displaying the greatest unease in these areas. Several factors may explain these concerns. Students from economically disadvantaged backgrounds or underfunded institutions often face challenges such as poor internet access, outdated digital tools, or unreliable platforms (Eubanks, 2018). The digital divide can widen educational disparities, making it difficult for some students to access learning materials, complete assignments, or participate in online discussions (Selwyn, 2020a). Accessibility concerns may also arise from poorly designed online platforms that fail to accommodate students with disabilities, linguistic diversity, or technological limitations. Institutions that do not implement universal design principles in their digital education systems may unintentionally exclude students who depend on assistive technologies or alternative learning formats (Burgstahler, 2020). At the same time, growing data collection by educational platforms has raised concerns about how student information is stored, shared, and used. Many students may feel uncertain or anxious about the handling of their personal data, especially in the absence of transparent institutional policies or proper education on data protection (Jiang et al., 2023). Previous incidents of data breaches involving educational platforms may have further increased students' sensitivity to data privacy risks (Mouta et al., 2024).

Conclusions, Limitations, Implications, and Future Research

This study examines students' ethical awareness in digital education, focusing on key concerns such as data privacy, academic integrity, accessibility, ethical awareness, and moral values. The findings reveal three distinct clusters of students with varying levels of ethical awareness, indicating significant differences in perceptions and preparedness. Cluster 2 showed the lowest ethical awareness, pointing to gaps in digital literacy, institutional support, and access to ethics training. In contrast, Cluster 3 demonstrated the highest ethical awareness, likely due to greater exposure to digital ethics education, clear institutional policies, and a stronger foundation in digital literacy. The results indicate that ethical concerns in digital education are not uniformly distributed and require targeted interventions to ensure that students from all backgrounds develop the necessary awareness and skills to navigate ethical dilemmas.

The study also reinforces the importance of accessibility and data privacy as central concerns in digital learning environments. Students expressed significant unease about the protection of their personal information and the inclusivity of digital platforms, indicating that institutions must take proactive steps to enhance security, transparency, and accessibility in online education. These findings call for stronger educational policies, curriculum enhancements, and technological improvements to support a more ethical digital learning landscape.

The findings of this study highlight the urgent need for institutions to implement comprehensive strategies aimed at enhancing ethical awareness in digital education. From an educational policy standpoint, institutions should establish clear, transparent ethical guidelines that directly address issues such as data privacy, academic integrity, and accessibility. These

policies must be consistently enforced and regularly updated to keep pace with evolving technological developments. Structured ethics training should be integrated for both students and educators to strengthen their preparedness in handling ethical dilemmas. In terms of curriculum development, ethical issues in digital education should be explicitly addressed through mandatory courses or embedded within existing subjects. The use of case studies, classroom discussions, and practical applications can help students critically engage with the ethical dimensions of digital learning. Educators should be supported through workshops and professional development programs to ensure they are well-equipped to guide ethical decision-making. Regarding technology integration, institutions must enhance data privacy by adopting secure platforms, enforcing stringent data protection measures, and educating students about their rights and responsibilities. Accessibility should be prioritized by ensuring digital platforms align with universal design standards to support students with diverse needs. Efforts such as providing affordable internet access, assistive technologies, and multilingual content can help bridge the digital divide and promote a more inclusive learning environment. By addressing these critical areas, institutions can foster a digital education ecosystem that is ethically informed, secure, and accessible to all learners.

This study has some limitations that should be acknowledged. One major limitation is the sample scope, as the study was conducted among students from only two institutions in Kazakhstan, which may limit the generalizability of the findings to broader educational contexts. The perspectives captured may not fully reflect those of students from other regions, institutions with different technological infrastructures, or varying levels of exposure to digital education ethics. Another limitation is the potential for response bias in self-reported surveys. Since participants were asked to assess their own ethical awareness and perceptions, there is a risk of social desirability bias, where respondents may have provided answers, they believed were more acceptable rather than their true opinions.

Future studies should explore the role of digital literacy in ethical decision-making, examining whether students with higher digital competence demonstrate greater ethical awareness and more responsible online behavior. By addressing these areas, future research can deepen understanding of the complexities surrounding digital education ethics and support the development of more effective interventions and policies.

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