information

Review

An Information Ethics Framework Based on ICT Platforms

Jeonghye Han

Department of Computer Education, Cheongju National University of Education, Cheongju 28690, Korea; hanjh@cje.ac.kr; Tel.: +82-43-299-0853

Abstract: With continuing developments in artificial intelligence (AI) and robot technology, ethical issues related to digital humans, AI avatars, intelligent process automation, robots, cyborgs, and autonomous vehicles are emerging, and the need for cultural and social sustainability through AI ethics is increasing. Moreover, as the use of video conferencing and metaverse platforms has increased due to COVID-19, ethics concepts and boundaries related to information and communications technology, cyber etiquette, AI ethics, and robot ethics have become more ambiguous. Because the definitions of ethics domains may be confusing due to the various types of computing platforms available, this paper attempts to classify these ethics domains according to three main platforms: computing devices, intermediary platforms, and physical computing devices. This classification provides a conceptual ethics framework that encompasses computer ethics, information ethics, cyber ethics, robot ethics, and AI ethics. Several examples are provided to clarify the boundaries between the various ethics and platforms. The results of this study can be the educational basis for the sustainability of society on ethical issues according to the development of technology.

Keywords: computer ethics; information ethics; cyber ethics; AI ethics; robot ethics

check for updates

Citation: Han, J. An Information Ethics Framework Based on ICT Platforms. *Information* **2022**, *13*, 440. https://doi.org/10.3390/info13090440

Academic Editor: Gordana Dodig-Crnkovic

Received: 16 August 2022
Accepted: 13 September 2022
Published: 18 September 2022

1. Introduction

Throughout history, people have been creating dolls, sculptures, and machines that resemble human figures, and with the advent of computers, we have developed accompanying software that conducts information processing and created a virtually connected world. Office software has recently incorporated intelligent process automation (IPA) for more accurate and quick processing, and the application of digital humans, avatars that look human and replicate human traits in the virtual world, has expanded to various fields such as broadcasting, education, counseling, customer service, and virtual assistance through social media. In addition, due to the COVID-19 pandemic, video conferencing and online learning platforms are beginning to be widely used. Artificial intelligence (AI) agents, or intelligent agents, which are physical robots or softbots that can perceive, act, and learn autonomously in a physical or virtual environment, have also begun to appear in the metaverse, a virtual reality space in which users can interact with others in a graphically rich virtual environment. (In this review, the term *AI agents* refers to softbots in virtual environments and *AI robots*, to physical AI robots.) Meanwhile, industrial robots created for manufacturing have led to factory automation and smart factories, and autonomous vehicles produced in smart factories are evolving into robots. Already, AI avatars, chatbots, smart speakers, delivery robots, and autonomous vehicles are a part of our daily lives. Even cyborgs are expected to gradually increase in number as wearable robot technology and embedded neural chip technology develop.

Bynum [1] noted that as information technology itself has grown and spread, additional subfields of information and computer ethics have appeared: online ethics, agent ethics (robot, softbot), cyborg ethics (part human, part machine), the open-source movement, e-government, global information ethics, information technology and genetics, and computer terrorism. *Computer ethics* and *information ethics* have historically been the oldest terms encountered by teachers and students, but *cyber ethics* has become more common as

the use of video conferencing and metaverse platforms increases. With the development of AI, robot technology, and the spread of 5G networks, even more, ethical issues have arisen surrounding digital humans, AI agents, robots, and self-driving cars. In response to these developments, Tzafestas [2] summarized the basic concepts of roboethics and twelve issues to be addressed in a roboethics framework, pointing out there are common issues in computer ethics, information ethics, automation ethics, and bioethics.

Currently, AI ethics is not as clearly defined as other ethics branches. Moreover, there is a mixture of terms in the areas of AI ethics, AI robot ethics, and robot ethics. These terms from various computing platforms can reduce the effectiveness of ethics education related to information technology since teachers and students may be confused by the ambiguity of terms, concepts, and boundaries. Bynum [1] stated that besides having a very wide definition and a metaphysical approach to information ethics, teachers and learners also need a professional, ethical approach that allows them to have direct or indirect experience as users and producers. For example, the terms *AI* and *robot* referred to in philosophical literature and in papers discussing information ethics or computer ethics are often used to describe concepts that include programmable softbots and AI agents. Meanwhile, Grodzinsky et al. [3] have also presented a model that distinguishes between e-communication (e.g., blogging, Skype) and p-communication (physical or proxy communication; e.g., touching, talking face-to-face) in interactions between artificial agents and humans.

However, teachers and students may be more easily reminded of industrial robots or food service robots that they have seen around them, not softbots or AI agents; thus, teachers and students can easily be conceptually limited to physical robots. Onyancha [4] pointed out the same problem the confusion surrounding exact meanings in different areas of ethics could not only cause problems for indexers when publishing literature but also pose a great challenge for educators who teach related topics. Therefore, this paper aims to provide a practical framework based on information and communications technology (ICT) platforms and examples so that teachers and students who are studying social sustainability can easily grasp empirical concepts and boundaries in computer ethics, internet ethics, cyber ethics, and AI ethics.

Section 2.1 reviews related research on concepts in information ethics and computer ethics and cyber ethics terms from various academic fields (e.g., computer science, philosophy, ethics) in historical order to highlight the mixed relationships among terms. Section 2.2 reviews literature on AI ethics and related subareas in which discussion has recently increased. Section 2.3 discusses related literature in education and search volume data from Google Trends. Section 3 presents the hierarchical relationship between information ethics and computer ethics. More specifically, Section 3 classifies them by platform type to present an intuitive framework, and Section 3.1 constructs a framework for information ethics using a Venn diagram and examples. Section 3.2 provides a horizontal view of the framework. Section 4 presents future applications of AI ethics and example classifications using the proposed information ethics framework so that teachers and students can easily understand them.

2. Theoretical Background

2.1. Computer Ethics, Information Ethics, and Cyber Ethics

Computer ethics is considered a branch of philosophy that analyzes the moral use and social impact of computer technology. It is applied ethics that includes concepts of user behavior and work ethics in computer systems. Information ethics is defined as the ethical standards and moral norms that govern human behavior in a field of ethics that focuses on the relationship between the generation, organization, dissemination, and use of information. Cyber ethics, also called internet ethics, is defined as a branch of applied ethics that studies moral problems caused by digital technology and the global virtual environment ("Cyber ethics", n.d.).

Bynum [1] presented a rich historical summary of the birth of computer ethics and information ethics based on Wiener [5]. According to Bynum's study, Wiener is considered the founder of metaphysical and scientific information ethics as he presented several ethical issues and crimes in areas such as program manipulation, computer security, computerization and unemployment, professional responsibility in computing, computers for the disabled, virtual communities, cyborgs, robot ethics, artificial intelligence, and computer addiction [6]. In the 1970s, problems such as illegal copying of software, privacy, computer crime, and the hacking began to rise as a result of the rapid spread of personal computers. Walter Maner coined the term *computer ethics* in 1980 and urged college students to educate themselves on computer technology use [7]. In 1985, Moore defined computer ethics as an analysis of the nature and social impact of computer technology and the corresponding formulation and justification of policies for the ethical use of such technology [8].

Not long after, Hauptman [9] coined the term *information ethics*, which included all ethical issues related to the production, storage, access, and dissemination of information, including literacy and media. Based on previous studies, Wong [10] defined computer ethics as ethics for both computers and information technology and stated that there was no significant difference between computer ethics and other types of ethics related to computing. Spinello and Tavani [11] wrote that cyber ethics was a larger concept than information ethics and internet ethics, but Froehlich [12] considered cyber ethics to be a particular area of computer ethics that included AI and robots. Floridi [13] proposed an information ethics framework that provided a metaphysical basis for computer ethics that was different from Wiener's materialistic and physical concepts. The metaphysical concept encompassed all objects in the universe (humans, animals, objects, robots, softbots, cyborgs, etc.), going beyond the focus on humans in traditional ethical theories.

Akbulut et al. [14] placed internet ethics below computer ethics, while Kuzu located computer ethics as a subset of internet ethics [15]. Brey and Søraker [16] defined computer ethics as applied ethics to express the ethical issues in the use, design, and management of information technology and the formation of ethical policies for social norms. They viewed applied ethics as a professional field that included computer ethics, media ethics, literacy ethics, and bioinformation ethics. In Kavuk et al. [17], the authors defined internet ethics as falling under behavioral ethics when people use the internet, but Lau and Yuen [18] regarded internet ethics as a component of computer ethics and argued it was a moral assessment of individual online behavior. Bynum [1] considered computer ethics as an additional subfield of ICT that had grown and spread, noting the existence of online ethics, agent ethics, and cyborgs. More recently, Reader and Savin-Baden [13] argued for a combination of Floridi's [19] view of information ethics as universal and a modest view of new materialism of information ethics as material.

As such, studies in computer ethics, information ethics, and internet ethics have presented similar terms and concepts. Onyancha [4] investigated the components of these three applied ethics by academic field and used a Google Trends analysis for worldwide trends in terminology. According to his results, "computer ethics" and "internet ethics" showed similarities with a correlation coefficient of 0.88. "Cyber ethics", which comprised the intersection of these areas in a Venn diagram, has gradually expanded.

2.2. AI Ethics and Robot Ethics

This section provides an overview of developments and issues in AI ethics and robot ethics. First, the United States' National Artificial Intelligence Research and Development Strategic Plan, the European Union's European Artificial Intelligence Ethics Principles, and international organizations such as UNESCO and the OECD have been quickly updating their guides and standards for AI ethics. In the area of AI ethics problems, smart speakers, chatbots, and digital humans represent some of the most pertinent to our lives. First, smart speakers pose various ethical problems involving ownership of voice data, social views based on biased data, psychological dependence due to the anthropomorphism of voice technology, and personal privacy [20]. IPA, which combines AI technology with RPA, saves

labor costs and reduces human error by replacing repetitive human tasks, but mistakes or crimes may occur when human intervention is required. Digital humans, also known in comprehensive terms as chatbots, dialogue agents, and education agents, emphasize integrity, personalization, and emotional engagement as ethically important [19]. Recently, due to the rapid development of deep learning technology and deepfake technology, problems that were not originally expected are occurring as AI technology has begun to be applied in various forms of services in medicine, education, entertainment, and gaming. Accordingly, countries around the world are developing guidelines in AI ethics to address the social implications and legal and ethical problems caused by AI-based products.

According to Tzafestas [2], the academic history of robot ethics begins with the European Robot Research Network (EURON). He argued that ethics-based robot design and legislation are needed through such a research network with experts in various fields (computer/robot/mechanical/automation/AI engineers, cognitive scientists, philosophers, and ethicists) and presented detailed explanations of roboethics branches: medical roboethics, assistive roboethics, sociorobot ethics, war roboethics, autonomous car ethics, and cyborg ethics. These branches take into consideration robots that can interact physically but do not include softbots in virtual space. Malle [21] divided robot ethics into two categories: the problem of designing, arranging, and utilizing robots and the problem of their moral ability. Reader and Savin-Baden [13] divided robot ethics into robot rights, using Floridi's [19] metaphysical perspective and interaction-based ethics from a general point of view.

As more robots are being used in schools and businesses and in the form of self-driving cars, ethical issues involving them have become more widespread, but for more than twenty years, robot ethics has revolved mainly around robots that engage in physical activities. Recently, Smakman et al. [22] investigated parents' and policymakers' knowledge of ethical considerations associated with introducing social robots to classrooms. They found most people assumed robot ethics pertained only to robots that performed physical activity. However, philosophers, ethicists, and some computer scientists who maintain Floridi's [13] or Grodzinsky et al.'s [3] perspectives consider even software robots, such as chatbots, to be included in robot ethics. Moreover, whether to apply AI ethics or robot ethics to physical robots equipped with AI may also be confusing.

2.3. Related Works in Education

Johnson [23] published the first textbook on computer ethics in 1985, and in 1992, Bynum [24] developed a computer ethics curriculum for college courses. More recently, the United States has created the AI4K12 initiative to develop national guidelines for AI education in elementary, middle, and high schools, as well as online resource directories for teachers, researchers, curriculum developers, and resource developers [25]. The European Union has also provided educators with a platform that allows them to search for European curricula and programs related to AI (www.ai4europe.eu/education, accessed on 1 May 2022) [25].

Han and Kim [26] and Jung [27] have collectively referred to this area as *ICT ethics* for educational purposes and consider it to consist of cyber ethics, AI ethics, and (physical) robot ethics, as described in Tzafestas [2]. If AI were installed on a physical robot, it would be included in AI ethics. The ethics framework proposed in the following section is similar to Dijck's [28] model, which divides information ethics on a platform basis. Dijck visualized the computing platform as a tree with roots consisting of infrastructure such as hardware, devices, and networks; a trunk consisting of SNS and cloud services; and branches/leaves consisting of sectoral apps. Her model includes overlapping examples, such as cloud services classified as both digital infrastructure (root) and intermediary platforms (trunk) and social network platforms classified as infrastructure services (root) and communication services (branch/leaf). Dijck's digital infrastructure (root) and brokerage platform (trunk) correspond with computer ethics and internet ethics in the proposed framework, and her communications service (branch/leaf) with cyber ethics.

More recently, Awad et al. [29] presented a framework of computational ethics based on reflective equilibrium, a process of matching moral principles with moral intuition. However, this framework is more useful for classifying researchers' fields and methodologies rather than establishing concepts for educational purposes for teachers or students. Considering this, what terms are non-researchers, such as teachers, usually interested in? A Google Trends analysis was conducted to determine what general terms are most widely used in regard to ICT and ethics.

Figure 1 presents the Google Trends search percentages for terms from 2004 to 2022. Most terms gradually decreased in search volume after 2004, after the dot-com bubble burst but have been increasing again since 2020. The most searched term was "computer ethics", but "information ethics" began to overtake it around 2020. Around 2004, "computer ethics" was searched for the most, followed by "information ethics", "internet ethics", and "cyber ethics", in this order. Within the last five years, "information ethics" has begun to overtake "computer ethics", followed by "AI ethics". These search percentages are applied proportionately to the sizes of the circles in Figure 2.

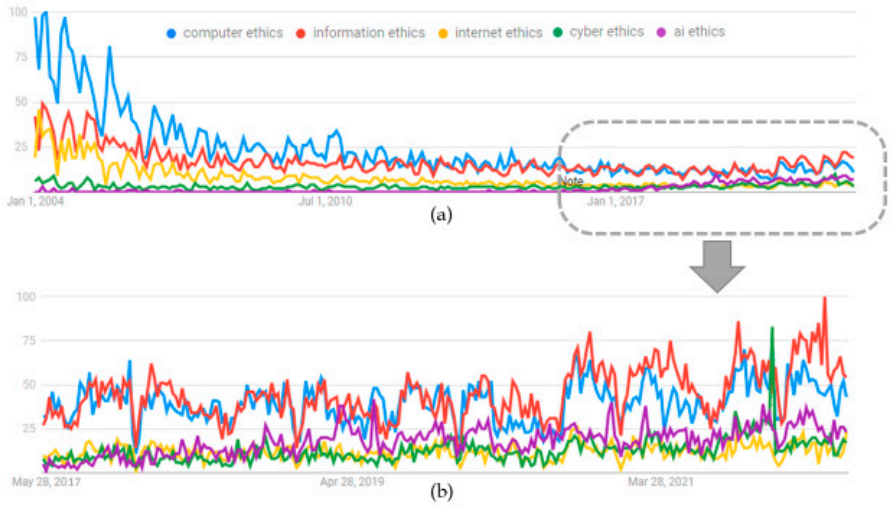


Figure 1. (**a**) Top: Google Trends search percentage for "computer ethics", "information ethics", "internet ethics", "cyber ethics", and "AI ethics" since 2004. (**b**) Bottom: Trends between 2017 and 2022.

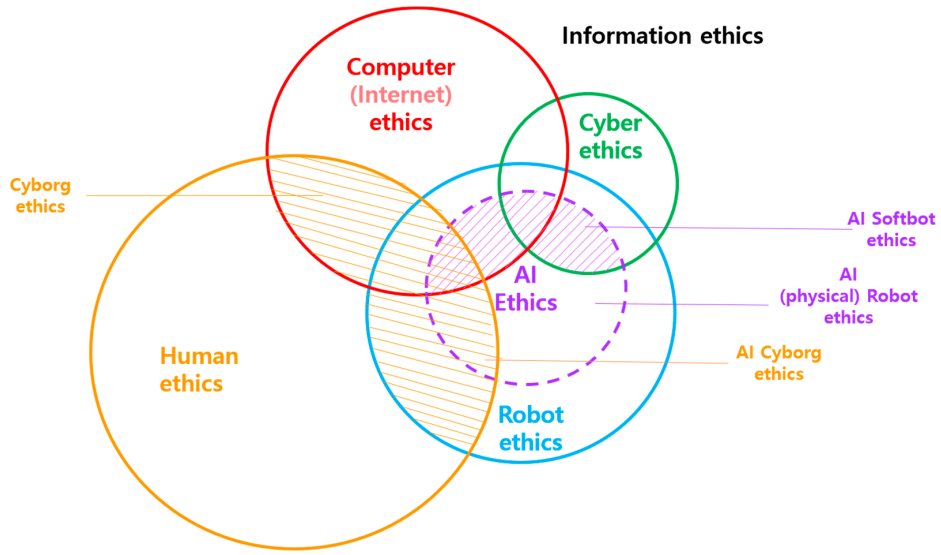


Figure 2. Framework for information ethics illustrating the union of computer (internet) ethics, cyber ethics, and robot ethics with human ethics.

3. Conceptual Framework for Information Ethics

This section introduces the proposed conceptual framework for five ethics domains—computer ethics, information ethics, cyber ethics, AI ethics, and robot ethics—that can be used to help teachers and students understand practical issues, definitions, and conceptual relationships.

"Computer ethics", "information ethics", and "internet ethics" have been the most frequently searched for and used terms, and since 2020, "information ethics" has been the most searched for term (Figure 1). Although they do not have as much search volume, "cyber ethics", "AI ethics", and "robot ethics" are additional terms that people are frequently exposed to, creating conceptual confusion around these ethical terms. Which term represents the highest order concept among computer ethics, internet ethics, cyber ethics, AI ethics, robot ethics, and information ethics? How can each area be visually distinguished for teachers and learners to be able to clearly understand their conceptual basis?

3.1. Overhead View of Information Ethics by ICT Platform

As information ethics was the most widely searched term, and studies such as Brey and Søraker [16], Bynum [1], and Onyancha [4] located information ethics higher than computer ethics and internet ethics, the proposed framework covering these five terms is defined within information ethics (Figure 2). This study classifies these ethical domains along three main computing platforms: computing devices (e.g., smartphones, laptops) without physical interaction, intermediary platforms (e.g., metaverse, video conferences, digital messengers, cyberworld), and physical computing devices (e.g., physical robots, self-driving cars, wearable robotic legs). Based on the related studies in Section 2 and the three platform types (computing devices, intermediary platforms, and physical computing devices), a relationship framework is drawn in Figure 2.

First, the domain of computer ethics, the ethics considered in the use of computing devices (e.g., smartphones, desktop computers), is put in the diagram. Traditional ethical issues belonging to this set may include game addiction, illegal software cloning, and unethical deepfake production or utilization. Issues mainly dealt with in internet ethics include hacking, personal information leaks, and defamation via internet connections. As shown in Figure 1, "internet ethics" steadily declined from 2004 to 2010, and the volume of searches for this term has remained relatively low since 2011. Because there are few standalone computers these days, with most connected to the internet, it is assumed that people tend to include internet ethics within computer ethics. Since the search volume for "internet ethics" is losing power, the ethics associated with computing devices are described as *computer (internet) ethics* in the proposed framework. Issues belonging to this set of ethics may include the aforementioned hacking, game addiction, illegal software cloning, unethical deepfake production, online abuse, personal information leaks, distribution of pornography, and others.

Second, where in the diagram should the cyber ethics domain, with its ethical issues on intermediary platforms (e.g., metaverse, SNS, online chat), be placed? According to the Google Trends analysis (Figure 1), "information ethics" and "computer ethics" are still frequently searched for terms, recently followed by "AI ethics." In contrast, "internet ethics" and "cyber ethics" show relatively small search volumes. However, why does cyber ethics continue to persist in terminology? "Cyber ethics" decreased slightly after 2004 and remained almost unchanged from 2010 to 2019. However, searches for the term increased slightly from 2020 on and, in the winter of 2021, soared suddenly close to the level of "information ethics". This temporary spike was likely caused by increased use of the metaverse due to the COVID-19 pandemic. Search interest in cyber ethics is expected to be more frequent after the pandemic than in internet ethics. Some of the main issues belonging to cyber ethics on intermediary platforms include SNS addiction, online defamation, illegal distribution of works, and sexual harassment in the metaverse. Because these issues overlap with those of computer (internet) ethics, the two domains are drawn to have an intersection in Figure 2.

Third, where is robot ethics located in relation to these circles in the diagram? Robots can refer to either softbots or physical robots equipped with programming. For example, chatbots are located at the intersection of robot and computer ethics, and metaverse or game agents, at the intersection of robot and cyber ethics. There are also areas of robot ethics that involve physical computing devices (e.g., robots and autonomous vehicles). As most people, including students, tend to think of robots only as physical computing devices, both softbots and physical robots should be clearly included as robots. Therefore, cyber ethics and computer ethics intersect with robot ethics and are thus overlapping domains, as shown in Figure 3.

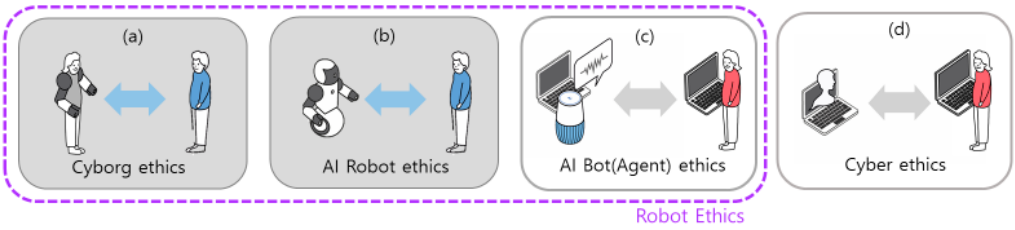


Figure 3. AI ethics among the four subcategories in information ethics by ICT platform.

Fourth, where is human ethics (ethics between humans) located in relation to computer (internet) ethics, cyber ethics, and robot ethics? As information technology and robot technology develop, humans are beginning to integrate them into the physical world to become cyborgs, for instance, by inserting computer chips into the body or by utilizing robotic legs. Therefore, human ethics is placed to intersect with computer ethics and robot ethics, with their intersection being cyborg ethics. However, it does not overlap with cyber ethics because the human body cannot enter the intermediary platform.

Last, how does AI ethics relate to these ethics areas, and where is it located? Since AI can be mounted on computers in the form of software, on robots, and on chips in the human body, AI ethics may overlap with all of them. These intersections consist of AI softbot ethics, AI physical robot ethics, and AI cyborg ethics. Examples of ethical issues in these areas are covered in more detail in the next section.

Finally, we obtained an information ethics framework consisting of computer (internet) ethics, cyber ethics, robot ethics, and AI ethics, as shown in Figure 3. The proposed framework locates computer ethics, robot ethics, and cyber ethics in close relation to human ethics. In the proposed framework, computer ethics encompasses internet ethics, while cyber ethics is independent. Figure 3 presents computer ethics as equivalent to internet ethics and as having an overlapping relationship with cyber ethics. The two circles are sized according to search volume. Since the search volume for "computer ethics" in Google Trends is higher than that of "cyber ethics", the difference is reflected In the sizes of the circles. However, although the search volume for "robot ethics" is insignificant compared to that of "computer ethics", the circle for robot ethics is similarly sized to that of computer ethics since it is distributed in a wide variety of the real world, such as automation machines and AI robots.

3.2. Horizontal View of Information Ethics by ICT Platform

Figure 2 presents the ethical domains of the ICT platform and the human platform from an overhead view. Figure 3 depicts Figure 2 from a horizontal view. Figure 3a represents cyborg ethics, in which AI chips and robot elements are combined with the human body; 3b shows a physical robot equipped with AI; 3c shows humans interacting with AI softbots, which include chatbots and smart speakers; and 3d illustrates humans interacting through real-time communication software or platforms. Both cyborg ethics (a) and AI robot ethics (b) are colored in gray to denote that interactions occur in the physical world (p-communication [3]), while AI bot ethics (c) and cyber ethics (d) occur in computing platforms (e-communication [3]).

Cyborg ethics (a), AI robot ethics (b), and AI bot(agent) ethics (c) can also be considered part of robot ethics and are marked with a purple dotted line. Depending on the type of platform on which AI is installed, AI ethics can exist in all areas (a, b, c, and d). An example of AI bot (agent) ethics might involve an AI bot in a game, while an example of cyber ethics might involve an AI bot that exists in real-time human connection platforms such as Metaverse. As AI ethics overlaps in many ways with information ethics, cyber ethics, and computer (internet) ethics, it is likely to be difficult for teachers and students to clearly distinguish the concepts of AI ethics from other ethics areas.

4. Application of AI Ethics

4.1. AI Ethics Cases

AI ethics overlaps with computer (internet) ethics, cyber ethics, robot ethics, and cyborg ethics. Their intersecting relationships may seem complicated, but taking a side view of their relationships, as in Figure 3, may make them easier to understand. This section provides examples of ethical problems that may arise in a current or future society in those four areas presented in Figure 3. The following are application examples that may be used in education to study AI ethics:

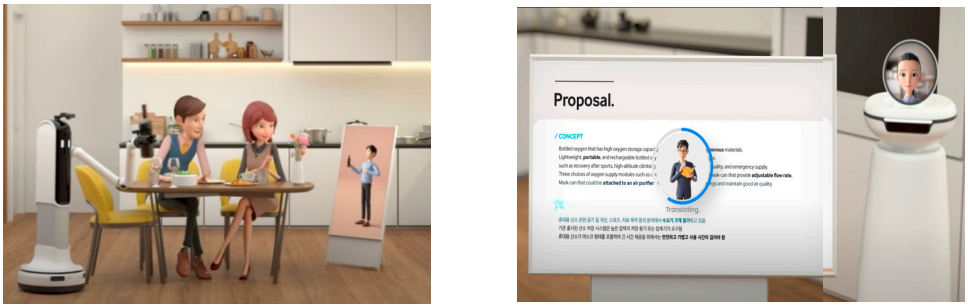
- Cyborg ethics cases: an accident caused by a malfunction in robotic legs worn by an elderly person; an AI chip in the head that can search for information on the internet and store it in the brain; use of a nudity application while using AR glasses. Tzafestas [2] emphasized not only issues arising from the enhancement of human physical functions but also issues that may arise due to changes in the nature of human mental processes brought on by linking human and machine functions.
- AI robotics ethics cases: acquiring and collecting sensitive personal information in interactions with social robots; interacting with autonomous vehicles to determine how to deal with accidents; illegal infringement of personal information by self-driving delivery robots (e.g., drones). For more examples, see Tzafestas's [2] cases in the branches of medical roboethics, assistive roboethics, sociorobot ethics, war roboethics, autonomous car ethics, and cyborg ethics.
- AI bot/agent ethics cases: a hospital appointment chatbot that selects and books only doctors who have paid an advertising fee; smart speakers that recommend services based on biased data; an agent in a game makes an optional attack after considering the gamer's win rate to promote purchase of game items.
- Cyber ethics cases: hacking during video conferencing; obscene dialogue or material presented in interactions with others' avatars in metaverse spaces; defamation or abuse in SNS; transfer and distribution through messenger platform of files not permitted due to copyright.

The ethics in each field of this proposed framework may be managed with guidelines or checklists provided by governments, users, and producers.

4.2. Classification of Examples from Future Society

In this section, examples from two animated shorts and a movie envisioning a future society are classified according to the proposed information ethics framework. In the first example, two robots, Bot i and Bot Handy, which appeared in Samsung's future home animations from CES 2022, illustrate different facets of the conceptual framework. Bot i is a medium-sized information-providing robot that connects people primarily through human-to-human communication services such as SNS and email, while Bot Handy is a robot that provides physical services, such as delivering water. In Figure 4a, the AI avatar in Bot i's monitor translates an email that the user receives. If the sender of the email has sent a file that infringes on the copyright, the situation can be classified under cyber ethics, and the main stakeholders become the sender and receiver of the email. If the AI avatar misinterprets transmitted email content based on biased data, the situation can be classified under AI ethics. Bot i also detects if users are at home and connects them with callers

for real-time meetings. If a problem occurs involving recording, transmitting, or hacking without user consent during a real-time meeting, it falls under cyber ethics.

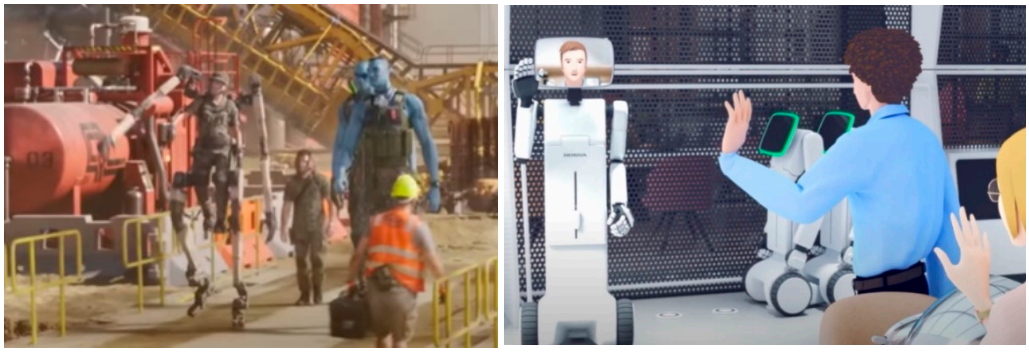


(**a**) Communicating with robots (**b**) Served by robots

Figure 4. Scenes from the Future Home Experience from Samsung (2022). (**a**) In the scene on the left, the user communicates with an AI avatar, Bot i. (**b**) In the scene on the right, users are served by Bot Handy and consult with a digital human.

In Figure 4b, a digital human offers information about wine, and Bot Handy pours the wine for the user. If Bot Handy does not stop pouring wine, crashes into a pet while delivering a wine bottle, incorrectly recognizes an order from the user, or rejects the user's order, its actions fall within AI robot ethics. If a digital human recommends wine from a wine company that has paid a lot of advertising fees or provided exaggerated favorable information, its actions will fall under AI ethics.

In the second example, Figure 5a shows a human boarding robot walking side by side with two Navi people from the movie *Avatar 2* (official teaser; 2022). What kind of ethics would apply to avatars created by injecting information from a human brain into another's body? It would be a violation of bioinformation ethics if avatars were made by putting distorted information into Navi people. If a human boarding a Navi-sized robot commits an assault, the action would correspond to cyborg ethics.



(**a**) (**b**)

Figure 5. (**a**) The image on the left shows a manned robot in Avatar 2 (2022). (**b**) The image on the right shows an animated telepresence robot from the Honda Lab.

In the final example, Figure 5b shows an animated version of a telepresence robot at the Honda Research Institute. In this scene, a person remotely connects to and controls real-time images with a robot and even performs physical interactions. Using this technology, doctors could also perform remote medical activities, and staff could give office tours of a business. However, using a telepresence robot, a remote controller could also face problems related to acquiring, storing, or transmitting images and photos without user consent. These circumstances could correspond to cyber ethics because they do not have harmful physical actions. If the robot were to malfunction and hit or injure someone, the action would be related to AI robotics ethics.

5. Conclusions

The "Ten Commandments of Computer Ethics" written by the Computer Ethics Institute consist of rules applying to hacking, digital literacy, netiquette, copyright protection, and privacy, and they are very clear and useful in education. However, these commandments represent only computer ethics, and certain problems, such as internet addiction, are mainly mentioned in the domain of internet ethics. They do not cover ethical issues surrounding AI, robots, and cyborg technology. The term *information ethics* is widely used and is sometimes presented as a concept similar to computer ethics, so it is difficult to clearly understand their differences, and they are easily confused. In addition, interest in various ethical issues related to AI is increasing as smart speakers, robots, AI agents, autonomous vehicles, and neural chips enter our lives. Countries around the world have begun to include policies for AI ethics education among policies to train human resources dealing with AI technology. Thus, to effectively implement AI ethics education, clear concepts must first be established for information ethics and computer ethics.

To help facilitate AI ethics education, the present study hierarchically conceptualizes information ethics, cyber ethics, AI ethics, and robot ethics based on existing research, including research on digital literacy and media ethics. It provides a framework that maps the relationship of terms based on three computing platforms: computing hardware devices, intermediary platforms, and computing devices. Since it is now difficult to think of computers and the internet separately, they are conceptualized as computer (internet) ethics or simply, computer ethics. Three major components make up the information ethics framework: computer ethics, cyber ethics, and robot ethics. Additionally, AI ethics consists of AI agent (softbot) ethics, AI (physical) robot ethics, and AI cyborg ethics. Through this conceptual framework, the ambiguous boundaries between cyber ethics, AI ethics, and robot ethics are clarified so students can distinguish various ethical issues based on platforms, such as hacking, information protection, copyright infringement, sexual harassment in the metaverse, fraud using deepfakes, and so on. Potential future examples corresponding to the ethical framework are also provided.

This framework was constructed by analyzing existing literature on computer ethics, internet ethics, cyber ethics, roboethics, and information ethics to find the boundaries and concepts that form AI ethics. It is intended to aid educators and students by making it easier to grasp the characteristics and commonalities of each ethics area. In addition, the examples of AI technology provided may help AI ethics policy makers organize checklists and policies in each area of ethics. This study made it an urgent goal to provide a visual concept of information ethics based on the ICT platform many teachers and students are familiar with. Future research should expand on what different scholars think about closely related topics and heuristically analyze this framework's appropriateness for AI ethics education designers, educators, and learners.

Funding: This research received no external funding.

Conflicts of Interest: The authors declare no conflict of interest.

References

1. Bynum, T. Computer and Information Ethics. 2015. Available online: https://plato.stanford.edu/archives/sum2018/entries/ethics-computer/ (accessed on 7 August 2022).
2. Tzafestas, S.G. Roboethics: Fundamental concepts and future prospects. *Information* **2018**, *9*, 148. [CrossRef]
3. Grodzinsky, F.S.; Miller, K.; Wolf, M.J. Toward a model of trust and e-trust processes using object-oriented methodologies. In Proceedings of the ETHICOMP 2010, Tarragona, Spain, 14–16 April 2010; pp. 265–272.
4. Onyancha, O.B. An informetrics view of the relationship between internet ethics, computer ethics and cyberethics. *Libr. Hi Tech* **2015**, *33*, 387–408. [CrossRef]
5. Wiener, N. *The Human Use of Human Beings: Cybernetics and Society*; Free Association Books: London, UK, 1989. ISBN 1-85343-075-7.
6. Wiener, N. *God & Golem, Inc.: A Comment on Certain Points Where Cybernetics Impinges on Religion*, 7th ed.; MIT Press: Cambridge, MA, USA, 1966. ISBN 978-026-273-011-2.
7. Maner, W. *Starter Kit in Computer Ethics*; Helvetia Press and the National Information and Resource Center for Teaching Philosophy: New York, NY, USA, 1980; (Originally Self-Published by Maner in 1978).

8. Moore, J. What is computer ethics? *Metaphilosophy* **1985**, *16*, 266–275. [CrossRef]
9. Hauptman, R. *Ethical Challenges in Librarianship*; Oryx Press: Phoenix, AZ, USA, 1988. ISBN 978-089-774-271-9.
10. Wong, E.Y.W. How should we teach computer ethics? A short study done in Hong Kong. *Comput. Educ.* **1995**, *25*, 179–191. [CrossRef]
11. Spinello, R.A.; Tavani, H.T. *Readings in Cyberethics*, 2nd ed.; Jones & Bartlett Learning: Burlington, MA, USA, 2004. ISBN 978-076-372-410-8.
12. Froehlich, T. A brief history of information ethics. *Comput. Soc. India Commun.* **2005**, *28*, 11–13.
13. Floridi, L. Information ethics: Its nature and scope. *Comput. Soc.* **2006**, *36*, 21–36. [CrossRef]
14. Akbulut, Y.; Şendağ, S.; Birinci, G.; Kılıçer, K.; Şahin, M.C.; Odabaşı, H.F. Exploring the types and reasons of Internet-triggered academic dishonesty among Turkish undergraduate students: Development of Internet-Triggered Academic Dishonesty Scale (ITADS). *Comput. Educ.* **2008**, *51*, 463–473. [CrossRef]
15. Kuzu, A. Problems related to computer ethics: Origins of the problems and suggested solutions. *Turk. Online J. Educ. Technol.* **2009**, *8*, 91–110.
16. Brey, P.; Søraker, J.H. Philosophy of computing and information technology. *Philos. Technol. Eng. Sci.* **2009**, *9*, 1341–1408. [CrossRef]
17. Kavuk, M.; Keser, H.; Teker, N. Reviewing unethical behaviors of primary education students' internet usage. *Procedia Soc. Behav. Sci.* **2011**, *28*, 1043–1052. [CrossRef]
18. Lau, W.W.F.; Yuen, A.H.K. Internet ethics of adolescents: Understanding demographic differences. *Comput. Educ.* **2014**, *72*, 378–385. [CrossRef]
19. Reader, J.; Savin-Baden, M. Ethical conundrums and virtual humans. *Postdigital Sci. Educ.* **2020**, *2*, 289–301. [CrossRef]
20. Akira, C. Ethics in Voice Technologies. Available online: https://www.compriseh2020.eu/ethics-in-voice-technologies/ (accessed on 7 August 2022).
21. Malle, B.F. Integrating robot ethics and machine morality: The study and design of moral competence in robots. *Ethics Inf. Technol.* **2016**, *18*, 243–256. [CrossRef]
22. Smakman, M.; Vogt, P.; Konijn, E.A. Moral considerations on social robots in education: A multi-stakeholder perspective. *Comput. Educ.* **2021**, *174*, 104317. [CrossRef]
23. Johnson, D.G. *Computer Ethics*, 4th ed.; Pearson: Toronto, ON, Canada, 2009. ISBN 978-013-111-241-4.
24. Bynum, T.W.; Maner, W.; Fodor, J.L. *Teaching Computer Ethics*; Southern Connecticut State University: New Haven, CT, USA, 1992.
25. AI4EU. Europe's AI-on-Demand Platform. Available online: https://www.ai4europe.eu/ (accessed on 7 August 2022).
26. Han, J.H.; Kim, J.W. Ethical dilemma on educational usage of AI speaker. *J. Creat. Inf. Cult.* **2021**, *7*, 11–19. [CrossRef]
27. Jung, I. Ethical judgments and behaviors: Applying a multidimensional ethics scale to measuring ICT ethics of college students. *Comput. Educ.* **2009**, *53*, 940–949. [CrossRef]
28. Dijck, J.V. Seeing the forest for the trees: Visualizing platformization and its governance. *New Media Soc.* **2020**, *23*, 2801–2819. [CrossRef]
29. Awad, E.; Levine, S.; Anderson, M.; Anderson, S.L.; Conitzer, V.; Crockett, M.J.; Everett, J.A.C.; Evgeniou, T.; Gopnik, A.; Jamison, J.C.; et al. Computational ethics. *Trends Cogn. Sci.* **2022**, *26*, 388–405. [CrossRef] [PubMed]