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Onoja Emmanuel Oche
Department of Cyber Security, Federal University of Technology, Nigeria

Suleiman Muhammad Nasir
Department of Computer Science, Federal Polytechnic Nasarawa, Nigeria

Adegboye Yusuf Kazeem
Department of Computer Science, Federal Polytechnic Nasarawa, Nigeria

Correspondence
Onoja Emmanuel Oche
Department of Cyber Security, Federal University of Technology, Nigeria

Ethical issues in computer as an instrument of technology growth

Onoja Emmanuel Oche, Suleiman Muhammad Nasir and Adegboye Yusuf Kazeem

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Abstract
The recent technological advancement in digital computers has provided a more robust computer based operations in modern industrial society, including manufacturing, transport and distribution, government, the military, health services, education and research. This impact of modern digital computers as an irreplaceable tool for technological growth may likely increase geometrically over the next century. Also, the numerous applications of computers in all facets of life are faced with known and unknown threats as the computer is vulnerable to malfunction and misuse. This creates problems such as computer crime, software theft, hacking, viruses, and the invasions of privacy. Each of these threats has created one or more ethical issues for the computer profession. This research therefore (i) investigates some of the fundamental aspects of ethical issues (such as privacy, computer crime, software piracy, and accessibility) in computer as an instrument of technology growth and its significance for the computer professional, (ii) evaluates the influence of computer ethics on technology growth from computer professionals' perspective and (iii) proposes solutions to ethical issues in computer through the help of practitioners who had excellent computer, information and communication technology background.

Keywords: Computer professionals, computer ethics, privacy, computer crime, software piracy

1. Introduction
The unlimited opportunities provided the increasing acceptability and application of computer since it global acceptability in the 1990s for general working approach, storing and sharing of data has given much ease and freedom which may be abused and used unethically (Li *et al*., 2023) [7] According Sargolzaei and Huang (2021) [2] the idea of having advanced technologies parallel to technological development is prevalent in most developing countries. The adoption of computers and the internet in all facets of society has not come with complimenting policies that will safeguard cyberspace.
To avoid this mishap, there is an urgent need for computer users and leaner to be conscious of the ethical issues associated with the computer profession as it will go a long way optimizing the usage and bailing computer users from errors of commission and omission besides freeing them from offending others and harming themselves (Ioannis *et al*., 2021) [11]. This research therefore aimed to determine ethical issues in computer as an instrument of technological growth, specifically, the study; (i) discusses some of the fundamental aspects of ethical issues (such as privacy, computer crime, software piracy, and accessibility) in computer as an instrument of technology growth and its significance for the computer professional, (ii) evaluates the influence of computer ethics on technology growth from computer professionals' perspective and (iii) recommends possible solution to ethical issues in computer

1.1 Fundamental Aspects of Computing Ethics
Computer ethics encompass personal morals and other legal rules that computer users will apply while using the computer in various forms such as software and hardware for various purposes such as transmission and usage of information and access to data. It describes various crimes in cyberspace (Li *et al*., 2023) [7]. These crimes may include access to data and information beyond users' privilege level, software plagiarism, hacking, social engineering, and espionage (MacIntyre *et al*., 2020) [3].
In computing technology, ethics is the analysis of the nature and social impact of computer

technology and formulation of policies to handle computer technology. Computer ethics arises because of a policy vacuum about how technology should be used. Technology is capable of many things. A conceptual vacuum exists inhibiting policy development. Policy makers are ignorant of the capabilities of new technologies. Individual preferences override sound legal reasoning for a policy (Kim, & Routlledge, 2018) [9].

Ethical issues in computer science discuss the relationships among facts, conceptualizations, policies, and values with respect to the trends in computer technology. This dynamism in technology calls for various policy controls in some areas such as; ubiquitous use of electronic mail, electronic transfer, reservation systems, the World Wide Web, artificial intelligence, computer security, smart card application, and information security (Kirsten *et al*., 2019) [1].

The phrase "emerging technology" refers to the notion of a technology's life cycle, which includes technological innovation or discovery, technological emergence, adoption, technological sublime, and technological surplus. Emerging technologies include, affective computing, ambient intelligence, artificial intelligence, bioelectronics, cloud computing, the future internet, human-machine symbiosis, neuro-electronic, quantum computing, robots, and virtual or augmented reality (Grosz *et al*., 2019) [13].

This recent advancement in information technology has brought a wide acceptance and implementation of smart cards as an ideal device for many transactions such as healthcare, telecommunication, banking, and many other applications, making the world a smart world. These technological paradigm shifts call for clear specification of norms and ethics in the cyber domain in order to deter breach of privacy and other security related issues (MacIntyre, *et al*., 2020) [3].

The primary goal of computer ethics is to serve as a policy of deterrence for all classes of computer users besides, it detects what is a computer crime, describes possible factors responsible for computer failure, how to protect the computer and software, and help to formulate the boundaries of individual and company privacy policy (Starke *et al*., 2021) [10]. Computer ethics also tries to resolves some issues in the cyber space such as; unauthorized use of hardware, the theft of software, disputed rights to products, the use of computers to commit fraud, the phenomenon of hacking and data theft, sabotage in the form of viruses, responsibility for the reliability of output, making false claims for computers, and the degradation of work (Li *et al*., 2023) [7].

1.2 Historical Milestone of Computer Ethics

In the mid-1970s, Walter Maner coined the phrase "computer ethics" to refer to the field of study concerned with ethical issues. He taught an experimental course on the subject at several colleges, as well as workshops and talks at computer science and philosophy conferences around the United States of America. In 1980, a slew of social and ethical ramifications of information technology were becoming public concerns throughout the world, ranging from computer-enabled criminality to disasters caused by computer breakdowns, breaches of privacy via computer databases, and big litigation challenges over software ownership (Kirsten *et al*., 2019) [1].

Throughout the 1990s, computer ethics received a lot of attention through many academic mediums. This period introduced a new chapter in computer ethics that focused on security. The critical task in this period is to think that future advances in information technology will make computer ethics more lively and essential than ever before (Kirsten *et al*., 2019) [1].

1.3 Ethical Issues in Computer

The four ethical concerns of the information era according to Li *et al*. (2023) are Privacy, Accuracy, Property, and Accessibility (PAPA). Other studies identified the most urgent ethical problems with computer technology as concerns with secrecy, privacy, access rights, fraud and abuse, patents, copyright, and piracy (Sargolzaei, & Huang, 2012) [2].

The development of information technologies and their capacity for processing, storing, and retrieving information and the increased importance of information in decision-making may encourage unauthorised individuals to get personal information by violating privacy (Li *et al*., 2023) [7].

With the rapid growth of technology, the problem of access rights has become a top concern for IT and the internet. This problem was made more serious for numerous business organizations and governmental organizations by the development of e-commerce and electronic payment systems on the internet. Unauthorized access cannot be prevented from a network on the internet. The intrusion detection systems are often used to assess whether a user is a legitimate user or an invader (Sargolzaei, & Huang, 2021) [2]. According to Kim and Routledge (2018) [9], important ethical problems in computers also include destructive behaviour, piracy, and patents. In the context of computer ethics, harmful behaviour refers to harm or unfavourable effects on information technology, such as the loss of crucial data, the loss of possessions, the loss of ownership, the destruction of property, and unfavourable significant effects. This code of ethics prohibits anybody from using information technology in a way that causes harm to any users, employees, employers, or members of the public (Kim, & Routledge, 2018) [9]. In order to secure computer software, before and immediately after a security breach, copyright law offers a very important legal weapon

1.4 Formulated Rules of Computing Ethics

As computer technology and innovations advance, computer ethics may need to develop. With the introduction of the internet, a wealth of etiquette became available to us. The Net: Use Guidelines and Netiquette (Hess, & Fore, 2018) is a well-known collection of online etiquette rules written by Arlene R. Some of this internet etiquette includes, but is not limited to: refraining from responding to phishing (a new scam that asks for personal information about computer users), checking the authenticity of any message requesting you to do something dubious, and avoiding flaming (i.e., sending messages that provoke). Typing in all capital letters is considered shouting and is therefore impolite.

Because of this, several professional organizations in the field of computers, like the Association of Computer Machinery (ACM), the Computer Ethics Institute (CEI), the Management Information Technology (MIT), and others, have created codes of ethics to engage in problematic behaviour, refrain from flaming (i.e., sending provocative remarks) and responding to phishing (a new fraud that

requests information about computer users) (Ioannis *et al*., 2021) [11].

In order to stop some of the aforementioned ethical problems in computing, several rules known as "commandments of computer ethics" have been developed by computer experts. These professional bodies and end users, in summary, are led by the following ten (10) commandments of computer ethics. Among them is (i) Do not use a computer to hurt others. (ii) Do not obstruct anyone else's computer work. (iii) Avoid looking into other people's files. (iv) Avoid using a computer to commit theft. (v) Do not fabricate evidence using a computer. (vi). Software that you haven't paid for should not be used or copied. (vii) Never use another person's computer without their permission. (viii) Avoid using the creative work of others for your own purposes. (ix) Do consider how the programme you develop will affect society. (x) Always treat computers with respect and attention (ACM, 2018) [14].

1.5 Impact of Computing Ethics

The ethics of computers have made a beneficial impact on the advancement of technology in all areas of life. It prevents dangerous and unlawful use of computing technology and offers guidelines for concept creation, implementation, application, usage, and protection of computers (Lester, & Dalat, 2019) [12].

Software engineers benefit from computing ethics because it ensures that their efforts will be focused towards excellent, ethical development and a respectable profession. This has produced advancements in robotic engineering, data mining, and smart gadgets (Starke *et al*., 2021) [10].

The founder of the Free Software Foundation, Richard Stallman, thinks that software ownership should never be permitted (Basnard, & Arief, 2020) [8]. He argues that everyone should have access to free knowledge and that all programmes should be open for everyone to copy, study, and alter. This philosophy gave rise to open-source software, which has generated significant technical advancement (Basnard, & Arief, 2020) [8]. The similar idea underlies the Android operating system.

According to Ioannis *et al*. (2021) [11], by enacting users' privacy rules that will foster user confidence and encourage technology adoption, computing ethics, according to Kirsten *et al*. (2019) [1], has been able to reduce the misuse of personal information generated from social media platforms, smart devices, e-banking (Credit and debit card), e-commerce platform, and e-health system.

In Tadayoshi *et al*. (2023) [4], by discouraging software users from downloading and using software illegally, computing ethics safeguards computer professionals at all levels against the loss of numerous employment, particularly in the field of software development and by establishing rules that prevent computer users and experts from acting unethically, computer ethics has aided in the advancement of technology. Such standards reduce the frequency of cybercrime, cyber espionage, and other dangerous activity, which in turn fosters technological innovation and improves the security of the computing environment.

Computer ethics therefore prohibits the theft of intellectual property, including data, software, hardware designs, discoveries, and other material stored online and in the cloud.

1.6 Summary Related Literatures

The most helpful examples of information technology and computer (IT) growth include current security policies, smart card application, and information security ethics, according to Aderibigbe, and Ocholla (2020) [6]. To assure the successful effect of information technology, many controls and procedures are adopted.

Emphasising on computer ethics, Grosz *et al*. (2019) [13], stated that the influence of computing ethics on society and human welfare has guaranteed a high standard of living for all, affirmed a responsibility to defend fundamental human rights and respect the diversity of all cultures, and minimized unfavorable effects of computing systems, such as risks to health and safety. This concept forbids the use of computing technology in a manner that endangers users, the public at large, employees, and employers.

Discussing confidentiality and privacy issues, Kirsten *et al*., (2019) [1] observed that computers enable users to access servers that are connected to each other and to users over a network even though they have their own hardware, operating systems, and software tools. Due to the network's extensive distribution, there is a high volume of data or information transmission, which increases the potential for information leaks and privacy violations against specific people or groups. The preservation of data integrity and privacy is a significant concern for IT society and organisations. The privacy problem also includes procedures to preserve the accuracy of data and accidental exposure to improper parties.

2. Methodology

This research adopted a critical literature review for knowledge gap and utilises a survey method of data gathering for evaluation and analysis. The data was gathered using questionnaires administered to computer professionals and students within Abuja Metropolis, Nigeria. A sample size of one hundred and twenty (120) questionnaires with respondents of one hundred and ten (110) and unfilled questionnaires of ten (10),

2.1 Evaluation, Analysis of Results and Discussion

This study therefore presents an analysis of ethical issues in computers as an instrument to technology growth as follows.

1. As a computer professional, do you observe most of the ethical principles in your profession?

Table 1: Observance of Computer Ethics

Variables	Frequency	Percentage (%)
Yes	109	99.1
No	1	0.9
Don’t Know	-	-
Total	110	100

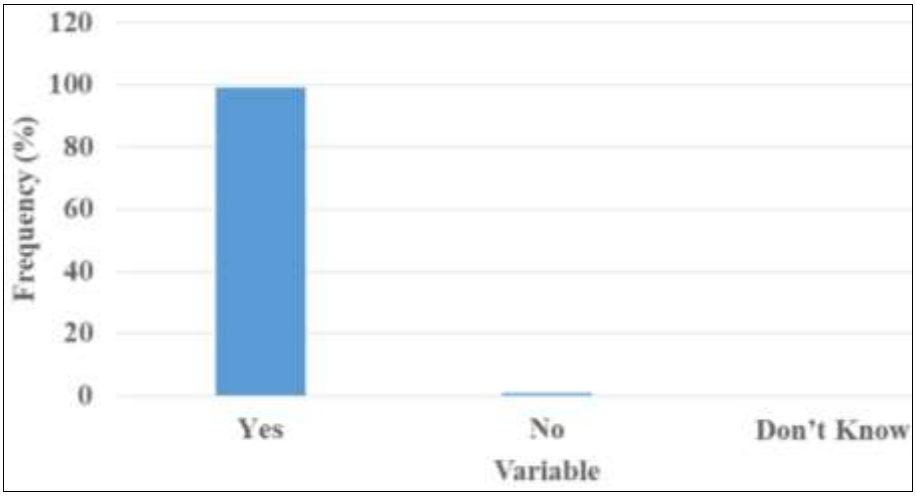

Fig 1: Observance of Computer Ethics

Table 2.1 and figure 2.1 show that 99.1% of computer professionals in the Abuja metropolis agreed to be guided by ethical principle guiding the computer profession with just 0.9% disagreeing.

2. Can awareness of computer ethics minimise major computer/technology crimes in the country?

Table 2: Awareness of Computer Ethics

Variables	Frequency	Percentage (%)
Yes	104	94.5
No	5	4.5
Don't Know	1	0.9
Total	110	100

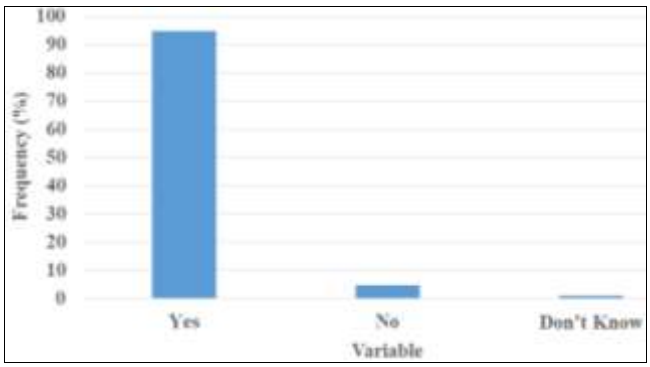

Fig 2: Awareness of Computer Ethics

Table 2.2 and figure 2.2 show that 94.5% of computer technology related professionals agreed that awareness of computer ethics can minimise computer and technology related crimes in the country, 4.5% disagreed while 0.9% is of no opinion.

3. To what extent does computer ethics promote technology growth?

Table 3: Influence of Computer Ethics on Technology Growth

Variables	Frequency	Percentage (%)
High	106	96.4
Medium	3	2.7
Low	-	-
None	-	-
No response	1	0.9
Total	110	100

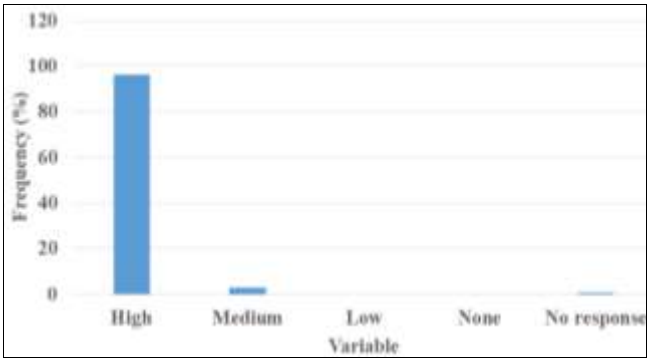

Fig 3: Influence of Computer Ethics on Technology Growth

Table 2.3 and figure 2.3 show that 96.4% of computer professionals agreed that computer ethics highly promotes technology growth whereas 2.7% agreed that computer ethics has a medium influence on technology growth.

4. To what extent does computer ethics promote standard software development and services?

Table 4: Influence of Computer Ethics on Software Development and Services

Variables	Frequency	Percentage (%)
High	106	96.4
Medium	3	2.7
Low	-	-
None	-	-
No response	1	0.9
Total	110	100

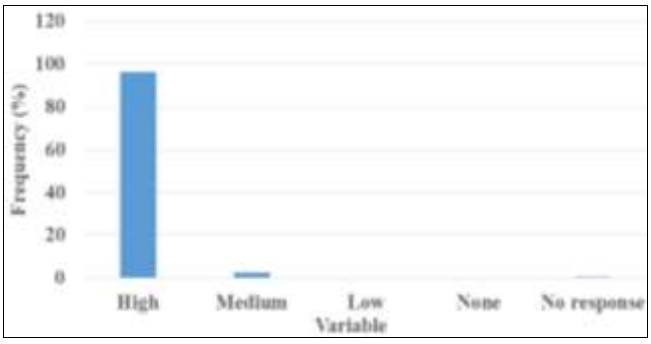

Fig 4: Influence of Computer Ethics on Software Development and Services

Table 2.4 and figure 2.4 show that computer ethics has a

high, 96.4% positive influence on software development and services. His implies that there is a better software services and design due to computer ethics.

5. To what extent has computer ethics enhanced security features against data breach and privacy in modern technology?

Table 5: Security Enhancement against Data Breach and Privacy

Variables	Frequency	Percentage (%)
High	108	98.2
Medium	1	0.9
Low	-	-
None	-	-
No response	1	0.9
Total	110	100

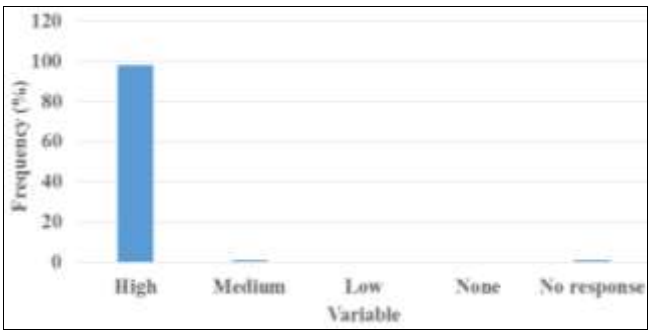

Fig 5: Security Enhancement against Data Breach and Privacy

Table 2.5 and figure 2.5 show that the availability of computer ethics in computer technology has enhanced data and privacy security in modern technology to about 98.2%.

6. What is the level of implementation of computer ethics in your organization?

Table 6: Level of Implementation of Computer Ethics

Variables	Frequency	Percentage (%)
High	42	38.2
Medium	27	24.5
Low	20	18.2
None	20	18.2
No response	1	0.9
Total	110	100

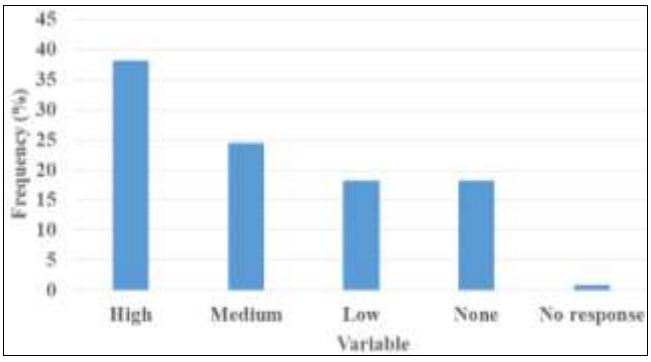

Fig 6: Level of Implementation of Computer Ethics

Though computer ethics has a high impact on technology, its implementation in some ICT organizations is at 38.2% high, 24.5% medium and 18.2% low as shown in table 2.6 and figure 2.6 above.

7. Do you agree that computer ethics has greatly reduced software piracy and other counterfeit technology?

Table 7: Influence of Computer Ethics on Software Piracy and other Counterfeit Technology

Variables	Frequency	Percentage (%)
Strongly Agreed	78	70.9
Agreed	20	18.2
Not Sure	4	3.6
Disagreed	7	6.4
No Response	1	0.9
Total	50	100

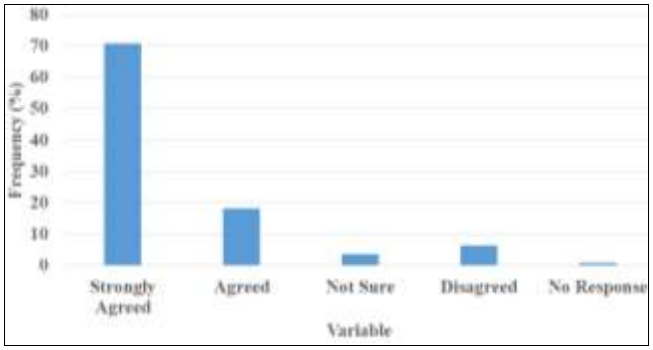

Fig 7: Influence of computer Ethics on software piracy and other counterfeit technology

Table 2.7 and figure 2.7 show that computer ethics has reduced software piracy and other counterfeit technology by 70.9%.

2.1.1 Conclusion

The paper investigates ethical issues in computers as an instrument of technology growth by highlighting basic concepts, common examples, and various applications of computer ethics. The need for ethical standards among computer professions was discussed as a major tool for good software development and services.

Survey of opinion from computer and other technology related fields showed that computer ethics has really contributed to advancement in all spheres of technology.

2.1.2 Recommendation

This study therefore recommends that computer ethics should be implanted in all organizations and incorporated into school curriculum as a means of creating awareness and maximizing rate of adoption. This research proposes that the only solution to ethical issues in computer science and other related fields is to include computer ethics in the system development life cycle.

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