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# Ethical issues in computer as an instrument of technology growth

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**Abstract**
The digital computer is a key technology of the modern era and has been central and essential to key operations in modern industrial society, including manufacturing, transport and distribution, government, the military, health services, education and research. Their impact as instrument for technological growth will most likely increase over the next century. Due to the numerous applications of computer in daily activities, they are vulnerable to malfunction and misuse, creating problems such as computer crime, software theft, hacking, viruses, invasions of privacy, an over- reliance on intelligent machines and workplace stress, each of which has created one or more ethical dilemmas for the computer profession. This study therefore (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) 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 increasing choices and opportunities provided by information technologies since the introduction of computers globally in the 1990s where the entire approach of working, communicating and storing important information has been changed have given so much of ease and freedom which may be used in an unethical way (Brey, 2012) [6]. It is therefore of great important that before an individual learn how to operate a computer system, he/she need to be conscious of learning associated ethics (Bernd, 2012) [4]. This goes a long way optimizing usage and bailing computer users from errors of commission and omission besides freeing them from offending others and harming themselves.

According to Sollieand and Duwell (2009), in most developing countries, individuals like to have advanced technologies parallel to technological developments. Among these, computers and Internet have been adopted in all areas of the society bringing them to an influential and unique position in these areas. Using computers to store and process information and using the Internet to access information have become rapidly developing habits in society. In this regard, developing and sharing policies to implement these technologies carry utmost importance as they are quite influential in individuals' current practices and future lives (Quilici *et al.,* 2010) [14].

Computer ethics are nothing but how a computer professional uses personal morals and ethics while using the computer for various purposes. They consist of all the rules that computer users would apply to not misuse any information, or to access any data beyond users' privilege level at the sometimes avoiding any form of cybercrimes, plagiarism, hacking and password thefts (Wassom, 2014) [19].

According to Popescul and Georgescu (2014) [13] the need for computer ethics is not limited to issues like; computer crime, responsibility for computer failure, protection of computer property, records, and software; and privacy of the company, workers, and customers but a policy of deterrence for computer professionals and technologists

Besides individual benefits, computer ethics 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

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form of viruses, responsibility for the reliability of output, making false claims for computers, and the degradation of work (Wright & Friedewald, 2013) [20].

Manipulating technology in a way to use information correctly and realize information flow effectively is a necessity (Brey, 2000) [5]. However, ineffectiveness of policies to guide individuals while using computers to serve for the greater good allows unique ethical problems to emerge. Such problems urge all individuals to consider computer ethics in a more meticulous way.

Discussing ethical issues in computer technologies, Johnson (2001) [8] suggested traditional moral norms and their underlying principles and applying new situations that are created by computer and communication technologies should be considered when analyzing computer ethics.

The research aimed to determine ethical issues in computer ethics 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) proposes possible solution to ethical issues in computer

## 1.1 Basic Concepts of Computing Ethics

According to Kirsten *et al.*, (2019) [9] researchers have recently concluded that computer ethical issues must be considered before building a prototype or developing a new computing paradigm. In software engineering discipline, high-level requirements such as ethical concerns raised by features of the system must be considered in the very first phases of systems development. If ethics are taken into account as an afterthought, the new system or paradigm may break a number of ethical principles and may be very difficult and costly to modify.

A sound understanding of ethics is a key component of the professional status that professional bodies such as the Association for Computing Machinery (ACM) aspire to. Professional computer scientists and related technical experts (e.g., software engineers, data scientists) are interested in the social and ethical consequences of their work to ensure that computing can realize its potential benefits. These professionals also need to understand the forces that shape the social and regulatory environment in which they act (Adekola *et al.*, 2013) [2].

The increasing ubiquity of computing technologies and artefacts leads to the growing relevance of ethical aspects of computing which most researchers refer to as standards of conduct, standards that indicate how one should behave based on moral duties and virtues, which themselves are derived from principles of right and wrong (Wright & Friedewald, 2013) [20].

As a practical matter, according to Stahl, (2012), ethics is about how computer professionals meet the challenge of doing the right thing in spite of the cost and consequences.

Ethics has many interrelated but distinct meanings, at the most basic level, it refers to the perception use of computer in a right, proper, acceptable, or socially appropriate manner (Sollieand & Duwell, 2009)

In computing technology, it 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 capabilities of new technologies. Individual preferences override sound legal reasoning for a policy (Adekola *et al.*, 2013) [2].

Computer ethics therefore includes consideration of both personal and social policies for the ethical use of computer technology as it is a study of relationships among facts, conceptualizations, policies, and values with regard to constantly changing computer technology (Sollieand & Duwell, 2009).

To ensure successful effect of information technology, various controls and measures needed to implemented in areas such as such as; ubiquitous use of electronic mail, electronics transfer, reservation systems, the World Wide Web, artificial intelligence, computer security, smart card application, and information security (Kirsten *et al.*, 2019).

In the current growth of information technology; the last decades have brought smart card as an ideal device for any transaction such as healthcare, telecommunication, banking, and many other applications. Norms and ethics needed to be clearly defined to avoid breach of privacy and other security related issues (Brey, 2012) [6].

## 1.2 Historical Milestone of Computer Ethics

In the mid-1970, Walter Maner began to use the term computer ethics to refer to the field of inquiry dealing with ethical problems. He offered an experimental course on the subject at many universities, workshops and lectures at computer science conferences and philosophy conferences across the United States of America (Adekola *et al.*, 2013) [2].

In 1980, frequent numbers of social and ethical consequences of information technology were becoming public issues in the world, from computer-enabled crime, disasters caused by computer failures, invasions of privacy via computer databases to major law suits on software ownership

In Kirsten *et al.*, (2019) [9], during the 1990s, much attention was given to the field of computing ethics through medium such as university courses, research scholars, conferences, journals, articles and textbooks. This era, generated new chapter of computer ethics with security in mind.

The important mission in this era is to believe that future developments in information technology will make computer ethics more vibrant and more important than ever

## 1.3 Ethical Issues in Computer

It is clear that technology provides individuals and the society with several benefits accompanied by serious ethical problems. When ignored or neglected, these accompanying problems might even interfere with the societal values and moral mechanisms.

Abdullah (2009) [1] lists four ethical issues of the information age: privacy, accuracy, property and accessibility (PAPA). Other researchers highlighted confidentiality, privacy, access right, fraud and misuse, patents, copyright and piracy issues as the major pressing ethical issues in computing technology.

In Abdullah (2009) [1], the growth of the information technologies with their capacity for control, communication, information processing, storage and retrieval; and the increased value of information in decision-making might

lead decision makers to try to acquire our personal information by invading our privacy.

Summarising ethical issues in computing, Abdullah (2009) [1] stated that accuracy is related to the correctness of information delivered through ICTs. Information might be used to mismanage people's lives particularly when the party using inaccurate information has more power and authority. The most confronted and complicated of ethical issues is the question of intellectual property rights. Information can be quite costly to produce in the first instance. Wright and Friedewald (2013) [20] stated that transmission and reproduction of the information might be problematic as it could invade the rights of the producers. In addition, there might be problems in allocating the access to this information where accessibility can be referred to as the conditions under which a person or an organization can have a right or privilege to obtain information. It is therefore necessary to determine rules and principles and to create a consensus within the society through conducting evaluations based on these principles,

Samson et al., (2015) discussing confidentiality and privacy issues, observed that computer facilitates the users having their own hardware, operating system and software tools to access the servers that are connected to each other and to the users by a network. Due to the distribution of the network on a large scale, data or information transfer in a big amount takes place which leads to the hidden chances of disclosing information and violating the privacy of any individuals or a group. It is a major challenge for IT society and organizations to maintain the privacy and integrity of data. Accidental disclosure to inappropriate individuals and provisions to protect the accuracy of data also comes in the privacy issue.

Adekola et al., (2013) [2] stated that access right becomes a high priority issue for the IT and cyberspace with the great advancement in technology. E-commerce and Electronic payment systems evolution on the internet heightened this issue for various corporate organizations and government agencies. Network on the internet cannot be made secure from unauthorized access. Generally, the intrusion detection systems are used to determine whether the user is an intruder or an appropriate user.

On the issues of fraud and misused of computer, Waleed et al., (2012) [18] asserted that the computer can create a unique environment in which unauthorized activities can occur. Crimes in this category have many traditional names including theft, fraud, embezzlement, extortion, etc. Computer-related fraud includes the introduction of fraudulent records into a computer system, theft of money by electronic means, theft of financial instruments, theft of services, and theft of valuable data (Brey, 2012) [6].

Discussing liability as an ethical issue, Kirsten et al., (2019) [9] stated that promises and affirmations made by the software developer to the user about the nature and quality of the program can also be classified as an express warranty. Such statements have to be realistic when stated and any claims and predictions about the capabilities, quality, and nature of software or hardware should stands as a warranty. In Brey (2012) [6], the legal aspects of these affirmative promises and prediction on product description should be as legally effective as though stated in writing. Thus, to protect against liability, all agreements should be in writing. A disclaimer of express warranties can free a supplier from being held responsible for any informal, hypothetical statements or predictions made during the negotiation stages.

Kim and Routledge (2018) [21], harmful actions, piracy and patent are also serious ethical issues in computing. Harmful actions in the computer ethics refers to the damage or negative consequences to the information technology such as loss of important information, loss of property, loss of ownership, destruction of property and undesirable substantial impacts. This principle of ethical conduct restricts any outsiders from the use of information technology in manner which leads to any loss to any of the users, employees, employers and the general public.

Piracy is an activity in which the creation of illegal copy of the software is made. As laws made for copyright protection are evolving, also legislation that would stop unauthorized duplication of software is in consideration (Kim & Routledge 2018) [21].

Copyright law provides a very significant legal tool for use in protecting computer software, both before a security breach and certainly after a security breach. This type of breach could deal with the misappropriation of data, computer programs, documentation, or similar material. For this reason, the information security specialist will want to be familiar with basic concepts of copyright law (Kim & Routledge 2018) [21].

The term 'emerging technology' is linked to the idea of a life cycle of a technology which include; technological invention or discovery; technological emergence; technological acceptance; technological sublime (in which its value is fully appreciated) and technological surplus (Wright & Friedewald, 2013) [20].

Emerging technologies can thus be defined as those currently being developed and holding a realistic potential to not only become reality, but to become socially and economically relevant within the foreseeable future. Instances of emerging technologies include; affective Computing, ambient Intelligence, artificial Intelligence, bioelectronics, cloud Computing, future Internet, human-machine symbiosis, neuroelectronic, quantum Computing, robotics and virtual / augmented reality (Brey, 2012) [6].

Focusing on effective computing and ICTs, this study considers ethical issues and impacts on large-scale socio-technical systems that make use of computer, network, and other information technology to significantly affect the way humans interact with the world (Adekola et al., 2013) [2].

These emerging technologies are perceived to exacerbate privacy issues or even create novel ones as they offer new ways of storing, processing, and interpreting this data deluge. A good example of this is affective computing, which holds the promise of harvesting data on emotional states, which may have consequences that are currently not been fully understood (Adekola et al., 2013) [2].

Personal autonomy can be affected by emerging technologies especially in a situation where people delegate tasks and decisions to (smart) applications. Emerging ICTs enable the creation of persuasive and coercive systems able to manipulate individuals into performing certain unwanted or involuntary behaviour. These and many more are ethical issues that confront computing technology. Rules and standards have been formulated to protect computer users and guide professionals in their daily usage, interactions and designs of computer (Brey, 2012) [6].

## 1.4 Formulated Rules of Computing Ethics

Computer ethics might have to grow as we have more computer technology and more inventions. The advent of the internet brought us a lump sum of etiquette to feed upon. Arlene R wrote a well-respected set of internet guidelines called "The Net: Use guidelines and Netiquette (Adesina & Stephen, 2013). Some of this netiquette include but not limited to; typing in all capital letter is considered shouting and therefore rude, use subject line to reveal an idea of the mail content, check the authenticity of any message requesting you to do something questionable, avoid responding to phishing (a new scam asking for information about computer user), and avoid flaming (i.e., sending messages that provokes).

Computer professional form part of the group who made tools available for use in the computing field. They include programmers, designers, database administrators among others. These are the people can cause great harm since they are familiar with the strength and the weakness of the computing system. For this reason, many computers professional bodies such as Association of Computer Machinery (ACM) Computer Ethics Institute (CEI), Management Information Technology (MIT) and others have developed codes of ethics (Adekola *et al.,* 2013) [2].

These professional bodies and end users, in summary are guided by the following 10 commandments of computer Ethics in order to curb some of the aforementioned ethical issues in computing, some guidelines known as "commandments of computer ethics" has been formulated by computer professionals. These include; (i) Do not use a computer to harm other people. (ii) Do not interfere with other people's computer work. (iii) Do not snoop around in other people's files. (iv)    Do not use a computer to steal. (v) Do not use a computer to bear false witness. (vi). Do not use or copy software for which you have not paid. (vii) Do not use other people's computer resources without authorization. (viii) Do not appropriate other people's intellectual output. (ix) Do think about the social consequences of the program you write. (x) Always use a computer in ways that show consideration and respect.

## 1.5 Impact of Computing Ethics

Ethics of computing has positively contributed to the development of technology in all spheres of life. It serves as a deterrence to malicious and criminal use of computing technology and provide guideline for idea design, implementation, application, use and protection of computer (Taherdoost *et al.,* 2009) [17].

The impact of computing ethics on software developers ensure that their efforts will be used for good, ethical development and for beneficial and respected profession. This has led to breakthrough in artificial intelligence, robotic engineering, data mining and smart devices (Samson *et al.*, 2015),

The impact of computing ethics on society and human wellbeing has ensured quality of life of all people, affirms an obligation to protect fundamental human rights and to respect the diversity of all cultures and minimize negative consequences of computing systems, including threats to health and safety. This principle prohibits use of computing technology in ways that result in harm to any of the following: users, the general public, employees, and employers (Wassom, 2014) [19].

In the current growth of information technology; the last decades have brought smart card as an ideal device for any transaction such as healthcare, telecommunication, banking, and many other applications. Smart card provides better possibilities for security, customization and improved services for users (Kirsten *et al.*, 2019) [9]. Understanding the factors that influence user acceptance of this aspect of current development is vital for sophisticated consumer with respect to ethical action and reaction, where knowing the customers ethical and intentional behaviour to use smart cards should be the key element in any decision-making process. Such issues that affect end users of new technology are centre focus of computing ethics. Rules have been put in place to protect individual through the inclusion of computing ethics in emerging technology.

According to Meysam and Hamed (2009) [22], Richard Stallman who started the Free Software Foundation, believe that software ownership should not be allow at all. He claims that all information should be free, and all programs should be available for copying, studying and modifying by anyone who wishes to do so. This ideology gave birth to open-source software which has led to a hug technological growth same concept working for android operating system. Other computer professionals argue that software companies or programmers would not invest weeks and months of work and significant funds in the development of software if they could not get the investment back in the form of license fees or sales, this idea gave birth to proprietary software such as Microsoft and Mac which have contributed hugely to computer technology (Samson *et al.*, 2015).

According to Kirsten *et al.*, (2019) [9], computing ethics has been able to minimize the misuse of personal information generated from social media platform, smart devices, e-banking (credit and debit card), ecommerce platform and e-health system by enacting users' privacy rules that will build trust and promote technology adoption.

According to Wassom (2014) [19] computer ethics prevents theft of intellectual property in form of software, hardware design, discovery, research, data and other information stored on cloud and internet.

In Bernd, (2012) [4], ethics of computing protects computer professionals at all level against loss of various jobs especially in the field of Software Development by deterring software user from illegal download and use of software.

Computer ethics has contributed to technological growth by stating standards which keep computer user and professionals from being unethical. Such standards minimize the rate of cybercrime, cyber espionage, and other malicious which in turn promote technology advancement and make the computing environment a safe and better place (Samson *et al.,* 2015).

## 2. Summary Related Literatures

In Taherdoost, *et al.*, (2009) [17], to ensure successful effect of information technology, various controls and measures is implemented, current security policies, smart card application, and information security ethics are the most useful examples of information technology and computer (IT) growth.

As one of the preliminary researches regarding computer ethics in Turkey, Çevik and Kuzu (2006) investigated problems experienced in K-12 computer laboratories regarding computer security along with solutions proposed by computer teachers. The most cited computer security problems were unauthorized access to others' personal files

(92%), and removing somebody else's files from a shared computer (82%). Findings suggested that K-12 students were not informed sufficiently about ethical issues regarding ICTs.

Mollavelioğlu (2003) investigated the ethical use of information technologies in small- and mid-size enterprises along with the perspectives of managers and vice managers regarding computer ethics. Findings revealed that more than half of the enterprises (53.3%) used unlicensed software. Forty percent of the managers thought that their employers had little working knowledge on computer ethics. The majority reported to be exposed to computer crimes (86.7%). Most managers (76%) thought that controlling and checking the contents of employers' e-mails was inconvenient. In addition, they considered employers' chatting (72 %) and surfing adult websites (93%) quite inconvenient even if employers did not hamper the work. Most enterprises did not have any formal precautions regarding computer ethics.

## 3. Research evaluation, analysis of results and discussion

Using a sample size of one hundred and twenty (150) questionnaires with respondent of one hundred and ten (110) and unfilled questionnaires of ten (10), this study therefore present analysis of ethical issues in computer 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 3.1:** Observance of Computer Ethics

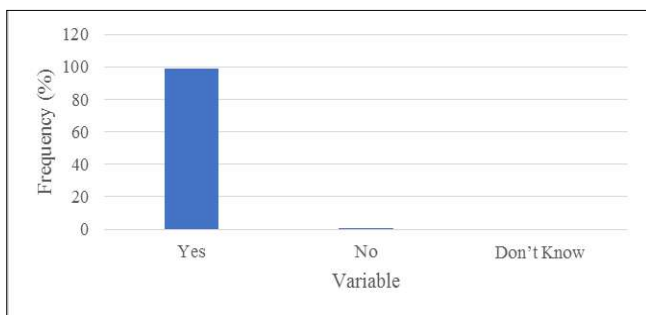| Variables | Frequency | Percentage (%) |
|---|---|---|
| Yes | 109 | 99.1 |
| No | 1 | 0.9 |
| Don't Know | - | - |
| Total | 110 | 100 |



**Fig 3.1:** Observance of Computer Ethics

Table 3.1 and figure 3.1 show that 99.1% of computer professionals in Abuja metropolis agreed to be guided by ethical principal guiding computer profession with just 0.9% disagreeing.

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

**Table 3.2:** Awareness of Computer Ethics

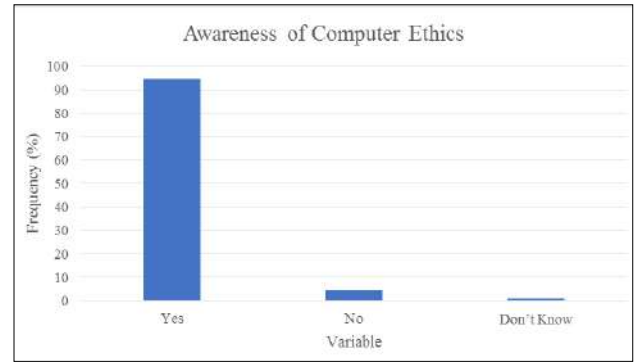| Variables | Frequency | Percentage (%) |
|---|---|---|
| Yes | 104 | 94.5 |
| No | 5 | 4.5 |
| Don't Know | 1 | 0.9 |
| Total | 110 | 100 |



**Fig 3.2:** Awareness of Computer Ethics

Table 3.2 and figure 3.2 show that 94.5% of computer technology related profession agreed that awareness of computer ethics can minimize 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 promotes technology growth?

**Table 3.3:** Influence of Computer Ethics on Technology Growth

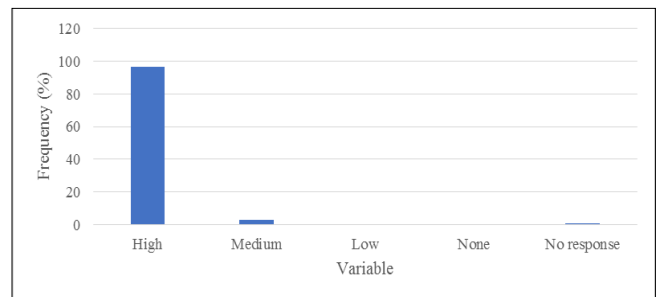| Variables | Frequency | Percentage (%) |
|---|---|---|
| High | 106 | 96.4 |
| Medium | 3 | 2.7 |
| Low | - | - |
| None | - | - |
| No response | 1 | 0.9 |
| Total | 110 | 100 |



**Fig 3.3:** Influence of Computer Ethics on Technology Growth

Table 3.3 and figure 3.3 show that 96.4% of computer professional 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 3.4:** Influence of Computer Ethics on Software Development and Services

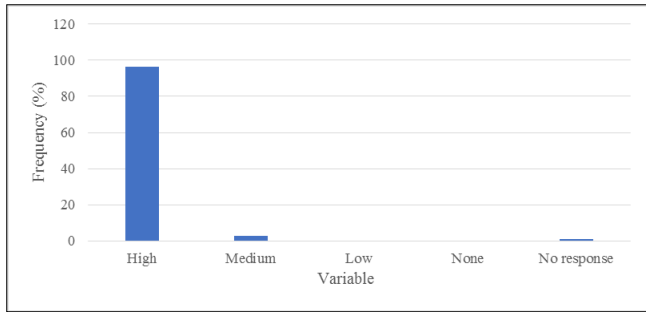| Variables | Frequency | Percentage (%) |
|---|---|---|
| High | 106 | 96.4 |
| Medium | 3 | 2.7 |
| Low | - | - |
| None | - | - |
| No response | 1 | 0.9 |
| Total | 110 | 100 |

**Fig 3.4:** Influence of Computer Ethics on Software Development and Services

Table 3.4and figure 3.4 show that the 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 3.5:** Security Enhancement Against Data Breach and Privacy

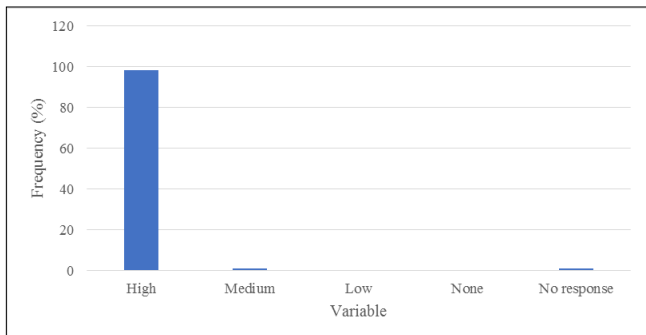| Variables | Frequency | Percentage (%) |
|---|---|---|
| High | 108 | 98.2 |
| Medium | 1 | 0.9 |
| Low | - | - |
| None | - | - |
| No response | 1 | 0.9 |
| Total | 110 | 100 |



**Fig 3.5:** Security Enhancement Against Data Breach and Privacy

Table 3.5 and figure 3.5 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 organisation?

**Table 4.6:** Level of Implementation of Computer Ethics

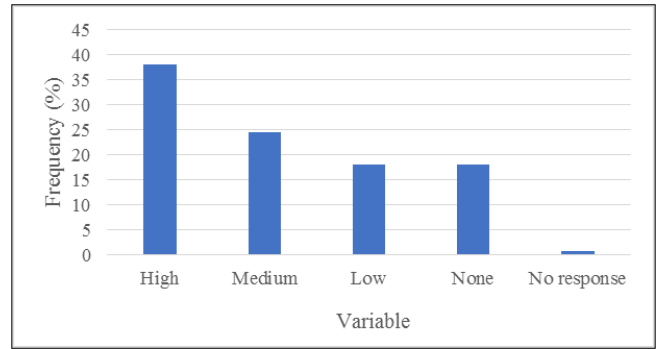| Variables | Frequency | Percentage (%) |
|---|---|---|
| High | 42 | 38.2 |
| Medium | 27 | 24.5 |
| Low | 20 | 18.2 |
| None | 20 | 18.2 |
| No response | 1 | 0.9 |
| Total | 110 | 100 |



**Fig 3.6:** Level of Implementation of Computer Ethics

Though computer ethics has a high impact on technology, its implementation in some ICT organisation is at 38.2% high, 24.5% medium and 18.2% low as shown in table 3.6 and figure 3.6 above.

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

**Table 3.7:** Influence of Computer Ethics on Software Piracy and other Counterfeit Technology

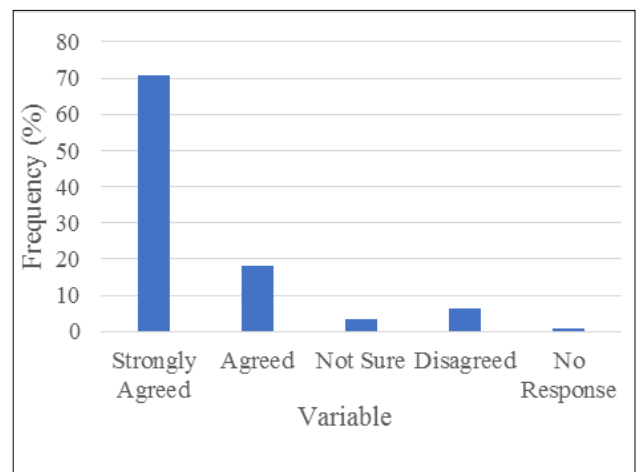| Variables | Frequency | Percentage (%) |
|---|---|---|
| Strongly Agreed | 78 | 70.9 |
| Agreed | 20 | 18.2 |
| Not Sure | 4 | 3.6 |
| Disagreed | 7 | 6.4 |
| No Response | 1 | 0.9 |
| Total | 50 | 100 |



**Table 3.7:** Influence of computer Ethics on software piracy and other counterfeit technology

Table 4.7 and figure 4.7 show that computer ethics has reduced software piracy and other counterfeit technology by 70.9%.

### 4.1 Conclusion

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

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

**4.2 Recommendation**
This study therefore recommend that computer ethics should be implanted in all organisation 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 field is to include computer ethics in the system development life cycle.

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