Problems and Prospect of Ethical Issues in Science and Application of Technology and Formulation of Policies for Sustainable Future

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Abstract

The degree at which some issues can be meaningfully discussed ethically arises from the nature of the issue at hand. Some issues are axiomatic, ambiguous and controversial mainly because there is evidence in dispute. In scientific research, and in the development and applications of technology, notably live saving technology. Scientists are confronted with ethical problems in their choice of research and education, and in ways and manner they deal with publications and media. The application of science and technology has chain of causes and effect on almost all areas of our lives. The social media, the globalization, the growing cultural pluralism, conflict and war. The development of new weapons, non-sustainable development, depletion of resources, and environmental degradation. Many of these possibilities that are opened by science and technology are harmful and retrogressive. Though, science also proffers possible improved living conditions, improved healthcare, and more awareness of the needs of people in other parts of the world and greater possibilities to assist them. However, the ethical gurus may lack the wherewithal to tackle some of the problems identified in terms of science and technology, they may still be able to say something useful about whether it is acceptable to indulge in a given risk such as stem cell research, GMO research, euthanasia, abortion, falsifying of data and other forms of research that may involve a colossal damage that could have some ripple effect on society and the environment. Ethical literacy, ethical imperative and Ethical bargain becomes a tool at hand.

Background to the Study

This discourse centered briefly on reflection of life of Avicenna, father, and herald of ethics of science and technology. The life of a hero (980 – 1037) ABU ALI AL-HUSAIN IBN ABDALLAD IBN SINA, also known by his Latin name as Avicenna, was one of the most eminent scientists and philosophers in the 10th and 11th centuries. He was of Persian origin, and was born near Bukhara in 370 in the year of the Hegira. He exemplified a curiosity of global scope; one may say that the whole of human knowledge concentrated in one person. This is precisely because he anticipates practices that centered on sustenance of human person and the environment. Avicenna carries a message of ethics and faith in humankind. He exemplifies the moral and ethical progress that should always accompany science and technology.

However, science can be seen as a human process of trying to understand and explain the world around us (Nwosu, 2015). It is an inquiry into nature Norwick as cited in Nwosu 2015). Scientific inquiry is an objective and dynamic process of exploring the natural or material world. It involves asking questions, searching for answers, evaluating information, making discoveries, rigorously and systematically testing those discoveries in the search for new understanding (National Science Foundation, 2000).

Technology is defined as the application of scientific knowledge in solving our everyday problems. Traditionally it is called applied science (Nwosu, 2015). Technology originates from human adaptation to environment, and results in proposed solutions to these problems whose endpoint is the solution to a problem (Bybee et al 1998).

Science and technology are human enterprises. Human beings are capable of developing tools. This capacity is as a result of their bipedal nature and the possession of a well - developed brain. The making of tools coupled with the use of language and the advent of writing helped in the spread of technology. The application of science and technology to a greater extent has both advantages and disadvantages. It has created its own world where what is moral appears not be moral and posed a created a great difficulty on the moral compass called ethics.

In ordinary language, the word ethics and morals are used interchangeably to refer to standards of conduct or social norms that guide proper behaviour. The English word ethics derives from the Greek word ethika, meaning character or custom, and is related to the Latin word mores, also meaning custom, which gave us the word moral. Some philosophers, however, distinguish between the two. Morals is often taken to refer to universal norms of human behaviour, the distinction between good and evil whereas ethics is used as a generic term or a yard stick for all the different ways scholars use to understand and examine our moral lives (Beauchamp & Childress 2001). Ethics could be defined as a universal spectrum of the moral conduct that tries to place checks and balances over the range of our activities. Some approaches to ethics are normative while others are non- normative. Normative approaches seek to discover and justify the general standards or continuous spectrum of behaviour that should be acceptable, and apply

them to specific situations. Non-normative approaches can be descriptive that is, a factual investigation of moral conduct and belief or what is called meta-ethics, the analysis of ethical language, concepts, and methods of reasoning.

Statement of the Art

The 19th century witnesses the influx of science and cutting-edge technological advancement cutting across all areas of human endeavors. The agriculture, the health sector, financial institutions, information communication technology and dissemination, educational sector, and a whole lot one could ever imagine. However, not without some consequences. The advancement in technology has made it possible to delve into some areas of research that were locked, and exposed things that were considered to be secret and sacred. The big bang theory is of good one, helping us to know that it is only 5% of the universe that is known thereby changing the earlier conception of the universe. The chemical weapons research, the GMO research, the stem cell research, the biological weapons research, cloning, etc. The approach and application of these cutting-edge technologies has led to the development of some theories and re-definition of certain concepts. The evolving nature of science and knowledge made it imperative that trying out new experiment in order to know the unknown are inseparable. To ask science not to carryout research to investigate things is like taking the fish out of the water. But then it is good and clever to take some fish out the water, in order to save some fish, other aquatic organisms and the water rather, than losing the water and all its inhabitants. Why Ethics? becomes a right question; Therefore, the study of ethics is necessary not only for the individual lives but also for developing the foresight and competence society need in other to face the challenges of the present and the future in a reasonable credit manner. And this can only be done with aid of the ethical theories.

Utilitarian Theories

Utilitarianism is a consequentialist ethical theory meaning, actions are judged right or wrong according to their consequences, not to the motives of the actor. Using this theory, one ought to choose the action that would lead to the best consequences for all persons affected by it. Thus, a certain action is better than a different one if it leads to the greatest possible balance of good consequences. It is important to note that utilitarianism is based on the implicit assumption that duty, obligation, and rights are less important than maximizing good or minimizing evil in a given context.

Deontological Theories

Deontology asserts that the rightness or wrongness of some actions is determined by binding patterns of conduct that are justified by more than consequences. Deontological theories vary in their dependence on consequences. Some declare that consequences are irrelevant to moral evaluations; others, barely distinguishable from the consequentialists, argue that only part of moral rightness is independent of consequential analysis. Perhaps the most widely known type of deontological theory is the "divine command theory," in which the will of God is the ultimate standard of judgment.

Virtue Theories

Virtue ethics adopts the perspective that the goal of ethics is the cultivation of virtuous traits. Virtuous acts are defined not as a moral requirement, but as character traits that are valued socially and morally. Virtue ethics emphasizes motivation in judging an action; an individual must have both the disposition to act morally and the appropriate desire. If the action is taken only out of obligation and the desire is not right, then a necessary condition of virtue is lacking. In virtue theories, a person's characteristics are the primary objects of moral assessment. In this regard, virtue theories differ from both utilitarian and deontological approaches. Aristotle one of the first ethical theorists constructed a philosophical system constrained by a functional understanding of natural and social organization. He understood aspects of the world, including individuals, in terms of their natural functions and proper goals. Ancient Greek society was highly structured, so the idea of people's "natural functions" was, for Aristotle, a fairly straightforward concept. Virtue, then, he explained as, "a disposition bred from an innate capacity by proper training and exercise of that capacity" (Beauchamp 1991, 217). Distinguishing between desire and reason, Aristotle divides virtue into "intellectual" and "practical" categories. He suggests intellectual virtue may lead to vicious action, whereas an individual with the virtues of character and practical life knows the proper action to take in the proper context. Still, both intellectual and practical virtues are means to the attainment of happiness, defined as the full realization of the human potential. Aristotle offers some advice on the details of practical moral judgment. He suggests avoidance of the extremes of excess and defect, defining the virtuous person as one who aims at moderation. Just like Plato would say that justice is a mean or compromise between the best of all.

Communitarian Theories

Communitarian ethical theory is most easily understood through a discussion of the philosophy of David Hume (1711–1776). He asserted that the concept of right and wrong arises from personal sentiment, not from reason. Thus, he saw the role of reason in ethics as a tool to discern the consequences of an action already chosen by sentiment. He asserted that the supreme moral good is benevolence, defined as an unselfish regard for the general welfare of society as consistent with individual happiness. Hume based his moral philosophy on three interconnected propositions. The first is that desire, sentiment, or passion determines one's interests and goals, and reason plays a subordinate role. Hume is famous for his statement "Reason is the slave of the passion in morals" (Beauchamp 1991, 257), which set him directly against Kant's rationalism.

Prima Facie and Actual Norms

Moral norms, whether expressed as principles or as rules, are not rigid standards that exclude compromise. Real life moral problems rarely have clean solutions. Often, two rules or principles come into conflict, or the facts of the case make it acceptable to bend or break a rule. For example, truthfulness is an important moral principle; but, in many situations, telling what is usually called a "white lie" can be justified. Philosopher W. D. Ross has distinguished between prima facie and actual obligations (Beauchamp and Childress 2001). A prima facie obligation is one that must be fulfilled unless it conflicts

with some equal or stronger obligation. A prima facie obligation is related to clear cases of those actions that are clearly right or wrong. When confronted with a situation in which two or more prima facie obligations are in conflict, morally responsible people must analyze the competing factors and determine what their actual obligation is. An example of a classic moral dilemma that involves competing obligations can be expressed in the question: Would you lie to save a life? Now to imperatives.

Ethical Imperatives

The 1st ethical imperatives of responsible citizens are to be informed about the possibilities opened by science and technology and their potential dangers. The 2nd ethical imperatives are to participate in decision making in an informed way with personal action or political influence in her/his own city and in the world with respect to impact of science and technology.

Ethical Issues and Problems in Science and Technology

The Protection of the environment, pollution, nuclear energy, nuclear waste, sustainable development, privacy, animal welfare, euthanasia, stem cell, cloning, gene-machine, genetically modified organism, weapons research. What are the social responsibility of scientists, experiments on human subjects, plagiarism, proper credit, contract research, benefit sharing and conflict of interest in international collaborative research projects, secrecy, information fraud and information monopoly, popularization of science, how to deal with publication and media, communication of probability and uncertainty, especially in connection with complex systems in biology, medicine and the environments, intellectual property rights, patenting, and justice in the allocation of research resources.

A very difficult ethical question for scientists' is whether to conduct research on chemical weapons. These substances are banned under the Chemical Weapons Convention of 1993, which has been signed by nearly every country in the world, including the United States. The Chemical Weapons Convention prohibits the development, production, stockpiling, and use of chemical weapons. It also mandated the destruction of all chemical weapons, and the destruction or conversion of all production facilities by 2007. Progress in accomplishing this latter goal has been delayed, but most of the stockpiles of these weapons have been destroyed and the production plants deactivated. In recent years, there has been less fear of the use of chemical weapons in wars between nations, but more concern about their production and use by terrorist organizations or by what are sometimes called "rogue states." Research on chemical weapons continues for example, at the US Army Medical Institute of Chemical Weapons Defense (Chemical Weapons Defense 2013). Of course, much of this research is classified, but even defensive research might involve the development of new chemical weapons with the goal of finding appropriate counter measures. There is also research on what are being called "nonlethal chemical weapons," which include anti-traction agents and malodorants or other novel chemical agents (Guardian 2008). There is some question as to whether these new nonlethal agents violate the Chemical Weapons Convention because it is not known

whether they are toxic at high doses. Malodorants might also have adverse effects other than toxicity adverse psychological effects, for example. The broader ethical question as to whether scientists should engage in war- related research is complex (Kovac 2013b), but chemical weapons raise that question in stark terms (Kovac 2016). As employees of a particular institution, there may be pressures to work on weapons- related research. On the other hand, as a member of the human community, the chemist might feel that use of chemical weapons is immoral. Unfortunately, the professional codes of ethics of chemists do not help to resolve this dilemma. Another example is better abortion drugs, the so called "morning-after pills." Here is where personal morals, perhaps derived from religious beliefs, come into play.

Green Chemistry

Whatever the substance to be made, there are ethical issues related to the method of production. Since its inception, the modern chemical industry has been responsible for widespread environmental degradation (Bensaude and Simon 2008). Well publicized accidents such as the disaster in Bhopal, where thousands of Indians were poisoned by methyl isocyanate leaking from a Union Carbide plant, have added to the negative public image of chemistry. There are practical, economic, and ethical reasons to improve safety at chemical plants and to reduce the environmental impact of the production of chemicals. The effort to make chemical production more environmentally benign is usually called green chemistry. One can stipulate that the chemical industry will adopt cleaner and greener methods of production if they make economic sense or are required by government regulation or severe public pressure. The question is: Who will develop the new chemistry? Certainly, some of the research will take place in industrial laboratories, but as recently argued by Roald Hoffmann (2012b), "the spiritual center of chemistry in our country remains in the research universities. Where people are taught, values are formed." The ideal of shared-fate individualism suggests that chemists in research universities should focus more of their research efforts on green chemistry: atom and energy economy and benign solvents. It will be a hard sell because there is a prejudice that such research is boring, routine, industrial style research to find a new way to make something ordinary. If a few prominent academic chemists responded to the moral ideal of shared-fate individualism and showed that green chemistry is both scientifically interesting and attractive to graduate students, the field might blossom. Adding case studies of the successes of green chemistry to the curriculum in textbooks and laboratory courses would also help interest students' in this field. The current environmental crisis raises other scientific and ethical questions.

First is environmental remediation, cleaning up the messes that industrial chemistry has made over the past century and more (oil spillage in Niger Delta Nigeria which has adversely affected the lives of this inhabitant is a good example here). A second is what has come to be called sustainability, finding ways to use renewable resources rather than petroleum as both fuels and feedstocks. Bensaude and Simon (2008) argue that we need a new chemical culture in relationship to the environment, one that proscribes the causes of human and environmental health. They suggest that chemists embrace the Hippocratic

principle of medical ethics: First, do no harm. They extend Hoffmann's argument that the chemist needs to consider the possible uses of a new substance or process and that chemists should anticipate the long-term negative consequences of their actions.

Biotechnology

The gene-machine approach to reproduction is epitomized by a development in Britain. It has been reported that a private clinic was offering women having abortions the option of storing their fetuses in liquid nitrogen so that they may later use a cell from the fetus and the cloning technique that produced the sheep Dolly to create an embryo genetically identical to the aborted fetus. The fetus is not a unique human being but becomes a replaceable object one that will be reconstructed when it is convenient to do so. The gene-machine approach is also operative, although in a less obvious and dramatic way, in practices that commercialize the human body or human reproduction the embryonic stem cell research also comes in here, such as the buying and selling of human gametes or embryos, or for profit surrogate motherhood.

The Need for Ethical literacy

The last two decades have seen a rapidly growing awareness of these ethical issues and of the need to deal with them (UNESCO, 2013). This rising interest in ethics seems to be mainly due to seven factors (UNESCO, 2013);

(i)   The rapidity of the changes. As much has been published during the past 20 years as during the whole earlier history of mankind. This rapid acceleration in scientific output has been going in for a long time and it seems to continue that way. Changes are hard to measure, but if the changes to any degree match the speed of publications, we may go through more changes in just a few years of our lives than earlier generations did in their whole lifetime.

(ii)   Increase contact between cultures strengthens our awareness that many of our norms and values are culturally conditioned and makes us as which one we ought to accept and why?

(iii)   Internet, satellite, TV and other media that cross national boundaries create particular ethical issues.

(iv)   Many upholders of ethical traditions have been weakened during the last generations.

(v)   The new developments in science and technology have made the range of our possibilities and the magnitude of the consequences of our actions greater than ever before.

(vi)   Concern for the environment. As the magnitude of man's input on the environment is increasing, mainly through over-exploitation of resources and through pollution, our environment is deteriorating fast.

(vii)   The most important reason is that one particular branch of modern science and technology, gene technology, has created new situations which are radically different from those one that has been confronted earlier.

Ethical Standards Regulatory Agencies in Nigeria

Ethical issues are considered very important in societies because of their ability to bring about development or underdevelopment. To overcome the unethical challenges in Nigeria and promote development, the Federal Government put in place various agencies to enforce ethical standards. Some of these agencies are: Economic and Financial Crime Commission, Budget Monitoring and Price Intelligence Unit and Code of Conduct Bureau and Tribunal. The Economic and Financial Crime Commission (EFCC) was established in Nigeria by the Federal Government under the leadership of former President Olusegun Obasanjo (1999-2007) in 2002 by an Act of the Nigerian National Assembly as amended in 2004. EFCC is one of the agencies put in place by the government to enforce ethical standards and bring about proper ethical behaviour amongst Nigerians in the area of economic crime both in business transactions, government activities and amongst public officials. Since its inception, the agency has continued to fight financial crime in the Nigerian society (EFCC, 2004).

Budget Monitoring and Price Intelligence Unit

Budget monitoring and price intelligence unit (BMPIU) was also established by the Obasanjo's administration in 2003 as part of the government's reform agenda to enforce ethical standards in government activities to ensure transparency in the implementation of public policies, programmes and projects for the enhancement of the living standard of the people. This agency of government is also known as "Due Process Unit" (DPU). This name is derived from the way the agency carried out its assignments in area of proper scrutiny of government expenditure to avoid wastages. The main goals of BMPIU include ensuring strict compliance with laid down rules and procedures guiding the process of contract invitation; contract award; and project implementation in Nigeria (Oladoyin, 2006).

Implication of Ethical Literacy on Science and Technology
1. The study should increase the students' awareness on ethical issues.
2. Provide a deeper understanding of ethical matters and greater clarity in ethical questions.
3. Place ethical problem in a wider context and make explicit the alternatives that we may choose from and how their various positive negative consequence are experienced by those who are affected.
4. Develop the skill for ethical argumentation and analysis.
5. Determines areas where a social practice of legislation is at odds with ethical standpoints which seem to be well-boundaries.
6. The moral obligation of scientists is to inform the general public of the possible ways that scientific knowledge can be used and misused.
7. The science researchers, and supervises should not falsify data from their research findings.
8. In as much as we clamor for science education we should not invest in inventing the weaponry of our own destruction.
9. Artificial intelligence (AI) is now gaining prominence and has led to legitimate concern about their potential use for unethical behaviour.

Way Forward/Ethical Bargain

In order to reduce the level of unethical behaviour, Nigerians need to embrace a new paradigm and realize that ethics and the pursuit of profit are not mutually exclusive (Gberevbie,2013). In fact, organizations which are ethical in the design and deployment of technological solutions are likely to be more sustainable, more robust and more profitable than those who are not (Gberevbie,2013). Science teachers should carry the message of ethics and morals to the classroom for inculcation on the part of the students'. The main argument in this paper therefore is that Nigeria's quest for development in science and technology is possible only if the ethical issues bothering on dishonesty in business transactions in both public and private sectors, in educational sector, and of the nation's economy are properly addressed by the government. Therefore, we have to develop competence in ethics and use it to deal with issues that face us. Because one common error is to think that the rightness or wrongness of an act is proportional to the strength of our feelings when we contemplate the act. A key issue of ethics today is how we can find out what is right or wrong when the strength of our feelings is no reliable guide. Particularly in modern science, where one is carrying out experiments in a laboratory and what happens in test tubes, seldom gives rise to strong moral feelings, systematic reflection on moral issues becomes a must. To stop scientific research is both impossible and unwise, but slowing down technological progress may be very wise. Though science is necessary, technology not always. This is because new science brings new technology, and new technology can be used in a good way or bad way. New science + resulting technology = New ethical problems. Therefore, establishment of science and technological ethical standard organization (STESO) is a necessity. This is because any one step made forward as development in science and technology without considering and addressing it ethical implication is one step backward as well, and the net movement will be zero.

Conclusion

Ethics is the systematic investigation of questions of right and wrong, good and bad. It reflects on the different moral principles and evaluates them critically. In many cases our principles survive this critical scrutiny. However often the critical reflection shows that some principles are unsatisfactory, they have to be modified or totally jettisoned. Sometimes we find other more satisfactory principles that replace them. The aim of ethics is to find a set of moral principles that ought to guide us in our lives. All scientists should commit themselves to high ethical standards and should behave properly in their professional life. When the United Nations Educational, Scientific and Cultural Organization (UNESCO) was established 60 years ago, its Constitution declared that peace must be founded upon the intellectual and moral solidarity of mankind. Julian Huxley, the first Director-General, pointed out that in order to make science contribute to peace, security and human welfare, it would be necessary to relate the applications of science to a general scale of values. Guiding the development of science for the benefit of humanity will therefore imply 'the quest for a restatement of morality in harmony with modern knowledge' (Huxley, 1946). Since its foundation, UNESCO has been concerned with moral issues in relation to science. From the 1970s onwards, the emergence of the life

sciences in particular has led to international examination of bioethical questions. The need to establish common values and benchmarks, as well as to promote ethical principles and standards to guide scientific progress and technological development, is becoming increasingly acute, especially in developing countries that do not equally enjoy the benefits of scientific and technological advances. UNESCO's work in ethics of science and technology reflects these global concerns. It examines such progress in light of ethical considerations rooted in the cultural, legal, philosophical and religious heritage of the various human communities. Thinking about Avicenna in the present-day context of ethics in science and technology is somewhat like thinking about one's parents in psychoanalysis. In trying to understand the consequences of being separated from them, one does not seek to go back to childhood but rather to overcome the difficulties that have resulted from these initial traumas. Through his extraordinary life and work, Avicenna thus invites us to reflect upon scientific ethics, which both UNESCO and the Islamic Republic of Iran encourage, notably by awarding the Avicenna Prize for Ethics in Science. Avecinna would say God has been generous to me I therefore put all my gift to good.

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