MSINGI JOURNAL
of the Department of Educational Foundations
Volume 6 Issue 2, 2022
ISSN 2663-1032
DOI 10.33886/mj.v6i2.308

Analysis of Technological Innovation and its Utilization in the Wake of the COVID-19 Pandemic, in the Light of Zedong's Law of Contradiction in Things

Edward Maina Andafu (PhD)
Kenyatta University
E-mail: andafu.edward@ku.ac.ke

Accepted November 2022 **Published December 2022**

How to Cite:
Andafu, E. (2022). Analysis of Technological Innovation and its Utilization in the Wake of the COVID-19 Pandemic, in the Light of Zedong's Law of Contradiction in Things. *Msingi Journal, 6*(2), 1-16. https://doi.org/10.33886/mj.v6i2.308

Abstract

Despite the devastation caused by the novel COVID-19 pandemic, its outbreak ushered in an era of fortunes in the sectors of global technology, education, health and economy. This paper analyzes the influence of the COVID-19 pandemic to technological innovation and utilization in the context of Zedong's law of contradiction in things. The law postulates that everything and even phenomenon contains a contradiction, and the struggle between the mutually contradictory aspects in things determine their existence and development. The paper argues that the outbreak of the pandemic triggered the reminiscence and actualization of human's innate technological and innovational potential that had hitherto been untapped. Had it not been for the outbreak of the pandemic, perhaps such innovations would not have been actualized in this era. In the event of such a phenomenon, it's devastating effects activate the human's rational faculty to figure out measures on how to mitigate it and in the event, such endeavour sets into motion a series of activities that culminate in research and emergence of technological innovation. It is recommended that an understanding of the correlation between catastrophic phenomena and emergence of technological innovation would form frontiers of research in education, science and technology.

Key Terms: COVID-19 Pandemic, Technological Innovation, Zedong's Law of Contradiction in things

Introduction

The Master of Public Health (MPH) Online (2020) notes that the COVID-19 disease that broke out in Wuhan, China in December 2019 has since spread worldwide, necessitating the World Health Organization (WHO) to declare it as a pandemic in March 2020. Following the outbreak of the pandemic, the human race all over the world has embraced the best body hygiene practices such as sanitization, hand washing and social distancing. In a bid to contain the virus, most countries worldwide declared mandatory stay-at-home measures, temporary closure of learning institutions, businesses and public social places. Therefore, the push for the human race to survive the pandemic became every government's priority. Despite the adverse effects of the pandemic, it has had a share of fortunes in the sectors such as technology, education, economy and health. This paper examines the role of contradictory aspects in the COVID-19 outbreak in directing its existence and spurring technological innovation and utilization. In his law of contradiction in things, Zedong argues that existence comprises constant transformation and contradiction. Therefore, if there were no contradictions and struggle, there would be no world, no process, and no life and there would be nothing at all. This paper therefore examines the technological innovations and utilization occasioned by the outbreak of the pandemic notwithstanding its adverse effects. The paper is divided into four sections. Section one trace the origin and meaning of the COVID-19 pandemic. Section two analyses the concept of technological innovation while the third section examines the technological innovation and utilization emanating from the pandemic. Section four discusses Zedong's law of contradiction in things in relation to the COVID-19 pandemic while section five constitutes findings and discussion of the study findings of the paper.

The objectives of the study were:

(i) To trace the origin and spread of the COVID-19 Pandemic

(ii) To analyze the concept of technological innovation

(iii) To establish the nexus between the COVID-19 Pandemic and emergence of technological innovation with reference to Zedong's law of contradiction in things**.**

Methodology of the study

Being a philosophical study, it adopted the philosophical method of logical (conceptual) analysis. This method entails breaking down a concept or statement into its constituent parts in order to display its logical structure (Beany, 1996). The origin of logical analysis in philosophical discourse is traced back to ancient Greece, where renowned philosophers such as Socrates and Plato employed it in their dialectical discourses. In the dialogue, *Euthyphro* (compiled by Elwany, translated by Jowett, n.d.), for instance, Socrates engages in philosophical analysis by persistently questioning the meaning of the term piety. In his work the *Republic,* Plato analyses the origin, the meaning, uses and the standards of justice (Aken, 1966). Plato's focus on the definition of concepts is central to his dialogues, and this clearly demonstrates what philosophical analysis can yield.

The modern application of analytic method to philosophical research is associated with British educational philosophers, Richard Stanley Peters and Paul Hirst. They contend that philosophical research can analyze concepts in the formal context as it is with empirical research. Peters and Hirst (1970) then hold that the role of philosophical analysis in education is to help us understand the

terms and concepts. This view stems from the position held by analytic philosophers that many problems encountered in life are rooted in lack of communication and understanding of terms used. As noted by Brightman (1957), this method breaks down concepts and statements into their respective constituent parts, focusing on the understanding of terminologies and statements in order to attain clarity. The analytic method of philosophical research thus seeks to unearth simpler constituent elements of a concept by splitting them in order to establish their logical relationships (Baldwin, 1998). This implies that the split parts of a concept under study are studied separately, and then synthesized in order to achieve clarity and understanding.

White (1991) equates the term analysis to the phrase 'break up.' Logical analysis in philosophical research aims to reveal the nature of a concept, by breaking it up into smaller units. Therefore, analysis is the first stage of philosophical thinking. A philosopher tries to clarify an issue using certain mental tools to break up the general concepts under inquiry into its simpler forms that are easier to understand. In practice, this amounts to searching for specific definitions of concepts, terminologies and meaning of statements in a philosophical inquiry. In this study, this method has attempted to unearth the underlying meaning of technological innovation through analysis of its distinct constituent components.

Analytic thinking is hence a basic tool in philosophical research that seeks to define the concept under study by uncovering its defining characteristics (the criteria that fits it). Conceptual analysis focuses on the study of statements and concepts used in varying contexts. Such a study helps in clarifying and justifying meanings. It calls for logical and systematic thinking in order to draw necessary distinctions between what is essential and what is not. Conceptual analysis also studies meanings that lie behind terminologies used in ordinary contexts (Kneller, 1964). The analytic method brought out a clear understanding of the meaning of COVID-19 pandemic by establishing its origin, meaning and influence on technological innovation. By clarification and delineation of the meaning of a term, conceptual analysis delimits the extent to which a term is applied in a specific context. Besides clarifying meanings of statements and terminologies used in different contexts, the method activates one's rational faculty, enabling them to discover the underlying meanings of terms and statements. It aids in understanding and explaining key concepts, terminologies and statements used in the study, whose ordinary usage is not self-explanatory. It further establishes logical inconsistencies among statements and ultimately clarifies ambiguities. The intended meanings of terms and statements are hence unearthed. Conceptual analysis has also facilitated the understanding of Zedong's law of contradiction in things in relation to the technological innovation that was influenced by the COVID-19 Pandemic.

The Covid-19 Pandemic

Vergnaud (2020) explains that the COVID-19 is an acronym that denotes the coronavirus disease of 2019. This is the name given by the WHO on February 11, 2020 to the disease that causes the novel coronavirus, Severe Acute Respiratory Syndrome Coronavirus2 (SARS-CoV2). The term novel implies that at the time of the outbreak, it was a new coronavirus that had not hitherto been identified in humans. It is thus different from the coronavirus that causes the common cold and those that caused Severe Acute Respiratory Syndrome (SARS) in 2002 and the Middle East Respiratory Syndrome (MERS) in 2012. However, studies reveal that all these kinds of coronavirus

are zoonotic diseases, meaning that they are transmitted to humans from animals.

At its discovery in Wuhan, China in 2019, the disease was named the "2019 novel coronavirus" (2019-nCoV). It was later renamed "Severe Acute Respiratory Syndromecoronavirus2 (SARS-CoV2) by the International Committee on Taxonomy of Viruses on February 11, 2020. It was renamed SARS-CoV2 because the virus is genetically related to the coronavirus that caused the SARS outbreak in 2002 (SARS-CoV). Vergnaud (2020) clarifies that diseases are named by WHO's unit, the International Classification of Diseases (ICD). For COVID-19, the name was chosen because it did not refer to any specific geographical location, a specific animal or a specific group of people.

Vergnaud (2020) reveals that coronaviruses are common human and animal viruses that were first discovered in domestic poultry in the 1930s. In animals, they cause a range of respiratory, gastrointestinal, liver and neurologic diseases. Seven coronaviruses are known to cause diseases in humans. Out of these, the four that cause symptoms of "common flu" are 229E, OC43, NL63, and HUK1. The other three cause more serious infections namely: SARS-CoV (Severe Acute Respiratory Syndrome or "SARS" in 2002), MERS-CoV (Middle East Respiratory Syndrome or "MERS" in 2012), and SARS-CoV2 (the current pandemic known as COVID-19).

WHO (2020a) explains that the coronavirus disease (COVID-19) is an infectious disease that mainly spreads through saliva droplets or nasal discharge when an infected person sneezes or coughs. Most infected person's exhibit mild to moderate respiratory illnesses and recover without specialized treatment. However, the elderly and those with underlying medical complications such as cancer, diabetes and cardiovascular diseases are likely to develop serious illness. WHO (2020b) indicates that the first case of COVID-19, caused by the novel coronavirus, named SARS-CoV-2 that was reported in Wuhan city, China in December 2019 has an ecological origin in the bat species of mammals. Another one, SARS-CoV, the cause of Severe Acute Respiratory Syndrome (SARS) outbreak in 2002 was also closely related to other coronaviruses identified in bats. The close genetic relations of SARS-CoV and SARS-CoV-2 suggest that they all have their origin in bats and can as well infect other animal species.

Due to its widespread and global impact on the human populace, the COVID-19 was declared a pandemic by WHO in March 2020. The MPH Online (2020) defines a pandemic as a widespread occurrence of a disease in excess of what might normally be expected in a geographical region. The World Health Organization (WHO) on the other hand construes a pandemic as the worldwide spread of a new disease (WHO, 2020c). The high magnitude of its severe impact on the overall livelihood of the human populace thus justifies its classification as a pandemic. Despite its ravaging impact on the human livelihood, the COVID-19 created an opportunity for the human person to exploit their untapped potential in the field of technological innovation, which positively impacted on the global economy, education and health.

The concept of technological innovation

Encyclopedia Britannica (2020) defines technology as the application of scientific knowledge to solve the practical problems of human life, or to the change and manipulation of the human

environment. In essence, technology points to the practical application of knowledge and skills in problem solving or invention of a tool(s) to solve a problem in a particular field. Technology and development have had a long standing correlation; hence the former is credited for industrialization and advancement. Therefore, technology goes hand in hand with innovation. The inventions occasioned by the outbreak of the covid-19 pandemic, range from production of personal protective equipment (PPE) to the vaccines developed to combat it. Freeman (1982) on the other hand, notes that the term innovation is often used indiscriminately, creating a wrong impression of its exact meaning. A technological innovation for instance does not necessarily refer to objects such as electronic gadgets, information technology or international networks . Furthermore, technological innovation does not have to occur in complex processes, production(s) or systems , but it has to be new and aim at implementing the technology it embodies in the marketplace.
Mentz (1999) associates the term innovation with a Latin terminology, '*innovare,*' which means 'to make something new.' From this definition, a number of conclusions can be drawn regarding its real meaning. To make something new entails:

- To generate a new idea (creativity and invention);
- To develop the idea into a reality or product (realization); and,
- To market the new idea (implementation)

Therefore, to make something new implies replacing old concepts or products with new ones, refining and improving them. The criteria of defining technological innovation should thus entail generation of a new idea (invention), development of the idea into a reality or product (realization) and marketing of the idea (implementation). Technological innovation focuses on technology and how to incorporate it successfully in processes, services and products. Technology is hence the foundation upon which research, design, development, manufacturing and marketing are founded. The criteria for technological innovation should thus make reference to invention, realization and implementation. As Edosomwan (1989) puts it, invention entails creation of new ideas for a product of a service. Invention should demonstrate the feasibility of the new idea (Girifalcao, 1991) and it covers all efforts aimed at creating new ideas and getting them to work (Roberts, 1988). Ramanujan and Mensch (1985) conclude that invention is organized creativity.

Mentz (1999) argues that the inclusion of realization in the definition of innovation lies in identifying a clear time in the life cycle of innovation, where the invention progresses from an idea to reality. The realization phase transforms the invention into a producible product and hence plays a crucial role in the innovation process.

The third component of innovation is implementation, which can be construed as successful exploitation and application of the new idea(s). Rothwell and Gardiner (1985) hold that innovation does not necessarily constitute commercialization of major advances in technology, but also the utilization of even small-scale changes in technological know-how. Innovation is the introduction of a new product, or service into the market (Edosomwan, 1989). Therefore, innovation refers to the technology or a combination of technologies introduced purposefully to meet the market need(s). Granted this analysis, then the creation and utilization of new ideas, machinery and products aimed at keeping the COVID-19 pandemic at bay constitute technological innovation.

Mentz (1999) states that implementation is an important component in the process of innovation that indicates the real or perceived need and its importance to the market. Every invention should be implemented into the market for it to be considered an innovation. The acceptance of an invention into the market thus changes it to the status of innovation.

Sahal (1977) perceives invention as the creation of a new device. To him, innovation on its part entails the application of the new device or invention. Innovation is therefore the process by which an invention is brought into use. It involves the improvement or refinement of the invention from its initial design to the production of a prototype (Girifalcao, 1991). Innovation is the total process from the inception of an idea through to the manufacture of a product and finally to its ultimate sale. Innovation is hence the sum of invention and exploitation (Berry and Taggart, 1994).

The above definitions of innovation bring out three criteria as the basis upon which innovation is gauged. These are invention, realization and implementation. The three criteria can be considered to be the stages of innovation. Based on these criteria, Mentz (1999) proposes a working definition of innovation as:

- To conceive and produce a new solution (from a scientific and technological knowledge) to a real or perceived need (invention).
- To develop the solution into a viable and producible entity (realization).
- To successfully introduce and supply this entity to the real or perceived need (implementation).

From the above analysis, innovation can be construed to be a process or cycle involving the three identified stages of invention, realization and implementation. Mentz (1999) observes that invention is a natural habit, practiced by all people, since even a simple interaction among few people culminates in new thoughts, perceptions and sometimes ideas. Realization is a stage of the innovation cycle in which new ideas are turned into usable products. Engineers, designers and developers belong to this phase. These professionals are pragmatic, and without the realization stage, their ideas would just remain hopes or wishes. Realization combines the skills of engineers with researchers and manufacturers to design and produce a working prototype that resembles the initial idea. To implement an innovation then means convincing people to use or purchase it from the innovator. It entails convincing the market to embrace a new innovation. Technological innovation therefore constitutes a cycle of invention, realization and implementation. However, the underlying factor in this cycle is the existence of a need, inadequacy or a problem that necessitates the innovation. It is the occurrence of a problem or existence of a need that sets into motion the innovation cycle. The problem or need triggers the human mind to engage in a thinking process on how to sort it out, culminating in the emergence of varying ideas, which constitute the first stage of the innovation cycle. The second phase constitutes actualization of ideas through realization, and finally implementation of the new innovation. This process is demonstrated by the technological innovation that was occasioned by the outbreak of the COVID-19 pandemic.

Influence of the Covid-19 pandemic on technological innovation and utilization

At times, it takes the occurrence of catastrophic events such as a war or a pandemic to either trigger

or accelerate the process of technological innovation and utilization. As the Covid-19 pandemic imposed demands on the health care, education, economy and changes in overall way of life of the human person, it in turn spurred research and technological innovation and utilization in an attempt to mitigate it.

In education, the unexpected closure of educational institutions occasioned by the COVID-19 prompted authorities to resort to alternative mode(s) of learning that would ensure continuity and consistency in learning (Maatuk, Elberkawi, Aljawarneh, Rashaideh and Alharbi, 2021). The alternative mode of teaching and learning was e-learning. The letter 'e' refers to 'electronic,' thus the term e-learning points to electronic learning. This is the teaching and learning that is delivered through the support of digital technologies and media (Vikoo, 2013). E-learning utilizes electronic teaching technologies to access and deliver educational content. It is a computer network enabled transfer of skills and knowledge that can be operated in a classroom, seminar as well as distance learning (Onyido, 2016). E-learning, which was then in existence though minimally utilized, instantly replaced the physical learning in order to not only combat the spread of the COVID-19 through the human physical contact, but also ensure continuity in education. Since then, most learning institutions worldwide have embraced the e-learning mode of content delivery in response to WHO's COVID-19 prevention protocol of minimizing physical contact among persons. E-learning has also revolutionized the entire global education, making it an area of interest among many educational researchers (Samir, El Seoud, Taj-Eddin, Seddiek, El-Khouly and Nosseir, 2014). The outbreak of the COVID-19 has thus elicited numerous educational research undertakings, centred around its impact on education and the practice of education amid the pandemic. Notwithstanding its devastative impact on education, the pandemic has created an opportunity for educational research among many scholars.In technology, China, the epicentre of the pandemic, pioneered in the innovation of robots that would assume some of the roles undertaken by the medics in hospitals. As explained by Ndungu (2021), the robots invented by a Shenzhen-based Chinese company, Ubtech, would conduct temperature checks on individuals, broadcast messages reminding people to sanitize, detect whether people are wearing masks and disinfect contaminated areas. Furthermore, they are programmed to collect patients' information, analyze data and provide instant statistics for investigation. They can measure the temperature of between 10-100 people per minute at a distance between two and four metres long. The robots can protect the medics by reducing direct contact with the people who might be suspected to have contracted COVID-19.

One of the crucial control measures in the spread of the COVID-19 is contact tracing. As observed by Technowize (2020), global economies have since developed and launched contact tracing software. The software traces individual movements and makes people aware of the potential covid-19 patients near them. The Apps includes but not limited to *Trace Together* (of Singapore), *COVIDSafe* (of Australia) and *Immuni* (of Italy), all whose working mechanism is based on the *Bluetooth* technology on phones for functionality. Among the latest is *E-Rinde* software, developed by a Rwandan Software Engineer, Jeanne Borine Ishemar. The software helps the frontline workers to trace persons who may have come into contact with the Covid-19 patients (Nkurunziza, 2021). Although it initially exposed Africa's weak health care system, the Covid-19 Pandemic uncovered the significant potential of emerging innovators. As explained by Muna (2020), the phenomenon has demystified the notion of Africa's over-reliance on the Western World on matters of health care.

The continent demonstrated adequate preparedness in the COVID-19 containment. The health crisis has witnessed the sealing of molecular testing across the continent as well as the integration of molecular diagnostics of diseases such as Tuberculosis (TB) and the Human Immunodeficiency Virus (HIV) with that of the Covid-19. With the surge in the number of covid-19 infections, the Kenya Medical Research Institute (KEMRI) for instance invented the rapid test kits to ease the testing burden. The new portable kits have made it possible for people to conduct self-tests in the comfort of their homes and get results between a duration of three and fifteen minutes (Hassan, 2020).

Kalekye and Robi (2020) observe that the COVID-19 Pandemic presented great opportunities for people to think fast and develop new technologies in response to the pandemic. Sixteen students drawn from Kenya's Kenyatta University's Schools of Medicine, Engineering and Pharmacy invented a prototype ventilator, designed to assist the body's breathing process in the event that the lung's capacity is compromised by the infection. Ghana on the other hand pioneered the process of pool testing of the COVID-19 samples hence speeding up the processing time and increasing the testing capacity. Therefore, the pandemic provided an opportunity for Africa to define itself with the relevant innovation and resilience in the face of the health crisis despite its isolation by the Western World.

Regarding personal hygiene as a primary mitigation measure, the British Broadcasting Corporation (BBC) reported that a nine-year old Kenyan boy, invented a wooden hand-washing machine to help curb the spread of coronavirus. The machine allows users to tip a bucket using a foot pedal in order to avoid touching surfaces so as to reduce the chances of infection (BBC, 2020).
In the sector of economy, Barasa (2020) observes that the pandemic led to the revamping of the e-platforms which have evolved in order to adapt to the current order. Although it was not a new innovation emanating from the outbreak of the COVID-19, digital payments have since been adapted as the new alternative to keep businesses and economies running, due to the risk involved in coming into conduct with the physical money. African countries have thus demonstrated their agility to adapt cashless transactions. Despite being in existence for a substantive period of time, cashless transactions had not been adequately utilized till the outbreak of the pandemic, enabling the masses to embrace it by transferring cash as well as shopping online. In Kenya, e-commerce initiatives have helped revamp the micro, small and medium enterprises due to the mobile money cash transfer, *M-Pesa*. The use of the electronic payment in business transactions has not only been a weapon for the fight against COVID-19, but also increased access to affordable financial services. Globally, the COVID-19 pandemic has 'supported' trading activities by creating an ideal environment for the strengthening of the digital payment system thus enhancing transparency and accountability.

In the second half of the year 2020, efforts of medical researchers began to bear fruits as WHO (2020d) announced a breakthrough in the invention of covid-19 vaccines, although they had to await its approval for their use. These include but are not limited to the Moderna, Pfizer Biontech and AstraZeneca vaccines. The Pfizer vaccine was developed by Biontech, a German-based company. The vaccine was invented by the Mainz-based company under the lead research pair of Ugur Sahina and Ozlem Tureci (Hilotin, 2020). In November 2020, the University of Oxford in the

United Kingdom and drug company AstraZeneca jointly developed the AstraZeneca vaccine that demonstrated an efficacy of between 62-90 percent depending on the dosage administered to the participant (Craw, 2020). A team of researchers from the American's Moderna Pharmaceutical Company, led by Dr Barney Graham and Dr Kizzmekia Corbet also developed the Moderna vaccine (Romero, Salzman & Folmer, 2020).

However, as vaccines were developed, to combat the severity of the Covid-19 virus, new variants of the same virus emerged. A variant refers to a new version of the virus that has undergone mutations to represent a separate branch of the same virus (Miller, 2021). As reported by Centers for Disease Control and Prevention (CDC), numerous variants of the COVID-19 disease have since emerged. These include the *Alpha*-B.1.1.7, first identified in the United Kingdom, the *Beta*-B.1.351, first identified in South Africa and the *Gamma*-P.1, first identified in Japan and Brazil. Others are the *Delta*-B.1.617.2 variant, first identified in India and the *Mu*-B.1.621 variant, first identified in Colombia, among others (CDC, 2021). The *Delta*-1.617.2 variant is highly contagious of the other variants, besides proving to be resistant to the existing vaccines. This poses a challenge to the virologists who are compelled to conduct thorough research on how to combat it. The emergence of these variants will in turn act as an impetus for virologists to retreat to the laboratories in an attempt to invent more effective vaccines and the ultimate cure for the COVID-19. This cyclic nature of occurrences emanating from the COVID-19 pandemic demonstrates Zedong's law of contradiction in things.

Construed with the innovations occasioned by the outbreak of the covid-19 pandemic, this paper argues that it was the adverse effects of the COVID-19 pandemic that set into motion the initiatives that ultimately yielded the said innovations. Frantic efforts to curb the massive spread of the virus and the search for its cure culminated in the said technological innovation. Had it not been the outbreak of the COVID-19 pandemic, such innovations would perhaps not have been actualized at this age and time. The devastative impact of the pandemic was hence a precursor to the technological innovations that were triggered by its outbreak. The outbreak of the COVID-19 activated the humans' rational faculty to figure out its mitigation measures, and in the event culminated in technological innovation. The outbreak of the COVID-19 pandemic and the resulting technological innovations are two mutually exclusive opposites that are interdependent, a phenomenon illustrated by Zedong's law of contradiction in things.

Zedong's law of contradiction in things

Zedong (1937) explains that the law of contradiction in things, that is, the law of unity of opposites is the fundamental law of nature, society and thought. The law postulates that there exists an interdependence of contradictory aspects in all things and the struggles between them determine their development. Without contradiction nothing would exist, thus "contradiction exists in the process of development of all things."

Lenin (1958) reiterates that there are mutually exclusive opposite tendencies in all phenomena and processes of nature, and that the law of contradiction in things is the basic law of materialist dialectics. Dialectics is the study of contradiction in the very essence of objects. Dialectics show how opposites can happen to be identical and transform themselves into one another. These opposites

should then not be seen as rigid, but dynamic and transforming themselves into one another.

Lenin (1958) expounds that contradiction exists in the process of development of all things and that, in the process of development of everything, a movement of opposites exists from beginning to the end. He, therefore, defines the law of unity of opposites as the recognition of the contradictory, mutually exclusive opposite tendencies in all phenomena and processes of nature. The interdependence of the contradictory aspects that are present in all things and the struggle between them determine their existence and development. Contradiction is hence the basis of all forms of motion. Engels (1959) supports Lenin's view by arguing that life is a contradiction which is present in things and processes, and which constantly originates and resolves itself. To him, as soon as the contradiction ceases, life too comes to an end.

Lenin (1958) provides examples to illustrate the existence of contradiction in selected disciplines. For instance,

- In Mathematics: addition (+) and subtraction (–)
- In Mechanics: action and reaction
- In Physics: positive and negative electricity
- In Chemistry: the combination and dissociation of atoms
- In Social Sciences: the class struggle

In war, he explains that there is advance and retreat, offense and defense, victory and defeat which are all mutually contradictory phenomena. One cannot exist without the other. The two aspects are at once in conflict and interdependence, and this constitutes the totality of warfare, pushing its development forward and solving its problems. Therefore, every difference in the human thought process reflects objective contradiction and it constitutes the contradictory movement of concepts, pushes forward the development of thoughts and ceaselessly solves the human thought problems.
In politics, Lenin (1958) observes that contradiction is manifested in the opposition and struggle between different ideas within parties. If there is no such contradiction within a party, and ideological struggles to solve them then the party's life comes to an end. It is evident that contradiction exists universally and in all processes. Contradiction is universal and absolute. It is present in the process of development of all things and permeates every process from beginning to the end. This movement of opposites should hence be used in studying the development of all things.

Lenin (1958) then concludes that no contradictory aspect can exist in isolation. Without its opposite aspect, it loses the condition for its existence. For instance, life and death are mutually interdependent, as it is with above and below, misfortune and fortune, knowledge and ignorance, among many others. Therefore, in every situation, there are contradictory aspects that possess the character of its identity. Opposite aspects can thus be identical because each one of them is the necessary condition for the other's existence, just like for death to exist, there must be life, for knowledge to exist, there must be ignorance, among other contradictory aspects.

Lenin (1958) further argues in addition to the contradictory aspects being a condition for each other's existence, there is identity between them that can co-exist in a single entity. They transform

into their opposites, for instance, life transforms to death, whereas war is transformed into peace and vice-versa. World War I for example was transformed into post war peace, World peace was in turn transformed into World War II. Therefore, contradictory things such as war and peace have an identity in given conditions. All contradictory things are interconnected; not only do they co-exist in a single entity in given conditions, but they also transform themselves into each other. In objective reality, the unity of opposites in things transforms them into their opposites for their continuity and development. Granted the understanding of the law of contradiction in things, the outbreak of the COVID-19 pandemic and the technological innovation that occurred thereafter is a manifestation of Zedong's Law of Contradiction in things. The pandemic prompted the need for human initiative to combat it, leading to the development of various mitigation measures that culminated into technological innovation. Mutation of the virus into a chain of variants in turn contradicted the initiatives to combat it, compelling the virologists to research for, and eventually discovered various vaccines to keep the virus at bay. This whole cycle of phenomena explains the existence of the law of contradiction in things and its necessity in determining their very existence.

Findings and discussion

The preceding sections have demonstrated the existence of a correlation between catastrophic phenomena and technological innovation. The technological innovations that emanated from the outbreak of the COVID-19 pandemic attest to this. However, it is noteworthy that in this context, the innovations were triggered by a problem, creating a need for its mitigation. The outbreak of the pandemic thus correlates to a mutually contradictory aspect of the urgent need to curb it. The endeavour to mitigate its spread set in motion a series of events leading to technological innovations. The innovations eventually culminated in the discovery of its vaccines that have not only assisted in checking the spread of the virus, but also contributed to revamping the economies of the respective manufacturing firms. In education, the adverse effects of COVID-19 necessitated the utilization of the technology in order to ensure continuity.

The law of contradiction in things is echoed by Plato in his dialogue, *Phaedo* (translated by Grube, 2002). Plato uses the analogy of opposites to explain the interrelationship between pairs of opposite things and phenomena. He observes that life precedes death in the same way day precedes night, small living creatures precede large creatures, strong people precede the weak and vice-versa. He argues that if life and death are opposites then they precede each other, hence there exists a correlation (a unity of opposite) between two opposite things and phenomena that determine their very nature of existence. What comes from being alive is being dead and vice-versa. In the event that the human body dies the soul lives on, awaiting implantation in another human body. Therefore, living creatures come from the dead because the opposite of dying is coming back to life again. Life and death thus define the very nature and existence of the human person.

Similarly, the existence of an inadequacy or a catastrophic phenomenon triggers the occurrence of technological innovation. Such a phenomenon provokes the human thought processes to engage in critical thinking in a bid to formulate a solution that can either mitigate or remedy the problem at hand. This problem solving approach is illustrated by Plato's doctrine of "*Recollection*." This point to reminiscence, the act of a person remembering what they once knew. In Plato's dialogue, *Meno*, (compiled by Elwany, translated by Jowett, n.d.) Socrates argues that human beings are born

with latent knowledge, embedded in their minds in the form of *ideas* that can only be 'recollected' and brought to the fore through a rigorous intellectual discourse. Socrates demonstrates the act of recollection using a slave boy (who has not studied Geometry before) to arrive at the correct answer to a geometrical equation through the dialectical approach. He is then convinced that the boy has not learnt but merely recollected the latent knowledge preexisting in his mind.

Plato, in the dialogue, *Phaedo* (translated by Grube, 2002), explains that recollection is occasioned by things that are either similar or dissimilar. He contends that a person's sight of one thing provokes the thought of the other. That is, it is possible for a person to perceive something they had forgotten by linking it to what is before them by either similarity or contradiction. This argument reiterates the existence of unity between opposite things. Thus, one's thought of death for instance, rekindles their thought of life, offense and defense, so is disease to a cure, among others. Based on this line of argument, occurrence of catastrophic phenomena activates the human mind to engage in intellectual discourse in an endeavour to mitigate its impact. As Gunga and K'Odhiambo (2019) argue, thought is mental and originates as a private individual's initiative to shape or cope with directions of their life. Other than behaviours that are instinctive such as growth and simple locomotion, several human actions and behaviour change are caused directly or indirectly by thought. Once thought is actualized, its execution is normally overt action in support of or against the purposes of the individual thinker. There is no human venture without a thought. Thought initiates everything that a human person does. It creates and shapes the direction of human attitudes and dispositions; it originates everything and is the confirmation that we as humans have minds, although our knowledge is latent and requires to be activated for any meaningful research and innovation to be actualized. Thought is ultimately actualized by action(s).

It is in contention of this paper that the technological innovation spurred by the outbreak of the COVID-19 pandemic was a culmination of the human thought process triggered by its devastative impact on the human's way of life. The innovations were initially ideas borne out of the human mind by thought processes activated by the outbreak of the pandemic. Contrary to their devastative effects, catastrophic phenomena act as impetus that propel educational research and technological innovation. Occurrence of such phenomena thus heralds a new dawn and frontier for educational research and technological innovation. Granted the correlation between catastrophic phenomena and technological innovation, it is recommended that the challenges caused by such phenomena should herald opportunities for research and innovation.

Conclusion

The foregoing discussion demonstrates the existence of contradiction in things that determines their very existence and development. The evolution of technological innovation is a contradictory component of the outbreak of the Covid-19 pandemic. The technological innovations spurred by the outbreak of the Covid-19 Pandemic might not have been realized if the pandemic hadn't broken out. The pandemic was an impetus that activated the human mind, setting into motion a series of thoughts that culminated in the technological innovations, aimed at mitigating the spread of the pandemic.

Therefore, there exists contradictory aspects in every natural phenomena and processes. The

interdependence of such aspects in things and the struggle between them determine their existence and development. Contradiction is hence the basis of all forms of motion and should be the basis of determining not only development in all things but also frontiers for educational research and technological innovation.

References

Barasa, P. (2020, May 17). Why pandemic could help spur growth of digital global trade. *Sunday Standard* newspaper pp. 33.

Baldwin, T. (1998). Analytic philosophy. In *The Routledge Encyclopedia of Philosophy*. Taylor Francis. Retrieved on January 5, 2021, from https://www.rep.routledge.com/articles/thematic/analytical-philosophy/v-1.doi:10.4324/9780415249126-DD091

Beany, M. (1996). 'Decompositions and transformations: Conceptions of analysis in the early analytic and phenomenological traditions.' *Southern Journal of Philosophy.* Vol. 40, Issue S1 pp. 53-99.

Berry, M. M. J., Taggart, J. H. (1994). *Managing technology and innovation: A review, R & D Management*, Vol. 24, No. 4 pp. 341-353.

BBC. (2020, June 2). Corona virus: Kenyan boy who made hand-washing machine awarded. Retrieved October19, 2020 from https://www.bbc.com/news/world-africa-52898797

Brightman, E. S. (1957). *Doing philosophy*. New York: Holt, Reinhart & Winston.

CDC. (2021). What you need to know about variants. Retrieved September 3, 2021 from https://www.cdc.gov/coronavirus/2019-ncov/variants/variant.html

Craw, V. (2020). University of Oxford and AstraZeneca vaccine is 70 percent effective, trials show. Retrieved January 23, 2021 from https://www.news.comau/lifestyle/health/health-problems/university-of-oxford-and-astrazeneca-vaccine-is-70-per-cent-effective-trials-show/news-st…

Edosomwan, J. A. (1989). *Integrating innovation and technology management*. New York: John Whiley and sons.

Encyclopedia Britannica. (2020). Technology. Retrieved December 31, 2020 from https://www.britannica,com/technology/technology

Engels, F. (1959). "Dialectics, quantity and quality," Anti-Duhring, Eng. Ed, Moscow: FLPH.

Freeman, C. (1982). *The economics of industrial innovation* (2nd ed.). London: Frances Printer.

Girifalcao, L. A. (1991). *Dynamics of technological change*. New York: Van Nostrand Reinhold.

Gunga, S. O. & Kili, A. K. (2019). Place of death in relational evolution. *Journal of International Academic Research for Multidisciplinary*, pp. 13-30.

Hassan, S. (2020). Covid-19 results in 15 minutes: KEMRI starts manufacturing rapid test kits Retrieved October 17, 2020 from https://www.standardmedia.co.ke/health/article/2001367 222/covid-19-results-in-15-minutes-kemri-starts-manufacturing-rapid-test-kits.

Hilotin, J. (2020). Meet the billionaire scientist couple who invented Pfizer's covid-19 vaccine. Retrieved January 17, 2021 from https://gulfnews.com/business/meet-the-billionaire-scientist-couple-who-invented-pfizers-covid-19-vaccine-1.160509333-9519

Kalekye, M. & Robi, S. (2020). Covid crisis drives Kenya's innovation. Retrieved October 17, 2020 from https://www.mediceastafrica.com/en/overview/news-and-articles/covid-crisis-drives-kenya-innovation.html

Kneller, G.F. (1964). *Introduction to Philosophy of Education*. New York: John Wiley and Sons.

Lenin, V. I. (1958). "On the question of dialectics." Collected works, Russ. Ed., Vol XXXVIII, p. 358, Moscow.

Maatuk, A. M., Elberkawi E. K., Aljawarneh, S., Rashaideh, H., & Alharbi, H. (2021). The COVID-19 and E-learning: Challenges and opportunities from the perspective of students and instructors. *Journal of Computing in higher education*, pp. 1-18.

Mentz, J. C. (1999). Developing a competence audit for technological innovation. A Master of Engineering Thesis, University of Pretoria.

Miller, K. (2021). What to know about new corona variants according to doctors. Retrieved September 3, 2021 from https://www.prevention.com/health/a35266961/what-is-covid-19-variant/

MPH Online. (2020). Outbreak: 10 of the worst pandemics in history. Retrieved August 20, 2020 from https:www.mpholine.org/worst-pandemics-in-history/

Muna, W. (2020, July 10). Pandemic uncovers potential for innovation across Africa. *China Daily*. Retrieved July 10, 2020 from https://www.chinadaily.com.cn/a/202007/10/WS5f07bd85a31 0834817258786.html

Ndungu, J. (2021). Kenya gets robots to work alongside doctors. Retrieved January 23, 2021 from https://nairobitimes.co.ke/2021/01/22/kenya-gets-robots-to-work-alongside-doctors/

Nkurunziza, M. (2021). Young woman entrepreneur develops software for Covid-19 contact tracing. Retrieved February 8, 2021 from https://www.newtimes.co.rw/business/young-woman-enterpreneur-develops-software-covid-19-contact-tracing.

Onyido, J. A. (2016). *Sociology of Education made easy*. Port Harcourt: Gen-X Press.

Peters, R. S., & Hirst, P. H. (1970). *The logic of education*. London: Routledge & Keegan

Paul.

Plato. (n.d.). *The complete works* (Compiled by M. Elwany, B. Jowett, Trans.). Retrieved July 7, 2021, from http: www.cakravartin.com/wordpress/wp-content/uploads/2008/08/plato-complete-works.pdf.

Plato. (2002). *Five dialogues: Apology, Crito, Euthyphro, Meno and Phaedo* (2nd ed.) (G. M. A. Grube, Trans.). Indianapolis: Hackett Publishing Company.

Ramanujam, V., Mensch, G. O. (1985). Improving the strategy-innovation link. *Journal of Product Innovation Management*, Vol. 4, pp. 213-223.

Roberts, E. B. (1988). What we've learned, managing invention and innovation. *Research and Technology Management*, Vol. 31. No. 1. Pp. 11-21.

Romero, L., Salzman, S. & Folmer, K. (2020). Kizzmekia Corbett, an African American woman, is praised as key scientist behind covid-19 vaccine. Retrieved January 23, 2021 from https://abcnews.go.com/Health/kizzmekia-corbett-african-american-woman-praised-key-scientist/story?id=74679965

Rothwell, R. & Gardiner, P. (1985). Invention, innovation, re-innovation and the role of the user. Technovation, Vol. 3, pp. 168.

Sahal, D. (1977). The multidimensional diffusion of technology. *Technological forecasting and social change*, Vol. 10. Pp. 277-298.

Samir, M., El Seoud, A., Taj-Eddin, Seddiek, N., El-Khouly, M. M., & Nosseir, A. (2014). E-learning and students' motivation: A research study on the effects of e-learning on higher education. *International Journal of Emerging Technologies in Learning*. Vol. 9(4) pp. 20-26.

Technowize. (2020). New Tech contact tracing Applications of 2020: Contact tracing Apps. Retrieved February 8, 2021 from https://www.technowize.com/new-tech-contact-applications-of-2020.

Utterback, J. M., Abernathy, W. J. (1975). A dynamic model of process and product innovation. *Omega*, No 6, pp. 639-656.

Vergnaud, S. (2020). What does COVID-19 stand for? Retrieved December 27, 2020 from https://www.goodrx.com/blog/what-does-covid-19-mean-who-named-it/

Vikoo, B. (2013). *Computers in educational research and development* (2nd ed.). New Owerri: Springfield Publishers.

White. T. I. (1991). *Discovering philosophy*. New Jersey: Prentice-Hall Inc.

WHO. (2020a). What is Covid-19? Retrieved 20 October, 2020 from https://www.who.int/health-topic/coronavirus#tab=tab_1

WHO. (2020b). Corona virus disease 2019 (Covid-19) Situation Report-94. Retrieved October 20, 2020 from https://www.who.int/publications.detail/infection-prevention-and-control-during-health-care-when-novel-coronavirus-(ncov)-infection-is-suspected-20200125

WHO. (2020c). What is a pandemic? Retrieved October 17, 2020 from https://www.who.int/csr/disease/swineflu/frequently_asked_questions/pandemic/en/

WHO. (2020d). Coronavirus disease (covid-19): Vaccines. Retrieved January 6, 2021 from https://www.who.int/news-room/q-a-detail/coronavirus-disease-(covid-19)-vaccines.

Zedong, M. (1937). On contradiction. Retrieved 19 August, 2021 from https://www.marxists.org/