D-Space, makerspace, and hackerspace in cyberspace: Cybersecurity strategies for digital preservation of library resources in the post-Covid-19 pandemic

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ABSTRACT

This paper explores the status of d-space in the milieu of makerspace and hackerspace in the cyber domain. These two belligerent sides excel in critical thinking, creativity, collaborations, and communication important for 21st-century skills a consequence of giving rise to difficulty in differentiating one side as an independent entity from the other. Organizations require one as a prerequisite for employment and application of the other in post-education. Covid-19 has consolidated these sides and brought with it many cybersecurity challenges that call for organizations to prepare for hacking activities in the post-pandemic era. It has opened a desire and demand for information at a logarithmic phase at the free of cost in an electronic format like never before. Many works of literature have been reviewed to supply the lack of an accurate sequence of events that shaped the behavior and attitudes of individuals in this era.
Keywords: D-Space, Makerspace, Hackerspace, Digital Preservation, Scholarly Communication, Covid-19 Pandemic.

INTRODUCTION

Covid-19 is the leading global health concern that thwarts the global health information community due to the failure to contain its spectrum and wavelength. Among its conspicuous effects is that Covid-19

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pandemic challenges switching to new normal, reverting to old normal, or maintaining neutral normal, which is still a smock-screened issue that lingers on the horizon. The covid-19 infection has taken a peculiar pattern of logarithmic progression (WHO, 2020; Gao *et al.,* 2020) unparalleled by its mutagenesis giving rise to different variants requiring different vaccines to contain their continuum. This pandemic touches individuals and those responsible for handling metadata, adept at information/cybersecurity matters, etc. in organizations that are not exceptional. This means that important organizational data are in critical situations if not properly handled. To contain the spread of the virus among the populace internationally, countries across the globe introduced lockdown orders following the advice of the World Health Organization (WHO). This created a kind of enhanced interaction between humans and machines specifically via the internet resulting in the sophistication of individuals concerning cyberspace. In other words, the fact that there was a restriction of physical/social interaction compelled the adoption of social media as the sole medium of human connections. This resulted in different forms of cybercrimes attacking different organizations. There is increased possession of an organization's security department to motivate cybercriminals and the opportunity to attack a given organization (McClure *et al.,* 2012).

Before this pandemic, Cyber Threatscape Report (2018) noted that 71% of the respondents used in the study agreed that "cyberattacks are still a bit of a black box; we do not quite know how or when they will affect our organization". According to delivery network Akamai (2018), there were 38 attempts at hacking activity in India per second. The company listed top attack destinations where America had 12522943520 attacks seconded by India with 1208749669 cyberattacks. Whereas in terms of top attack sources countries, the US was on top with 4016181582 logins followed immediately by Russia with 2509810095 attacks. These were all unsuccessful login attempts for accounts using the email address as a username across several countries, using stolen accounts. This happens only as the world at present has just a few thousand satellites and it is expected that companies in US and China, to build networks of several thousand satellites to allow access to information from any angle on earth, a move seen by others to dominate political influence of the entire globe (Voelsen, 2021). This will add to the vulnerability of satellites already in orbit as the knowledge of orbital mechanics, antenna physics, and hacking skills increases. Unfortunately, institutions of learning seem to think that they are at zero entry hacking space not knowing that they are already in the pool of hacking trajectory by many others. To support this view, Cyber Threatscape Report (2018) reported that cyberattackers are incessantly networking, researching, and testing

newer tactics, techniques, and procedures (TTPs) to make money, mess up services, or spy on their targets.

That is why researchers regard computer networks as the nervous system of contemporary society, which is always defenseless to attacks from intelligently unintentional teenagers to high-tech hackers, to military personnel (Kesan & Hayes, 2012). This indicates the susceptibility of both government and commercial sites. The identities of the perpetrators are unknown and can thus belong to organized or well-funded sources. This is to the extent that "the men in black hats can strike anywhere, while the men in white hats have to defend everywhere" (Katyal, 2005). Thus, cyberattacks refer to "the use of deliberate actions —perhaps over an extended period— to alter, disrupt, deceive, degrade, or destroy adversary computer systems or networks or the information and/or programs resident in or transiting these systems or networks" (Kesan & Hayes, 2012, p. 439). It also has to do with tempering the authenticity, originality, integrity, availability, etc. of information over networks (Lin, 2010). This gives some degree of difficulty in distinguishing cyberattacks from cyber-exploitation. While cyberattacks are destructive, cyber-exploitations, which deal with the extraction of classical information, are not (Kesan & Hayes, 2012). This action gives rise to types of cybercriminals namely, unsophisticated (script kiddies), more sophisticated, crackers, and benign hackers. They also categorized the type of hacking activity to include distribution of malicious software, unauthorized access to organizational data, and DoS (Kesan & Hayes, 2012).

The covid-19 pandemic has untied the knitted globalized world and seems to challenge the re-globalization phenomenon in a near future. It renders the world more porous than before and equips individuals and organizations to fuse the disjointed components of experiences gathered to make a collective whole. This porosity has enabled a continuous exchange of desired commodities or undeserved products among individuals, organizations, or societies. In this regard, because of its cosmopolitan nature in all human endeavors (i.e., social, cultural, religious, scientific, political, economic, technological activities), information is the main wealth or asset of every organization and an indispensable tool required for carrying out all related activities in an organization (Ohtoshi & Gottschalg-Duque, 2017). Additionally, in this context, information technology that enables an intensive mechanism for facilitating the collection, production, processing, transmission, and storage of information (Ohtoshi & Gottschalg-Duque, 2017) brings about changes on the global scale. More so, data and information remain as a goldmine of criminals to the extent they frequent several sites where numerous cyber-attacks in cyberspace occur every second.

Inappropriately, during this pandemic crisis, many organizations have expressed concerns over the number of cyberattacks on individual and organizational data. A critical examination of attitudes and behavior of individuals during the Covid-19 pandemic brought most private, and government firms, institutions, among others to convert to e-platforms to ease transactions or scholarly communication and, as a result, digital natives and migrants are becoming more complex with technology like never. This increases the desire to become a hacker. To be precise, before this pandemic Ogutcu *et al*. (2016), referenced by Dijle (2006), noted that 42.1% of the respondents, who were mostly digital natives in his research, indicated the desire to become hackers. This implies that, the more someone becomes associated with these technologies, the greater the chances or desire of becoming a hacker (Ogutcu *et al.,* 2016). Imposition of lockdown and other precautionary measures by local, state, national, and international governments assisted individuals in this regard.

It is crystal clear that the spectrum and wavelength of cybersecurity threats seem to be endlessly infinite (Ohtoshi & Gottschalg-Duque, 2017). This is owing to the speed with which information accumulates on the web and necessitates the innovation and evolution of newer information retrieval (IR) tools (Stenmark & Jadaan, 2007). They further reiterated that understanding users' behaviors is crucial as it assists users to formulate better strategies, helps designers plan better interfaces (e.g., metadata), signals developers when to construct new IR tools as well as its consequences on the web design (Stenmark & Jadaan, 2007). Unfortunately, organizational workers specifically cybersecurity professionals are constrained to develop and maintain "cryptography, policies, norms, methodologies, threats, vulnerabilities, attack techniques, and forms of control" (Ohtoshi & Gottschalg-Duque, 2017) surrounding different information sources. Similarly, management, policies, data, and technology used in organizations have their corresponding defects on the integrity of the organization. This corroborates Goldsmith and Siegel's submission (2012) that there is an imbalance between the management response to security threats and the sophistication and organization of those responsible for the attack. Similarly, the policy design is sketchy; as it does not capture the ingredients of the cyber threat that can annul its effects than can the physical threats (e.g., war, biological weapons, etc.). In other words, designing policy on cybersecurity is challenging due to the changing nature of the threat, technology, organization requests, and situation. With regards to technological implications, organizations, institutions, etc. are accustomed to purchasing new programs and adopting new practices. However, the software applications are complex, insecure and can cause a lot of financial vulnerabilities by hackers.

To augment the above assertions, the International Chamber of Commerce (ICC), observed exceptional disruption over its customers' data. The report is released in 2020, it indicated that Covid-19 has resulted in extraordinary health and economic crisis affecting the source of revenue of workers and sustained business across the globe (ICC, 2020). To "ensure business continuity, protect workers and continue to serve customers, many organizations are moving to online operations" (ICC, 2020, p. 1) for enhancing communications. In the report, ICC noted that, even before this pandemic, 1 in 5 SMEs experienced cyberattacks, and hackers target over 40% of small businesses nearing an average loss of more than $ 188,000 (ICC, 2020). These created two sub-surfaces with a one-on-one hand trying to bridge the digital divide between customers and sellers while the other one on the other side trying like a Trojan to get unauthorized access to organizational and individual data. Regrettably, when everything is connected, there are chances of cyberattacks. This corroborated with Raytheon, Forcepoint, and the National Cyber Security Alliance's (2017) submission that "the ever-evolving era of internet-connected technology has provided the world with unprecedented ways to make our lives easier and more productive. Unfortunately, when everything is connected, everything is potentially vulnerable to cyber threats". Because of these, several programs and interventions have been put in place to reduce the cyber threats caused by cybercriminals. Examples of such interventions include government configuration (Martin, 2005), assistance to form a sound investment strategy to defend against a strategic attack on financial services (NCDFSWR, 2009), raising awareness, strengthening remote access management policy and procedures, securing supplier portals, updating incidence response plans in a more distributed environment (ICC, 2020), among others.

However, despite these programs and interventions to reduce the risks associated with cyber threats, the problems of cybersecurity remain a big challenge. The consequences of not addressing this problem led to reduced wellbeing, disturbance of elements of development and economic growth thereby affecting security (Stewart, 2004); an embarrassment for a company, institution, or individual resulting in significant financial or operational impairment (ACS, 2016), social and psychological problems (Bada & Nurse, 2019), infringement of organizational data (ICC, 2020), to mention but a few. This calls for further studies to be conducted to reduce cybersecurity issues from a potentially useful perspective. Unless the problem of cybersecurity is addressed from the innovations of diffusion, the problem of cybersecurity threats will continue. Even though studies about cybersecurity focused on a pragmatic approach applying only technological, information needs-seeking-behavior of workers, un-

less the problem is addressed from how innovation is communicated over time among workers and users in an organization, the problem of cyber threats will persist. One of the key theorists that discussed the issue of diffusion of innovations is Everett M. Rogers, who states that diffusion is "the process by which an innovation is communicated through certain channels over time among the members of a social system".

Furthermore, previous studies that discussed cybersecurity issues focused on using methodologies neglecting an approach that allows an in-depth understanding of the real problem from a theoretical perspective. The persistent increase in cybersecurity issues globally is attributable to a shortage of research on the problem of cyberattacks. This is because previous studies to date are yet to provide the proper solution to the issue of cyberattacks from a single study that uses theoretical review. This type of review provides a foundation for a theoretical framework, discussion of various theories, models, and definition of concepts; highlights relevance of a specific approach or combines various theoretical concepts to create a framework (Pillai, 2020).

PROBLEM STATEMENT

Closure of schools and universities necessitated accelerated remote access to information resources (Sukula & Babbar, 2020). Technological advancement brings about changing institutions' faces thereby redefining their roles, motivates management to include uncertainty when developing vision, and sharpens managerial evaluation capacity in measuring the achievement of library services (Cawthorne, 2015). Sukula & Babbar (2020), referenced by Brynjolfsson *et al.,* (2020) noted that the Covid-19 pandemic has forced the adoption of non-conventional means of accessing information resources, particularly e-books and e-journals to supplement the lack of and dissatisfaction with information access. EZproxy and RemoteXs are the software used for remote access (Bhat, 2019). That is why digital preservation has attracted more than 90 million euros since 2002 (Strodl *et al.,* 2011), due to the rapid technological advancement and incompatibility of old media with newer ones over a short timeframe. This implies that as the information need increases and technology improves, information security control must remain up to date. Depending on policy on information security models, which encompass Bell-LaPadulla *et al.* (Hare, 2010), under an ideal situation, management of organizations should consider the impact of organizational culture, history of security policies, and technological encroachment that can ensure the safety of information between its owners and custodians. However, accepting new technology that is risk-based or cross-government

policy by management of many organizations is hard, which is highly documented in the literature (Rogers, 2003), and this action presents threats to metadata terminology, vocabulary, program designers, and developers. Even if the management accepts to incorporate new technologies in their daily dealings; whatever the situation at hand implies, the design shall capture that in that direction. Additionally, most institutions in sub-Saharan Africa do not have scholarly communication office that includes librarians and legal practitioners (Cohen, 2017), a consequence of giving hackers clues on how to attack institutional websites through scanning (Choo, 2001).

For a long, Choo (2001) observed that environmental scanning has to do with acquiring and using information about an organization's external environment. A thorough understanding of the external environment gives hackers an impression on how to target the weakest point in time to avoid surprises (Choo, 2001). Furthermore, data loss disaster is highly documented in the literature. Most often than not, it occurs due to the migration from one database to another (such as VIRTUA to KOHA), contracted service providers steering businesses on behalf of the government, among others. The presence of cybersecurity standards concerning human resources, data entry, vendors, etc. is a clear indication of possible attacks on the databank of organizations.

Change occurs in the structure and function of a social system whenever a new idea introduced into such a system (Rogers & Shoemaker, 1971) avails itself. It starts as a unique phenomenon and later becomes a tipping point or common (Rogers, 2003). The newness of innovation entails knowledge, persuasion, and the decision to adopt (Sharma & Romas, 2012). The fact that the innovation can be incremental, distinctive, or breakthrough (Sharma & Romas, 2012) indicates that there are many variables of interest to take into cognizance when communicating new ideas to organizations. Concerning the library community, several studies discussed digital scholars (Weller, 2011) and suggested ways on how libraries should adopt technologies to meet the information needs of such users. In response to this issue, libraries are often described as an incubator for digital scholarship (Bryan, 2014), e-science hubs (Hey & Hey, 2006), supporters of digital scholarship (Mulligan, 2016); thereby developing models to scaffold institutional infrastructure to support digital scholarship (Wolski & Richardson, 2014) and training of librarians for digital skills (Zhifang & Huifang, 2018).

To be precise, d-space is becoming more acceptable in most libraries because of risking its contents to intellectual theft or hacking activities. Unfortunately, organizations are mostly not up to date with the broader threat landscape and specific threats that come their way. This corre-

sponds with the Cyber Threatscape Report (2018) that, only 13% of organizations acknowledged that future threats must be budgeted for, which calls for use of actionable threat intelligence. Moreover, this implies that organizations' research competencies, strategic visions, and immediate desire to use cyber research apparatuses, technologies, and data-driven tools are at their lowest ebb. In addition, understanding the architectures of the systems, the strength and weakness of hardware and software, perpetrators, and their capacities obtained through surveillance and analysis, is important in protecting the integrity of organizations (McClure *et al.,* 2012). Despite digital natives are becoming more conversant and sophisticated with technologies like never (Ogutcu *et al.,* 2016), and covid-19 has encouraged their broadmindedness, quickened their imaginations, strengthened their curiosity, implanted many attributes of data mining techniques, etc., only very few or no studies discussed the safety of information resources in the post-covid-19 pandemic. Therefore, the current research is an attempt to add to the body of knowledge.

GLOBAL INSECURITY AS A FACTOR FOR RETARDED DEVELOPMENT

Globalization refers to "the vision of a borderless world in which territory has lost all importance and functionalism is predominant" (Hettne *et al.,* 1999, p. 7). In other words, globalization must concern itself with "the multiplicity of linkages and interconnections that transcend nation-states and societies, which currently make up the modern world system" (McGrew, 1992). In a more elaborate form, Giddens (1990) reiterated that the concept of globalization has relationality with "the intensification of worldwide social relations, which link distant localities in such a way that local happenings are shaped by events occurring many miles away and vice versa". Thus, it follows that marrying the two words *global insecurity* can give a sense of the array of threats the planet earth faces, its nations, and billions of people harboring within it. These threats include but are not limited to international trans-border wars, civil wars, imbalance of energy supply, natural disasters, poverty, hunger, failed, and failing states, to mention but a few (Intriligator, 2006). This is to the extent that, as the interconnectedness of nations, a threat to one nation is a threat to all nations and it is beyond the capacity of a single entity to solve all its problems itself. Global insecurity exposes the weaknesses of organizations, individuals and thus renders societies unimmunized from attacks (Farley, 2015). It has become an aspect of everyday life (McLaughlin, 2015; Agyei & Möller, 2019). The commodity of interest for cybercriminals is data or information thereby becoming a goldmine for

criminals. For instance, in just a minute, more than half a million attacks occurred in cyberspace (Biggest Cybersecurity Threats, 2016; ACS, 2016). That is why some scholars attribute this trend to globalization. It is important to note that, global security and human security are complementary and mutually reinforcing. Therefore, human security refers to

> freedom from pervasive threats to people's rights, safety, or lives, "involving both "safety for people from violent threats, such as organized conflict, gross violations of human rights, terrorism and violent crime" and "safety from non-violent threats, such as environmental degradation, economic crises, illicit drugs, infectious diseases and natural disasters (Intriligator, 2006, p. 2).

From the information gathered as of outside and far-reaching history since the beginning of this pandemic and the ones gathered from the historic occurrences of such pandemics around the world, it is important to acknowledge that the Covid-19 pandemic has left an unerasable scar that indicates the world has changed and never again will be the same. Therefore, the world has already changed owing to the advancement of science and technology before this pandemic and Covid-19 has fused such transformations and made them even more complex. In this context, fear of the unknown and health insecurity resulted in many attitudinal and behavioral changes of workers in organizations. To support this claim, previous studies indicated that, there is a strong relationship between insecurity and negative attitudes and behavior of employees, which has an impact on their health (Reisel *et al.,* 2007). In other words, any slight organizational change ranging from downsizing, mergers, restructuring, among others have adverse effects on employee performance and can change the employees to become rigid in discharging their activities thereby displaying less cognitive flexibility (Lee, 2016) and exhibiting absenteeism at work (Probst *et al.,* 2007). To augment this assertion, when employees are confronted with insecurity challenges, they become more rigid and show a smaller amount of creativity resulting in activities that are less than innovative (Lee, 2016; Probst *et al.,* 2007). Further, job insecurity results in employees concentrating on personal concerns and neglecting any job commitment that garners support for organizational development (Lee, 2016). This results in retarded development, where customers patronizing such organizations, remain easily duped. This finding in Lee's (2016) research could be linked with the submission of Raytheon, Forcepoint, and the National Cyber Security Alliance (2017) that, despite 15% increment in the awareness of cybersecurity issues, Millennials believe that cybersecurity is important (83%), but their be-

haviors, if used in the working place, could jeopardize the employers. For instance, the report indicated that Millennial is perfect in protecting their smartphone (87 %), and computers (83 %) use password and PIN neglecting to protect other devices with a password.

THE NECESSITY FOR E-LIBRARY AND ADOPTION OF TECHNOLOGIES IN LIBRARIES

There is no clearer understanding of the concept of e-library. Many institutions use e-library resources but experience low utilization (Lwehabura, 1999). Improving the utilization of e-library requires re-conceptualization of the concept e-library. It is a known fact that migration and retrospective conversion from print to paperless medium has become a crucial issue for scholarly development for setting libraries at a competitive edge. It bridges troubled clientele's inability to access and use information resources, which requires a global/uniform actor of a strategy and e-library serves as a social innovation that brings about transformation in the scholarly community. That is why Sharmin, (2005) noted that e-resources have diffused in popularity and use since university functions as a conserver, transmitter, and creator of new knowledge via teaching and research. Of course, the university library is the principal instrument in the conservation of knowledge through its systematic procedures that add value to the content and access (Daramola, 2016). However, the introduction of the Internet into libraries has dramatically changed the way libraries acquire, process, and disseminate information (Haroon & Ata, 2010).

The fact that different users have different cognitive processes, learning style preferences, and experiences that they apply when learning takes place (Honey & Mumford, 1982; Kolb, 1984) necessitated the shift from the system- to user-centered approach (Dervin & Nilan, 1986). To remedy these challenges, availability of a computer, network infrastructure, and the ability to work with the tools have affected users remarkably (Daramola, 2016) and thus a corresponding reduction in their library patronage attributable to domesticating their transactions, surfing, searching, etc. indoor (Sharmin, 2005). In response to this low patronage, libraries adopted electronic technologies aimed at easing accessibility and utilization of information anywhere anytime (Vakkari, 2008) and e-library is now receiving recognition and applicability across the globe for meeting the demands of a new age for both digital natives and digital migrants.

Before this development, several scholars pointed out the paradigm shift in the 21st century in attitudes towards online education (Harasim,

2000). A review of various literature shows that the emergence of the Internet during the 1990s added various options for libraries to automate (Mutula, 2004). From the 1990s to date, several portals serve as a gateway for access or facilitating library information networks (University of Botswana, 1999; Innovative Interfaces, 2002). Libraries have reinvented themselves to start offering automation systems, consultancy, and training to remain relevant in a volatile competitive market (Mutula, 2000a; Cibbarelli, 1996). Developments in information technology have enhanced the openness of the library systems to the Internet and occasioned the evolution of digital libraries across the world. The concept of digital libraries is used interchangeably with electronic, virtual libraries or libraries without walls in literature (RAU Law Library, 2004). The emerging information society demands the ability on the part of the user to identify, locate, evaluate, and apply information (Mutula, 2004). Several studies have shown that lack of information literacy is partly the cause of the underutilization of existing ICTs and information resources (Mutula, 2004) where many students at various levels of education are unfamiliar with a variety of information sources and services within and outside the library. This is largely exacerbated by the lack of libraries at the school level, reading materials, and qualified staff. In addition, user education in universities within Africa is not comprehensive enough for the required skills (Lwehabura, 1999).

From another perspective, user literacy has been indicated to be uncoordinated, purely introductory, and non-examinable (Adeyemi, 2002). This scenario is replicated in most universities and other educational institutions across Africa (Mutula, 2004). Consequently, the meager information resources that one finds in libraries are grossly under-utilized. However, with the emerging information society as characterized by the rapid growth and use of information and the widespread exploitation of varied information sources; people have multi-sectoral needs, and the way they find information is crucial for their advancement. It is important for them to know and appreciate their information needs, where to get the information, how to get the information, and in the end, how to use it critically (Mutula, 2004) which calls for the provision of e-library resources and services for them to be relevant in the information society.

DIFFUSION OF INNOVATIONS

Diffusion of innovation (DOI) theory has received prominence across disciplines and editions almost every decade from the year the theory became published and popularized. Different studies draw several conclusions from this theory that are still applicable for aiding the theoriz-

ing process and informed practice or decision-making (Murray, 2009). Notably, the domain-specific disciplines that use the theory most are anthropology, communication, geography, sociology, marketing, political science, public health, and economics (Murray, 2009; Moseley, 2004; Rogers, 2004). To begin with, as cited in Murray, (2009), Rogers, (2003, p. 1) observed that, "getting a new idea adopted, even when it has obvious advantages, is difficult". The basic premise of the theory is "an innovation is communicated through certain channels over time among the members of a social system" (Rogers, 1962). In other words, according to Rogers (2004, p. 16), the theory is "a general process, not bound by the type of innovation studied, by who the adopters [are], or by place or culture." As per the basic components of the theory, Rogers (2003, p. 5) denoted diffusion, to refer to "the process in which an innovation is communicated through certain channels over time among the members of a social system" and innovation is "an idea, practice, or object that is perceived as new by an individual or other unit of adoption" (Rogers, 2003, p. 12).

According to Sharma & Romas, (2012, p. 207-208), the theory has the following constructs:

- Perceived relative advantage: Perception regarding how much better the new product, idea, or practice is than the one it will replace
- Compatibility: Perception of the innovation's consistency with the values, past experiences, and needs of potential adopters
- Complexity: Perception of the degree of difficulty in understanding and using the new idea, practice, or product
- Demonstrability: The degree to which an innovation may be experimented with on a limited basis
- Clarity of results: The degree to which outcomes of innovation are visible
- Costs: The tangible and intangible expenses incurred in the adoption of a new idea, practice, or product
- Reversibility: The ability and degree to which the status quo can be reinstated by ceasing to use the innovation
- Pervasiveness: The degree to which an innovation requires changes or adjustments by other elements in the social system
- Reinvention: The degree to which a potential adopter can adopt, refine, or modify the innovation to suit his or her needs
- Communication channels: This refers to the links between those who possess the know-how, and those who have not adopted the innovations. Communication channels are through mass media, interpersonal or interactive communication

- Time: This means the interval between becoming aware of the innovation and adopting it. This entails innovation-decision process, adopter categories, and rate of adoption
- Social system: This refers to people in a society connected by a common goal and is composed of individuals, groups, organizations, or communities. Similarity among group members is called homophily. Innovations spread faster among homophilous groups.

D-SPACE AS A COMMUNICATION CHANNEL IN SCHOLARLY COMMUNICATIONS AND INSTITUTIONAL REPOSITORY

The rapidity of data generation in institutions, the necessity to store such a seemingly unstoppable number of research and educational sources in secure places, and the speed with which data are lost when stored in hard drives after restructuration of institutions, and the dire need to retrieve published works with ease compelled institutions to adopt D-space (Kudim & Proskudina, 2007). D-space allows interaction and collaborations among users in an organization (Velmurugan, 2013). That is why several archives use D-space for serving as an institutional repository. For example, in September 2007, 254 archives were running D-Space (Kudim & Proskudina, 2007). Velmurugan, (2013, p. 314) reiterated that D-space is "a digital repository system that captures, stores, indexes, distributes, and preserves an organization's research data". It is easily customizable, suitable for any organization, and the design supports the participation of all components of institutions such as schools, departments, research centers, and other units (Velmurugan, 2013). This makes scholarly communication possible among scholars. In other words, since institutions are concerned with the relevance of impact of their scholarly outputs by their academics (Nylon *et al.,* 2014), D-space answers most of the questions researchers are eager to ask. These impacts are beyond the consumption of scholarly community rather includes "influence on policy, improvement in health and living standards, cultural enrichment or an improved environment" (Nylon *et al.,* 2014, p. 1).

For over two decades, scholarly activities have adopted ICT tools resulting in digital scholarship. This is possible through integrating digital tools, simulations, visualizations, virtual environments, etc. more than texts (Wolski & Richardson, 2014). This has paved the way for scholars to adopt digital tools for conducting research, and devise means of imparting knowledge to students resulting in libraries adjusting in a similar direction (Lippincott, 2017). From altimetric analyses, frequent use of blogs or number of re-tweets serves as a measure for scholarly outputs (Torres-Salinas *et al.,* 2013; Priem & Hemminger, 2010); which

implies the visibility of scholars, and impacts of scholarly publications (Czerniewicz *et al.,* 2014) for solving societal problems or contributing to the body of knowledge. From another perspective, this means that open access is the sole hub to access studies (Lwong, 2013); which threatens the relevance of academic libraries (Schonfeld & Housewright, 2010) since most libraries have failed to employ strong technology, service policies, and marketing strategies. This is contrary to the fact that libraries were the main sources that scholars referred to for supporting their investigations (Budd, 2009). This brought many researchers to raise some questions regarding the relevance of academic libraries' roles currently practices of scholars (Nyquist, 2010).

Pieces of evidence show that scholarly communication is taking another dimension due to the transformation in research activity itself (Etzkowitz, 2004; Cooper 2009, 2011; Gibbons *et al.,* 1994) and emerging technologies (Tenopir, 2003; Palmer, 2005; Thorin, 2006; Procter *et al.,* 2010; Weller, 2011). These make research topography an open space (van der Vaart *et al.,* 2013) against the traditionally acclimatized one. In other words, libraries and scholarly communication are changing rapidly in a similar proportion (Pendleton-Jullian, 2013) due to the demands of a new age. The choice to pay more considerable emphasis on practice in scholarly communication is because of "practice return" in social sciences (Czerniewicz *et al.,* 2014). According to Palmer and Cragin (2008, p. 169), practice refers to "arrays of human activity" that is "materially mediated" and "organized around shared practical understanding". This pays particular importance to activities rather than texts and goes opposite to many models of scholarly practice like UNISIST (1971), the Garvey-Griffith (1972), Hurd (2000), and Sondergaard, Andersen, and Hjorland (2003) models. These models are process-based ones that show where texts go and which group of people takes responsibility for processing them (Czerniewicz *et al.,* 2014). Against these models, Proctor *et al.* (2010), Kraker & Lindstaedt (2011), and Czerniewicz *et al.* (2014) developed another model that does not concern itself with text and its movement rather the activities undertaken by scholars and their choices in these activities across the scholarly culture of each domain-specific environment. The fact that scholars find and disseminate investigations (Bulger *et al.,* 2011; RIN (2009), they are consumers and producers (Palmer, 2005), scholarly practice is very important for exploration. From the research cycle, which involves knowledge creation and dissemination cycle, certain features define it (Czerniewicz, 2013), there are basic elements, which include conceptualization, data collection, and analysis, articulation of findings, and translation and engagement. (For a detailed description of the practice of scholarly communication, see Czerniewicz *et al.,* 2014).

The movement for open access (OA) paved way for the institutional repository, a digital archive of the intellectual product (Johnson, 2002) which, to some is at the dead end. Institutional repositories, usually developed and managed by academic librarians, offer them the opportunity to outreach and promote the contents to the scholars in a respective institution (Narayan *et al.,* 2018). To some scholars, institutional repository did not escape their misconception about it because they perceive green OA as a substitute that provides alternatives especially with regards to personal repositories, disciplinary repositories, social networks, and innovative combination of three (van de Velde, 2016). Conversely, some scholars in HASS (i.e., humanities, arts, and social sciences) have expressed slow adoption of OA (Suber, 2017) and negative attitudes towards OA (Rodriguez, 2014). This implies that scholarly communication practice across disciplines is different.

Knowledge creation is a process that entails "quite rigidly codified pattern" (Dubini *et al.,* 2010, p. 119) that is tedious to adapt, and beyond that, challenges, and causes scholars to limp back and front as if doing nothing with regards to research but works for as a podium for gratification and solving societal problems. It subjects scholarly knowledge to rigor and into a "systematic, premeditated, reflective, and continuously submitted to the scrutiny of a community of experts" (Dubini *et al.,* 2010, p. 119) for inputs from these universally recognized scholars usually following standardized practice in their respective disciplines for guiding the novices and continuity of scholarly knowledge in a logarithmic phase. The enthusiasm and passion to contribute to scientific growth and development is the ultimate motivating factor for scholars to publish their works (Dasgupta & David, 1994) in recognized journals or aids as a badge of sort and scaffolding for promotion and recognition in their institutions (Adakawa *et al.,* 2019).

Thus, from this purview, it appears that the process of creation of knowledge is long, energy-, time-, and steps-consuming before conveying knowledge delivery to readers (Cope & Kalantzis, 2000). Similarly, scholars do publish their works for economic and social professional progression and as visibility, reputation and personal achievement of scholars increases so does the ability to publish in prestigious journals that give them insights into developing other publication patterns for younger researchers (Dubini *et al.,* 2010, p. 119; Kress, 2000) to adopt and prosper. The creation of knowledge marks the first stage in the scholarly process (Cope & Kalantzis, 2009) which depends upon the design, a backbone to represent the social process of knowledge. This immediately follows with the integration of concepts whose choice depends upon *inter alia* the domain of interest and inclination (Dubini *et al.,* 2010). The created

knowledge can be stored in a form, like D-space that ensures longevity, recycling of ideas, and long-term retrieval for research purposes.

TIME ABOUT MAKERSPACE AND HACKERSPACE ENABLER OF PROGRESSIVE DEVELOPMENT

From the unified theory of human information behavior, Spink & Cole, (2006) noted that a user has been a problem-solver, sense-maker, everyday life information seeker, and information forager. Making sense of the environment entails experiencing a problem and providing a unique solution to such a problem (Sualman & Jaafar, 2013). From this scenario, making is an attribute of humans and predated civilization and it is concerned with creating, inventing, or producing (Oyewole & Igbinovia, 2017) that will solve contemporary problems from a historic perspective. In this sense, libraries remain the only avenues that prepare and support users towards creativity, good academic achievement, equal access to quality physical, intellectual resources, and tools needed for learning (Oyewole & Igbinovia, 2017) motivate progression, independence, and connectivity. In other words, libraries are the engine for harnessing the mental capacity of users. To reflect on the above, libraries enhance cognitive development, critical thinking capacity, critical reading ability, critical reflections, logical reasoning, etc. of users (Oyewole & Igbinovia, 2017), and that, for affective issues, makerspace is important as a retooling component. Makerspace or fab labs or hackerspace or tech shops (Davis, 2018) is a technology-based community workspace that allows interaction of humans with computers, machining, and digital art (Curry, 2016) that makes innovations and creativity possible. Makerspace receives prominence as of 2016 there were more than 500 makerspaces globally serving communities, museums, and libraries, and Lou (2016) contradicted that there are more than 1, 400 spaces in 2016. This is to the extent that the schools that have makerspace outweigh those without (Nagel, 2018), especially in developed countries. It is more of Do-It-Yourself (DIY) or active learning that opens curiosity, innovations, creativity, etc., it involves using old technologies and new platforms (Curry, 2016) and survives mostly through crowdfunding. In effect, makerspace is more of turning knowledge into practice (Flaming, 2015). Makerspace despite appearing in different organizations has common objectives of encouraging literacy, providing access to new technologies, and nurturing ethos of making (Davies, 2018) to the extent makerspace equals librarianship.

The transformation from knowledge repository to knowledge economy has fueled unprecedented acceptance of the concept makerspace. For instance, Galaleldin *et al*. (2017, p. 1) reiterated that makerspace is

important for impacting positively to "provide opportunities for experiential and hands-on learning experience". This is the reason why makerspace gains recognition and acceptability in schools and universities that encourage preceptors to think differently about imparting knowledge. According to Novac (2019), students who used makerspace are good at using their creativity to solve problems, employ communicative and collaborative skills with other makers using critical thinking abilities to deal with hurdles in each circumstance and under different situations. Students who interacted with makerspace are found to perform excellently at schools and in workspaces (Nagel, 2018). This created a shift in education where schools, colleges, and universities prepare students for 21st-century skills that lead to their success in higher education and the workforce (Vongkulluksn *et al.,* 2018). Creative thinking and problem-solving skills are the prerequisite components required by industries and prepare individuals to make technologies rather than just use technologies (Graves, 2014). In a similar narration, Novac (2019) referenced Leopold *et al.* (2016) who reiterated that 65% of the students in schools will have careers that don't even exist today, and this reveals the relevance of makerspace in ensuring creativity, collaboration, communication, and critical thinking among individuals.

The increased global reliance on computer networks for accessing, storing, and exchanging information, and over-dependence on computer-operated or computer-assisted infrastructure (McClure *et al.,* 2012) has opened a desire to hack other organizations or individuals' assets. Hacking involves "irritating but harmless activities of youthful pranksters to the very damaging, sophisticated, targeted attacks of state actors and master criminals" (McClure *et al.,* 2012). For instance, Joe hacker, ingenious in cogitation, uses ninja technique via Nmap employing Tor or onion router to hide his/her identity to hack innocent internet users utilizing domain-specific names of organizations or individuals; among the most hacked information in an organization is the archived information (McClure et al, 2012). This is where the issue of d-space comes in. The work of Donohue (n.d) on how to hack the d-space community details why organizations must take good care of the information contents of the institutional repository. This is because; a hacker using WayBack Machine or Google's cached results can retrieve even the deleted archived information on an organization's website. For d-space, the hacker has a multitude of options to get access to contents depending on the crime at hand. For instance, Donohue (n.d) reiterated that hacking can take place by understanding how things get done, knowing the doers in an organization, their motivation, and why they care much about it, and finally the motivation of the hacker and his/her desired goals to achieve.

The time interval between imparting knowledge on makerspace-users-to-be, and when they become an expert is paramount in understanding the scope of their expertise. Perhaps this is the reason why some scholars treat both makerspace and hackerspace alike (Davis, 2018). In the beginning, they are firstly open to the mastery of STEM (a science, technology, engineering, and mathematics-based curriculum) where they expose themselves to the physical realities in gathering data from these sciences and come up with a possible solution that could solve a given puzzle based on their logico-mathematical abilities. Novac (2019) has failed to attribute 4Cs (i.e., communication, collaboration, critical thinking, and creativity) to time frames particularly using stages of cognitive development in Piaget's theory. Looking at it from a socio-cognitive development perspective, this opens learning by imitation (Piaget, 1977) which occurs in succession from amateur users of the traditional culture of makerspaces to the sophisticated producer of the more complex culture. In other words, individuals partaking in activities in makerspace or hackerspace follow a sequence of events described by Piaget such as sensorimotor stage, preoperational stage, concrete operational stage, and formal operational stage.

Furthermore, referencing Piagetian theory, it follows that, there are three types of knowledge: social, physical, and logico-mathematical knowledge. There is a strong relationship between physical and logico-mathematical knowledge. Intermingling with technology, for instance, enhances one's understanding, increases critical thinking, collaboration, communication, etc. in a unit time. Physical knowledge, knowledge of an object in external reality (Kamii, 1982), includes observable facts about the features of an object such as shape, weight, texture, and color. For instance, each individual constructs his or her understanding and meaning of numbers (Kamii & DeVries, 1980). According to Williams and Kamii (1986), it is impossible to separate physical and logico-mathematical knowledge because of their reciprocal dependability and development together. For this reason, Piaget (1977, p. 41) described the two types of knowledge as "inseparable" because, without observable features, relationships cannot be constructed. Furthermore, McClellan & Conti (2008) referenced Gardner & Hatch stating that "intelligence is traditionally defined in terms of Intelligence Quotient (IQ), which measures the range of simple Verbal/Linguistic and Logic/Mathematical abilities". This implies that, in the learning process, every individual has distinct abilities, features, and intelligence (Arum *et al*., 2018).

The covid-19 pandemic has deepened the logical reasoning of individuals particularly digital natives where they grow with the growth of these technologies. To augment the above, Prensky (2001) noted that, digital

native, contemporary generation continuously gets immersed in a world permeated with networked and digital technologies. This trend makes them behave differently from previous generations to the extent they think, learn, and interact differently, they display different social characteristics, and their expectations about life and learning differ markedly from previous generations (Tapscott, 2009; Howe & Strauss, 1991, 2000).

A SOCIAL SYSTEM ABOUT MAKERSPACE AND HACKERSPACE

In principle, it is common to compare "like" with "like", and like minds (homophiles) accept technology and thus, work whole-heartedly (Sharma & Romas, 2012). This implies that hemophilic collaborators embrace and use technology based on the nature, functions, and scope of the technology itself and makers. For this reason, it can be argued that makerspaces through collaborations can be a blessing and another way round. From a blessing angle, using a bottom-up scenario, against the profit-driven industries, a local collaboration of makerspace with organizations yields promising results. For instance, during the heightened pressure by the Covid-19 pandemic, where the supply chain was cut near collapsing, the global health community was faced with inexperienced burden coupled with failure to react to the emerging infectious disease head-on; it was the makerspaces, which began prototype. In the first instance, through collaborating with healthcare facilities, they contributed production of personal protective equipment and later prepared open-source healthcare products to meet global needs (Kieslinger *et al.,* 2021). According to these authors, there is the possibility of makerspace-driven open hardware movement in the future to complement the already open-source software that has been running around the globe. This can be attested to as of March 2020, in the first wave of Covid-19, Open-Source Medical Supplies recruited more than 70, 000 makerspaces to collaborate (Kieslinger *et al.,* 2021). Work undertaken by Browne, (2018), indicated how social networking enhances makerspaces' contributions to their communities. In other words, both makerspace and hackerspace collaborate to function on small scale facilitating community-based initiations thereby filling in gaps in areas that communities are left behind forming hackathons to conduct community projects or group learning sessions (Jameson-Ellsmore, 2021).

On the other hand, in the first wave of the Covid-19 pandemic, hackers' activities skyrocketed and have changed the way they hack individual or organizational data. According to DeLisi (2020), hackers were presented with an opportunity from various parts ranging from using people's concern about the virus to phish or use malware to disguise as

Centre for Disease Control and Prevention to luring people to the extent some well-sponsored hackers tried to hack Covid-19 vaccines data from various labs. Applying social innovation theory in this context it is obvious that, social innovations respond to social needs and societal challenges (Millard, 2020). Similarly, using the submission of the Bureau of European Policy Advisers, (BEPA) (2010), societal levels of social innovation, there are three levels, which are social needs (micro-level), societal problems (Meso level), and systemic change (macro-level). This policy indicates that there are three layers, upon which social innovations can impact societies. At each level, makerspace or hackerspace can collaborate to either leverage on their goals or benefit their societies. Social-arbitrary knowledge is conventional knowledge particular to one's culture that can only be transferred from generation to generation through oral or written language (Kamii, 1982). Perhaps that is why Gangadevi & Ravi (2014) cited Gardner as defining intelligence as a "bio-psychological potential to process information that can be activated in a cultural setting to solve problems or create products that are of value in a culture". To support this point, Vygotsky, (1978) noted that, human learning is a "social process and the origination of human intelligence is in society or culture". This means that, from the interaction of social systems, the social construction of reality of either solving a societal problem or hacking individual accounts, is apparent.

CYBERSECURITY COPING STRATEGIES FOR DIGITAL PRESERVATION

Even though many scholars such as Al-Ahmad and Mohammed (2018) have detailed some of the commonest information risk assessment challenges, there are many more to grasp from other perspectives. Using the d-space data governance model shows a promising avenue to tackle the probable data attack than can other sources. In this sense, there are two components, which serve similar coins namely, standing working groups and data governance roles. Steps in ensuring coping strategies of information resources are possible through

a. Product planning process: The steering committee should consider ethical issues, in-depth knowledge of makerspace/hackerspace, and prevalent mistrust among *ad hoc* staff to be recruited for contributing the vision of the product. In addition, community surveys should indiscriminately capture regions be it Africa, Asia, Europe, etc. that use d-space for storing institutional contents gather the data can ensure a product free of lapses.

b. Technology Advisory Group: Metadata and program designers are important in advising the steering committee on how the product should remain intact. In other words, the steering committee should be mindful of downsizing; intentional termination of the offer, feeling insecure on the part of the employees, etc. Of significance, the term limit of participation should be reviewed from two-year-old to a more accommodative timeframe. This is intended to show members that they are still part and parcel of the committee to avoid unnecessary breach of trust.
c. D-space Community Advisory Team (DCAT): In this era of data mining, creativity, communication, collaboration, critical thinking, etc., DCAT should be careful with the conventional ways of communicating its information to end-users. The fact that makerspaces/hackerspaces are taking steps in serving as open-source hardware movement, inserting microchips in application software is possible. Furthermore, discussing the area of focus for DCAT should be an internal issue restricted to very few members of the committee.

CONCLUSIONS

The covid-19 pandemic continues to challenge the global health community exponentially. It has opened the knitted globalized world that dares to revert to old normal a burden. Computer networks have become the central nervous system of contemporary society. This makes individuals engage with the internet like never a potential of making them hackers enabling the exchange of desired commodities or undeserved products free of cost. Attack on SMEs is conspicuous, and individuals are becoming adept with the complexity of the internet. Possibly, hacking activities will increase especially the one never imagined like hacking D-space. Examination malpractice and theses or dissertation coping mechanisms will increase. Pirated webinars, conferences, false book chapters, articles, journals, etc. used in scholarly communications for promoting scholars will dramatically increase. The earlier the D-space steering committee takes precautionary measures to safeguard institutional repositories across the globe, the safer the information resources contained in those spaces.

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