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Review

Creation and utilization of maker spaces in academic libraries: Bridging the gap between theory and practice

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In recent time, library mannagement creates a space in the library called Makerspace where researchers work together and share ideas in their various areas of specialization. It promotes conversation, collaboration, creativities and innovations. Indeed, this study focused on creation and utilization of makerspaces in academic libraries as well as bridging the gap between its theory and practice. This study explored the creation and utilization of makerspaces in aacademic libraries. The study utilized the library research approach and relied on secondary data for analysis sourced from articles, journals, periodicals and publications. It furthermore, conceptualized makerspaces and provides considerations that would necessitate its establishment in academic libraries. The terms used in the framework are Piagetian and Vygotskian interpretation of constructivism. These terms were derive from constructionism and multiliteracies. Thus, masterspaces practice members' involvement. The two theories deepened and expanded the knowledge on learning that could enable the framework to be modified as the makerspaces issue and aids to deepen the understanding of the phenomenon rather than predicting. It also identified needs to design makerspaces, what is required in setting up a makerspace, the major tips to consider when developing a makerspace and discuss intensively how academic libraries utilize makerspaces. Finally, this study recommended that library management should not hesitate to establish makerspace in their respective institutional libraries as this will aid research and promote scholarship.

Key words: Creation, utilization, makerspaces, academic libraries, theory, practice.

INTRODUCTION

Makerspaces are growing service areas in schools, public and academic libraries. According to Burke (2015), shared equipment and resources that can be used to create digital and physical items in common working spaces by participants or makers. In library, spaces called makerspaces are created by librarians to ensure that researchers could collaborate and share ideas in their various areas of interest. Makerspace could equally

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be described as a way of creating new things that are equipped in that space (Turner et al., 2013). Makerspace is used as a mechanism or an avenue to assist learning and experiment for students outside the formal school setting Burke (2015). The introduction of makerspace technology has created a way of allowing wide spread of knowledge amongst researchers. This technology is spreading globally and libraries have keyed into it. They are advocating for makerspace in libraries as part of library services to their clientele (Okpala, 2016). As a result of this, most libraries are hosting makerspace activities as an option in their programme so as to establish a dedicated area for makerspace inside their library.

The up-dating of devices and improvement on creative activities such as music recording spaces, large format printing, art-related workshops, audio and visual capturing, are done by librarians. The installation of internet network in the building inspired most of the library staff to develop wide makerspace program in the library for their users, (Burke, 2015). Similarly, Colegrove (2013) opined that libraries are directly expanding makerspace in their physical structure as well as benefiting from its impact. According to Balas (2012) and Britton (2012b) in Pryor (2014), the current trending topic in libraries is makerspace, this concept has been a continuous discourse and also gaining popularity with researchers in the field of librarianship, however public libraries have been identified as the major institutions for its drive. Boyle et al. (2014) emphasised that developing creative spaces are current trends in libraries in our present day.

Moreover, it aids the libraries to be an active and attractive information centre and encourage physical visit to the libraries (Al-Mousawi, 2018). However, there is need for Academic libraries to focus on creation of common working spaces for learning and resource sharing among members of their communities. The creation and utilization of makerspaces practices in Academic library have to be documented. Therefore, this paper explored through the library research approach, and the creation and utilization of makerspaces in Academic libraries.

THEORETICAL FRAMEWORK

Makerspace is a new trend that changes teaching and learning activities in the society. According to (Martinez and Stager (2013) makerspace is seen as a method of building, innovating and designing with appropriate materials and mechanise to share knowledge. In their views, (Anderson, 2012; Honey and Kanter, 2013; Martinez and Stager, 2013; Sousa and Pilecki, 2013) researches carried out on makerspace describe it as a means or ways of creating, learning and research activities in different learning environments and implementation method of the makerspace activities into learning centres Fried and Wetstone (2014) explained that through the makerspace movement, the world is changing on building stuff, i.e. such inventing and building items. Ratto and Boler (2014) stressed that the motive behind makerspace is to enable someone to build and invent things by himself rather consuming. Indeed, policymakers and sponsors have aided maker movement from grassroots to an international issue which has successfully been integrated into the school setting. Many scholars are working towards understanding the relationship between makerspace and learning and how it functions in learning centres.

Consequently, various practitioners in formal learning environments are adopting makerspace as a learning mechanism. Honey and Kanter (2013) discussed the integration of makerspace into formal and informal school environments and enumerating its implications from series of cases and issues. Museums like the Exploratorium and the Children's Museum of Pittsburgh showed the design practices and processes of their learning supporting maker-based initiative. In another development, (Brahms and Werner, 2013; Petrich et al., 2013). Martinez and Stager, (2013), took a practitioner-method in connecting makerspace with learning. He equipped teachers particularly in engineering disciplines with tools to integrate makerspace into their classrooms. As the resources expanded,they strenghtened the activities within the learning environment via makerspace. Consequently, makerspaces is consider by scientists and researchers in educational discipline as viable options on the actual traditional science, Technology, Engineering, Mathematics (STEM) learning environments (The White House, 2009). According to Anderson (2012), the vast popularity of makerspaces in formal and public have naturalized as the make movement which was resulted from maker mobilization across the globe via avenues such as magazine, World Maker Faire, Internet and maker (Litts, 2015). However, the movement is becoming popular in learning and community environment/centers, which lead to vital question that was largely non-answered is: what does makerspace mean?

Thus, there is little report despite the increase in makerspace deployment learning centres. Lately, the Institute of Museum and Library Services (2012) were the first to give a meaningful effort in defining makerspaces: Consequently, this Institute of Museum and Library Services (2012), viewed makerspace as a leading mentor learning environments that foster invention, experimentation, exploration, creation and learning. The makerspaces comprises of tools, space and community. Library as Incubator Project (2012) opined that, community who design makerspaces sustain it and wasn't develop out of necessity but for partnership, invent and collaboration (Baichtal, 2011; Britton, 2012a). In numerous cases, makerspaces came into existence when minded thinker come together to have a common

place or space for community buiding (Litts, 2015).

However, in substantiating makerspace as learning activities, educational practitioners are endeavour to have evidence to support learning of makerspace. Papert's Learning theory of constructionism (1980), New London Group's multiliteracies (Cazden, 1996) as well as Lave and Wenger (1991) were supported through learning spirit, but the adoption of new information technologies have widened the learning capacity. In this study, constructivist-based and sociocultural theories of learning are revolved around three makerspaces aspects which are community, space, and tools. Constructivism is all about the making of something. The idea was derived from convergence theories of multiliteracies and constructionist. However, the idea formerly relied more on convergence for Piagetian interpretation of constructivism and Vygotskian interpretation of constructivism, which all affirm that building of new knowledge largely relied on previous knowledge. Although, they are differ in their opinion on exploring on how meaning are made. Vygotsky distributes sense making as social practice and interaction but Piaget sees it as an individual experiences (Litts, 2015).

Knowledge gains through experience was seen to be meaningful, an active knowledge was constructed from interaction with environment (Piaget, 1956; Kafai and Resnick, 1996). Piaget's recognized from constructivism that knowledge was gain through putting different external factors but found in learner head. According to Piaget (1956), experiences recognised the construction of schemata. These schemata change occurs through assimilation and also equilibrium internal cognitive. However, Vygotsky (1978) proposed a lot of social-based constructivism. According to him, knowledge could be constructed through social interaction, norms, values, language, and learners adopt the knowledge. In Vygotzky's theory of the Zone of Proximal development, the developmental stages were overcome by learners from apprenticeship and scaffolding. This as results to interaction and social context try to help learner through learning and knowledge development (Vygotsky, 1978).

The concept of constructivism was perceived by both Piaget and Vigotsky on cognitivisim and socio-cultural perspective respectively which invariably has positive on constructivism and multiliteracies. Both theories have led to knowledge expansion on the application of makerspace. The process and practice of makerspace with member's participation equally defines makerspaces. Conversely, these theories outlined natural collision that existed between multiliteracies (New London Group, 1996, 2000) theoretical orientations and constructionist (Papert, 1980, 1991, 1993), thereby construct a framework that is viable on the natural collision that is usable for makerspaces interpretation as learning environments. In understanding the afore-mentioned theories, one would say that makerspaces in educationist's view is still in its infancy.

This study contributes by comparing makerspace learning and learning in the making spaces in Academic libraries. It also outlined theoretical framework by Piagetian and Vygotskian as grounded in the evolution of constructionism and new literacies; therefore, providing insights into the understanding of makerspace.

CREATION AND UTILIZATION OF MAKERSPACE IN ACADEMIC LIBRARIES

Makerspace is unique and as a result of this uniqueness, diverse projects are worked on inside them. Example of some of the diverse project as explained by Okuonghae, (2019) include 3d printing, electronics/audio, inventing, laser cutting, coding, soldering, learn circuits, robotics and electricity with paper circuits, wood working, sewing and partial practical sessions. Hence, the need for such programs to be created in the Academic libraries. Library management planned makerspace programs to help users to learn, create, use, share and do it your own (DIY) knowledge. For instance, academic libraries organized makerspace activities such as learning common, workshop and in-house seminar. Acquiring the knowledge will not only increase the ability of critical thinking of the learners, rather it will also help them to be inventive. However, asides space, creativity is provided in the library for clients to utilize and create resources, information and collaborate. Therefore, the community can share techniques, information or the tools underlining creation at the library (Okuonghae, 2019). Abram (2013) further explained that the following needs which are to derived from makerspaces includes:

1. Allow access to a wide variation of technologies and tools that aids resources sharing, knowledge and group interaction;
2. Encourage individual project development through provision of access to physical space;
3. Create a disclose environment for innovation and creativity;
4. Provide access to tools used in the companies for prototyping project purpose.

The adoption of makerspaces in libraries is to keep the library clients busy and productive which means through makerspaces, libraries can promote inventions, creativity and ingenuity. Makerspaces as a platform is provided for learner or makers to be inventive or to develop a new ideals and things from experimental and during interaction with human. Therefore for a maker, in order to be in genuine and original, there is need for them to function within a condusive atmosphere so as to allow for proper flow and actualization of ideas. Developing it (makerspace) in libraries is above fusing the ideal and idle space. It involves engaging library patrons choosing for them vibrant formators to coordinate. The requirements that are expected in the libraries for the establishment of makerspaces are as follows:

1. As regards Makerspace policy (Okpala, 2016), it is expected that the place should always remain open as long as the library is opened and closes when the library is closed.Librarian should be in charge of the space along with the assistance of not less than two technical staff.

a) Clients that will patronize the space should be those that have registered with library. This caegory of patrons will comprise of researchers, community users, staff and students.
b) Training on the usage of the available technologies, tools and equipments should be put in place once or on weekly basis.
c) Snapping of pictures in the space should not be accommodated without due authorization.
d) Staff and students should be able to use the space free of charge.
e) Users are to be responsible for raw materials of their product when coming to the space.
f) In the space, neither eating nor drinking should be allowed.
g) The space should be maintained for innovation and collaboration purpose only and not to be serve as a reading room.
h) All those who intend to use the makerspace should register.

2. Objective of makerspace according to Okpala (2016) is to;

a) Createe an avenue in the university environment for innovative and creative ideas to take place as well as center for knowledge acquisition, learning and sharing new ideas
b) Provide an atmosphere that is suitable for potential users (researchers) to generate new things or ideas.
c) Enable people with like minds to share ideas.
d) Assist university community to acquire knowledge, new ideas and learn from the experts and specialist in a specific discipline.
e) Make the university communities to be innovative centers.
f) Promote library service delivery through the aid of makerspace.
g) Foster collaboration and trust that provide for contemporaneous and multidisciplinary in ideas development.
h) Housing of fanciful tools and equipments that will help in prototyping ideas and development.

3. The right space: The location of the makerspace should be far from the reading section. The area allocated for the makerspace should be partitioned to have doors, window and the makerspace equipment. Apart for the advantage of space, the area which will be used for the location of the maker space should be such that it will provide adequate security of the equipment. This can be achieved with the allocation of security personnel and library porters to that area. Furthermore, its area of operation should be central, with open access within the library meaning that the area should be located in a strategic position very close to the Open Public Access Catalogue (OPAC). This should be done to ensure and encourage high user's interest and participation. Scalfani and Sahib (2013) evaluation of the University academic libraries policies on 3D Studio management showed that 3D studio should provide 3D users independent authorization and open access visible experiment that will largely contribute to gain the program success.
4. Makerspace theme or program: Creativity and Innovation
5. The target audience should be user's especially students and lecturers who are registered.
6. The sources for funding should be from Annual Vote/Budget of the library, it could also be through nations and local investors.
7. Get training and support expert/mentors like Librarians, instructors and teaching staff for the program according to Burke (2015), the web survey conducted affirmed that the library staff (49%) was responsible in teaching at workshop, classes and training sessions. Other instructor/ expert include volunteers, instructors from outside the library that usually paid for their services or "others" which include IT personnel, members of maker group 49, 27, 13, and 12% respectively.
8. Makerspace tools and materials: Burke (2015) pointed out materials and tools for makerspace to include digital technologies which are made up of computer programming, videos cum image editing, computer programming and animation. These tools are highly essential and popularly available at makerspaces in the library. However, Okpala (2016) lists technologies/tools/ activities in his proposal sample for academic library makerspace:

a) Space in the library to be used for the makerspace.
b) 3 Dimensional (3D) Printer.
c) 3 Dimensional (3D) Scanner.
d) Digitization technology.
e) Computer-Aided Design (CAD) Software which include AutoCAD, Autodesk, etc.
f) Hardware like computer, etc.
g) Furniture: tables, chairs, white board, duster, etc.
h) Consumable materials which include but not limited to super glue, electrical tape, sandpaper, modeling paint, and acetone).
i) Supply of electricity.
j) Internet which is needed for accessing social media so as to enable opportune collaboration cum public display of ingenious child/product.
k) Soldering iron.
l) Cutting machines like knife, cutter
m) Digital camera.

n) Large screens.
o) Sewing machines, needles, scissors.
p) Audio equipments which include microphones, speakers, etc.

The basic principle that must be followed before setting up a makerspace in the library as explained by Pisarski (2014) include the following:

i) Sustainable and long lasting activities should be planned: This means that the expert in charge of creating makerspace should not invest in materials that are expensive and unsustainable to be taking by users rather they should invest in items seemed recycled in different ways.
ii) Design your activities: This is one of the most challenged aspect participants engaged on, by doing this, there will be limit of direct instruction needed per session thereby providing enough time for practical engagement.
iii) Procurement of less expensive materials: It should be noted that simple activities that are not expensive can encourage creativity than items of high cost equipment, such as 3dimensional (3D) printers. Box filled with scrap materials can be used for game creation. Examples of these scrap materials include plastics, markers, buttons, cardboard, fabrics and paper. Mostly materials that are of low-cost quality are gotten from donation and other means.
iv) Online resources should be considered. These materials include resources such as Cameo, Snap Circuits, Maker Shed and Little Bits,. These materials could provide lesser cost technology-based products. Topics range from the science of circuitry, graphic design, computer programming and electronic music.

According to Okpala (2016), it is already established that library is a hub of knowledge where researchers come to explore new ideas and information about new library resources and innovations that are of interest to them. The main reason why makerspace should be established in the library was due to numerous numbers of students that visit the library for research purpose (Okpala, 2016). Also everyone who visits the library finds it easy to visit the makerspace.

Participants elucidate that as result of available materials, tools/equipment/technologies as well as spaces, it resulted to opportunities of learning, boost community commitment, allow access to information and attracting to a variation of clients, in which both contribute to subsequent proof of its organization thereby making the library to serve as innovative spaces (Slatter and Howard, 2013; Chan and Spodick, 2014). Okpala (2016) opined that because of this makerspace movement, library is seen as a center for innovation that provides its users with a serene learning environment and sharing of ideals. Due to its role, particularly in creation of knowledge and in the field of Science, Technology, Engineering and Math education (STEM) further endorsed the library to provide a center for makerspace.

According to Bagley (2014), academic library particularly in higher institution supported teaching, learning, research and creates a suitable ambiance that encourage creation, innovation and invention. Though every section in a university bring people together to carry out experiment also to collaborate and share resources in the libraries.

CONCLUSION

In a nutshell, makerspace promotes conversation, collaboration, creation and utilization of variety of resources and compels the patrons with the frequent use of the library. However, there is great need to improve academic library services due to users, so that they would become more aware of makerspaces. It is assumed that there is the need for clients' adjustment of time and libraries must also endeavor to meet up with its clients' needs. Thus, in an attempt to redefine the library as a center to radiate civilization, librarians should ensure that spaces are made available for clients to aid learning on various forms of literacy which will encourage creation and innovation at all levels.

The Work in this paper conceptualized makerspaces and provided considerations to necessitate its establishment in aacademic libraries. The terms used in the research framework are based on Piagetian and Vygotskian interpretation of constructivism as both experts exert positive influence on constructionism and multiliteracies. Thus, the process, practice and members' involvement in making is known as makerspaces. These two theories deepened and expanded the knowledge on learning from makerspace.

It is equally of importance to note that the concept of makerspace is becoming popular in the field of librarianship in the 21st century of information age with lots of idea generation for future engagements of libraries. These include the following:

1) The futuristic aspect of makerspace is such that it will bring and harness national integration which will enhance better education for development.
2) Librarians with years of experience impact knowledge on a group of people and this knowledge so impacted will assist younger ones in their future endeavor.
3) The process of makerspace is like bringing resources together (collection development) in the library. All tools such as 3D prints, 3D scanners, electronics and workshop or work places and other information resources such as software computers and other gadgets are brought together by different and experienced experts who now train people thereby enabling them to use same for their future needs.
4) People who are knowledgeable and well-versed in a discipline could teach others who are more or less learners in that particular discipline. This will bring co-operation and collaboration among the makers.
5) Users/learners are highly engaged in hands-on

creation which will invariably take place in a collaborative environment created within the library.
6) In order not to subject the makerspace to the wrong notion that “the library is a place for storing books” thereby considering the makerspace as a mere workshop; the following ideas could attract users to the makerspaces in libraries.
7) Making people to change their innovative ideas of making in the library. This means that people should not think of only using books (print resources) in the library but other resources that could be made through collaborative efforts that would enhance their usage in the library.
8) People of different disciplines come together to create or make a new thing that will improve human development through the knowledge put together by makers.
9) It brings unity in many diverse ways, making the people that come together to bring into practice the idea of makerspace.
10) It could bring about community development in many ways. This will enable the people residing in a particular community to work and collaborate for a better way of living.
11) Makerspace will bring people together in an opportunistic way to create and make things that will be of common benefit to them.
12) Makerspace as a way of improving literacy can equally improve on the economy of a country.
13) Users would be assisted to improve economically by putting into practice what they have learnt through makerspace and better their lots in the society.
14) Network in knowledge sharing in all aspects of human endeavor could assist people through the use of makerspace.
15) It Makerspace also promotes collaboration by locating entrepreneurs, innovators and researchers together to encourage entrepreneur-based activities cum transfer of technology.
16) It will bring about exposure to new technologies and developing related skills.

Finally, the study recommended that aadministrators in institutions of higher learning should encourage the setting up of makerspaces in their libraries.

CONFLICT OF INTERESTS

The authors have not declared any conflict of interests.

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