VIRTUALIZATION OF KNUST'S TANGIBLE HERITAGE: AN ALTERNATIVE MEDIUM TO ENHANCE ACCESS

By

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DECLARATION

I hereby declare that this submission is my own work and that, to the best of my knowledge and belief, it contains no material previously published or written by another person nor material which to a substantial extent has been accepted for the award of any other degree or diploma at the Kwame Nkrumah University of Science and Technology, Kumasi or any other educational institution, except where due acknowledgement is made in the thesis.

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ABSTRACT

Indisputably, museums provide research, educational and recreational benefits to mankind. This has been carried out manually for centuries. But with the emergence, and spread of Information Communication Technologies (ICT's) this manual services are changing rapidly to virtual services; all because the current generation of students and researchers alike unconsciously resonate towards electronic platforms to access and utilize information. Not very mindful of this, Kwame Nkrumah University of Science and Technology attempted to establish a brick and mortar museum between 2002 -2012 to showcase her heritage but to no avail. Meanwhile huge sums of money, technical and managerial resources had gone into it. In order to salvage such investment and to be able to enjoy the benefits inherent in museum services, the idea of a virtual museum was hatched as an alternative medium to achieve the same goals. The study therefore, analyzed museum services in Kwame Nkrumah University of Science and Technology (KNUST), designed, developed and implemented a demonstration virtual museum (Virtual Museum of KNUST– (*VIMU KNUST)* and finally evaluated the effectiveness and efficiency of *VIMU KNUST* in enhancing access to KNUST's tangible Heritage. In advocating for the creation of such a resource, the Sequential Exploratory Design in (mixed method) was employed. Questionnaires, interviews, documentary reviews and observation were used to gather data. Initial assessment results were reinforced by a subsequent survey in order to be sure of the preference of the virtual museum by the University. Additionally, a demonstration virtual museum was designed for evaluation and the evaluated opinions were used to refine it for implementation. Analysis of Data revealed that, apart from access enhancement of Kwame Nkrumah University of Science and Technology's (KNUST) heritage by the Virtual Museum (VIMU-KNUST), it will also provide monetary, visibility and educational benefits. More so, it became evident that the preference of the university community was on a virtual museum where patrons could sit anywhere and access it via the internet. As a sequel to these, the study recommended among others that the University Management Committee prioritizes the creation of a virtual museum as needed by the University community while ensuring that, the resource is well advertised and that the interactivity as well as navigability features of the resource is up to task.

TABLE OF CONTENTS

LIST OF TABLES

LIST OF FIGURES

LIST OF PLATES

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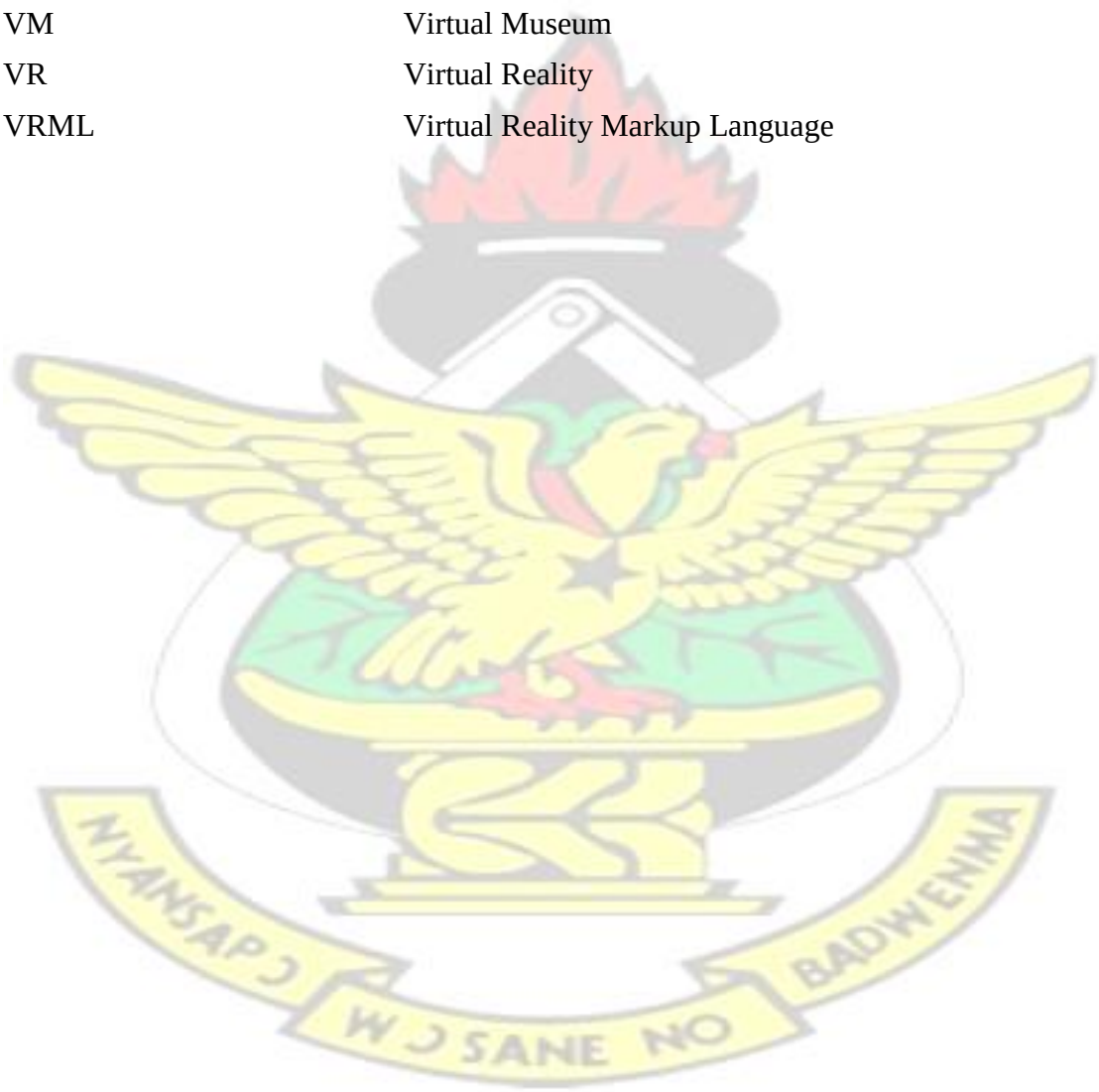
LIST OF ABBREVIATIONS

3D	3 Dimensional
AFRICOM	International Council of Africa Museum
AR	Augmented Reality
CABE	College of Art and Built Environment
CAM	Commonwealth Association of Museum
CANR	College of Agriculture and Natural Resources
CoE	College of Engineering
COHASS	College of Humanities and Social Sciences
COHS	College of Health Sciences
COS	College of Science
DSL	Digital Subscriber Line
GMMB	Ghana Museum and Monuments Board
HTML	Hypertext Markup Language
HTTP	Hypertext Transfer Protocol
ICHIM	International Conferences on Hypermedia and Interactivity in Museums
ICOM	International Council of Museum
IDL	Institute of Distance Learning
KCT	Kumasi College of Technology
NMAI	National Museum of the American Indian
NMNH	National Museum of Natural History

OER	Open Educational Resource
OI	Oriental Institute
OPRS	Office for the Protection of Research Subjects
OSG	Open Scene Graph
PDA	Personal Digital Assistant
QTVR	Quick Time Virtual Reality
SHAPE	Situating Hybrid Assemblies in Public Environment
UITS	University Information Technology Services
USC	University of Southern California
VM	Virtual Museum
VR	Virtual Reality
VRML	Virtual Reality Markup Language



CHAPTER ONE

INTRODUCTION

1.1 Background to the Study

The thrust of this study is to advocate for the creation of a virtual museum to enhance access to KNUST's tangible heritage. The beginning chapter therefore introduces the subject matter and justifies the value of embarking upon such a project. The scope and challenges of the study have been described; technical terms and abbreviations have been explained and the research questions guiding the study have all been treated.

Ordinarily, a Museum is a place where a collection of objects illustrating science, art, history or other subjects are kept and displayed (Dierking & Lynn 1992). At various museums, visitors can learn how people lived and worked in early times or what makes a work of art a masterpiece. Some people also consider the term museum to apply to such educational institutions as Planetariums, Botanical Gardens, Zoos, Nature Centers and even Libraries. A Museum collects, cares for and researches the object it displays. It also keeps a study collection of un-displayed objects. These objects sometimes called artifacts are often studied by students and researchers.
Broadly there are Art, History and Science Museums.

A virtual museum is a digital entity that draws on the characteristics of a museum, in order to complement, enhance, or augment the museum experience through personalization, inter activity and richness of content. According to ICOM (2007), Virtual Museums can perform as the digital footprint of a physical museum, or can act independently, while maintaining the authoritative status. In tandem with the ICOM mission of a physical museum, the virtual museum is also committed to public access; to both the knowledge systems imbedded in the collections and the systematic, and coherent organization of their display, as well as to their long-term preservation.

As with a traditional museum, a virtual museum can be designed around specific objects (akin to an art museum, natural history museum), or can consist of new exhibitions created from scratch (akin to the exhibitions at science museums). Moreover, a virtual museum can refer to the on-site, mobile or World Wide Web offerings of traditional

museums (e.g., displaying digital representations of its collections or exhibits); or can be born digital content such as net art, virtual reality and digital art. Often, discussed in conjunction with other cultural institutions, a museum by definition, is essentially separate from its sister institutions such as a library or an archive. Virtual museums are usually, but not exclusively delivered electronically when they are denoted as online museums, hyper museum, digital museum, cyber museums or web museums.

Institutions like museums play an important role in education by providing their collections of cultural materials and knowledge through the Internet to a global audience. In recent years, the advent of 3D web technologies has impacted on museum websites, particularly as the connection systems for broadband Internet access have become faster and more widely available. This has allowed the development of 3D on-line virtual museum displays and exhibition applications for educational purposes. According to White et al. (2004), recent surveys indicate that about 35 percent of museums have already started to develop virtual forms of 3D presentation of their artefacts in online virtual exhibition environments as a novel mode of communication. In addition, the notion of creating 3D virtual museum environments is not only to increase accessibility, but also to use the potential of the innovative 3D web technologies to present their cultural content as both informational and educational resources from which virtual visitors can learn the historical and cultural significance of museum artifacts and associated information in 3D virtual worlds.

Kwame Nkrumah University of Science and Technology (KNUST) is a university in Kumasi, Ashanti, Ghana. It is a public university established in the country, as well as the largest university in the Kumasi Metropolis and in the Ashanti Region. KNUST has its roots in the plans of the King Asantehene Agyeman Prempeh I to establish a university in Kumasi as part of his drive towards modernization of his Ashanti Kingdom. This plan never came to fruition due to the clash between British empire expansion and the desire for King Prempeh I to preserve his Ashanti kingdom's independence. However, his younger brother and successor, King Asantehene Prempeh II, upon ascending the Golden Stool in 1935, continued with this vision. Events in the Gold Coast in the 1940s played into his hands. First there was the establishment of the University College of the Gold Coast. Secondly, there were the 1948 Accra riots and

the consequent Watson Commission Report which recommended that a university of sciences be established in Kumasi. Thus, in 1949, the dream of the Prempehs became a reality when building started on what was to be called the Kumasi College of Technology (KCT). Further chronicling from the past as narrated by Pitcher (1976), Kumasi College of Technology's (KCT) land was generously offered by the Asantehene the late Otumfuo Sir Osei Agyeman Prempeh II. It was a vast parcel of land with Ayigya in the North; Kumasi in the South; Ayeduase in the East whilst Bomso Township bordered the land in the West. The early buildings for tuition, practical work, residence and laboratories were all prefabricated which were constructed hurriedly within six months under the supervision of Eichenberg popularly known as 'Uncle Ike'. The structures were needed to start classes in 1952. Examples of the temporary buildings which were urgently acquired to be used by the Science and General Studies and Teacher Training Department included: The Housecraft Block which contained sections for laundry, cookery, housewifery, needlework and a practice house. School of Arts and Craft which was sub-divided into the following sections - Drawing and Painting; Modelling and Sculpture; Graphic Art illustrations and Book production; Pottery and Ceramics; Textiles. These were situated in the present-day Faculty of Art enclave. There was also the School of Music Block with its lecture rooms and studios; and the Gymnasium used by the School of Physical Education. All these temporary structures were put up barely a year before classes started on the campus.

The Kwame Nkrumah University of Science and Technology (KNUST) succeeded the Kumasi College of Technology which was established by a Government Ordinance on 6th October, 1951. It was however, opened officially on 22nd January, 1952 with 200 Teacher Training students transferred from Achimota, to form the nucleus of the new College. In October, 1952, the School of Engineering and the Department of Commerce were established and the first students were admitted. From 1952 to 1955, the School of Engineering prepared students for professional qualifications only. In 1955, the School embarked on courses leading to the University of London Bachelor of Engineering External Degree Examinations. A Pharmacy Department was established in January, 1953, with the transfer of the former School of Pharmacy from Korle-Bu Hospital, Accra, to the College. The Department ran a two-year comprehensive course in Pharmacy leading to the award of the Pharmacy Board Certificate. A Department of

Agriculture was opened in the same year to provide a number of ad hoc courses of varying duration, from a few terms to three years, for the Ministry of Agriculture. A Department of General Studies was also instituted to prepare students for the Higher School Certificate Examinations in both Science and Arts subjects and to give instruction in such subjects as were requested by the other departments.

Once established, the College began to grow and in 1957, the School of Architecture, Town Planning and Building was inaugurated and its first students were admitted in January, 1958, for professional courses in Architecture, Town Planning and Building. As the College expanded, it was decided to make the Kumasi College of Technology a purely science and technology institution. In pursuit of this policy, the Teacher Training College, with the exception of the Art School, was transferred in January, 1958, to the Winneba Training College, and in 1959 the Commerce Department was transferred to Achimota to form the nucleus of the present School of administration of the University of Ghana, Legon.

In December, 1960, the Government of Ghana appointed a University Commission to advise it on the future development of University Education in Ghana, in connection with the proposal to transform the University College of Ghana and the Kumasi College of Technology into an independent University of Ghana. Following the report of the commission which came out early 1961, Government decided to establish two independent Universities in Kumasi and at Legon near Accra. The Kumasi College of Technology was thus transformed into a full-fledged University and renamed Kwame Nkrumah University of Science and Technology by an Act of Parliament on 22nd August, 1961. The University's name was changed to University of Science and Technology after the Revolution of 24th February, 1966. The University of Science and Technology was officially inaugurated on Wednesday, 20th November, 1961. However, by another act of Parliament, Act 559 of 1998, the University has been renamed Kwame Nkrumah University of Science and Technology, Kumasi.

The KNUST has, since January 2005, transformed from its previous centralized system of administration into significantly decentralized one called the Collegiate system.

Under this system, the various faculties have been condensed into six Colleges. Since its inception, the University has been administered on the Facultybased system.

This naturally led to a situation where new Faculties and Institutes were created to meet the ever-growing academic pursuits of students. The resultant collection of Faculties largely hampered efficient administrative and academic operations, as duplication of efforts and long administrative processes were rampant. The need to deal with these complexities and harmonize the operation of the existing structures became apparent and unavoidable. This was more so, with the ever-increasing numbers in student population. True to the vision to make KNUST the model for technological education in Africa and the Institutions' commitment to academic excellence, the Collegiate System came into being with the promulgation of the statutes on November 29, 2004.

The University since its establishment has created and continue to create a number of heritage (tangible and non-tangible) worthy of global appreciation. These have originated from the six colleges of the university of which the College of Art and Built Environment, College of Engineering, the College of Agriculture and Natural Resources and the College of Humanities and Social Sciences have made unsurpassed contributions. The remaining two colleges – Colleges of Science and Health Sciences have also made appreciable inputs to the repertoire of heritage created in the University. These manifests themselves in non-tangibles, tangible immovable artifacts like historical buildings and a number of interesting sites and other tangible movable artifacts.

Apart from monetary gains (though not a mandate of museums), projection of institutional excellence, preservation of institutional heritage, the additional benefits of creating a virtual museum for teaching, learning and research can also not be overemphasized. What is more, the advocated project which has been created now is a complete Open Educational Resource (OER) for KNUST. This is in tandem with KNUST'S OER's policy where it envisions that it will be a leading developer of OER's while the use of its own as well as other OER's will become fully incorporated into teaching and learning at all levels within the institution to further ensure that the highest standards of education are achieved. Kwame Nkrumah University of Science and

Technology (KNUST) needs to be known globally as an institution of excellence, her products and services need to be visible and the created heritage need to generate revenue for the institution and the key to open this door is the creation of a virtual museum.

1.2 Statement of the Problem

Despite the numerous benefits of virtual museum, currently there is no University in Ghana that has such a facility. Meanwhile, the current generation of students, staff and researchers alike unconsciously resonate towards electronic platforms to access and utilize information. They therefore tend to embrace activities that harness the use of online and internet services for their needs. This situation underscores the International Conferences on Hypermedia and Interactivity in Museum's (ICHIM 1991) and (Museum and the Web 1997) assertion that, the interest in the manual ways of accessing information is shifting to the electronic formats. The interest and regular use of the internet has equipped the users with an appreciable amount of computer literacy that enables them to surf globally, digital platforms for information. If students and researchers can remain at one place and navigate the whole world via the internet, why cannot they visit museums virtually, and derive the aesthetic, educational and social values associated with such pilgrimage? This has been the desire of many students, staff and researchers alike. Unfortunately, this need of client did not come to the notice of top managers of the university. Because the University was not fully aware of this user need, when the laudable idea to establish a museum in the University dawned, it was implemented without the *virtualization concept*. As asserted by Schweibenz (1998) … projects implemented without the consideration of user-needs often receive less patronage … This was exactly what happened – for four to five years, the museum could not function as expected and the university kept struggling to operationalize the museum. The under-utilization of the newly constructed edifice warranted the hiring of part of the building for business incubation. This, the researcher considers as unfortunate and thinks that a second look is needed into the situation. It was therefore not surprising that in 2019 a new administration was tasked to ensure effective and efficient provision of museum services. The efforts being made by the new administration has been captured under discussion of findings (**4.3**) in chapter four. The purpose of creating the virtual museum therefore is not only to respond to user

preference or fulfill the University's strategic mandate for innovation (KNUST - Corporate Strategic Plan 2005) but also to device an open educational resource for teaching, learning and research. The advocated virtual museum could also exist independently or augment the physical exhibitions.

1.3 Objectives of the Study

The objectives of the study are to:

1 Analyze stakeholder's perspective on tangible heritage in KNUST's Museum.
2 Design, develop and implement a demonstration virtual museum (Virtual Museum of KNUST – (*VIMU KNUST)*
3 Evaluate the effectiveness and efficiency of *VIMU KNUST* to enhance access to KNUST's Heritage

1.4 Research Questions

The study was guided by the following questions:

- What are the perspectives of stakeholders regarding tangible heritage in KNUST's Museum?
- How can a demonstration virtual museum (*VIMU KNUST)* be designed, developed and implemented?
- How effective and efficient is the *VIMU KNUST* in enhancing access to KNUST's heritage?

1.5 Delimitations

The study focused on KNUST because it was aimed at solving an institutional problem. Again, data was gathered from only the main campus and no other campuses and affiliated institutions outside Kumasi. Furthermore, not all Faculties and Departments were selected to provide data for the study. This does not mean that the uncovered Faculties and Departments do not have relevant archival materials. The intension was only to reduce the targeted population. Apart from documentary review, observations and historic data, the rest of the data gathered on registered students and staff at post focused on 2017/2018 academic year.

1.6 Limitations

Getting the professionals to design the DEMO for illustration posed a great challenge. The amount of money quoted as a fee for the DEMO was throat-cutting. The researcher had to rely on students with the guidance and support of some UITS staff – all due to financial constraints. Working and conducting the study within the stipulated time was also a major hurdle. The researcher wished to have ample time which was not feasible. The other nut was the low response rate to questionnaires by students and faculty. At a point the entire university was closed down for a couple of weeks which distracted the administration of questionnaires and the conduct of interviews. These notwithstanding measures were taken to mitigate the impact of the respondent's responses.

1.7 Definition of Terms

Virtual museum: A virtual museum is a digital entity that draws on the characteristics of a museum, in order to complement, enhance, or augment the museum experience through personalization, interactivity and richness of content. Virtual museums are usually, but not exclusively delivered electronically when they are denoted as online museums, hyper museum, digital museum, cyber museums or web museums.

Heritage: All the artefacts, historic buildings and interesting sites of KNUST that are worth show-casing.

Historic Buildings: Buildings which are 50 years older and above and possesses traditional and historical relevance to the identity of the University.

Education Programme**:** This covers the delivery and content of what is involved in the learning process, which is based on the appropriate philosophy and practice of Museum Education.

Interpretation: The media or activities through which, a museum carries out its mission and educational role. Interpretation is a dynamic process of communication between the museum and the audience. It is the means by which the museum delivers its content. Interpretation media/activities include, but are not limited to: exhibits, tours, wed, sites, classes, school programs, publication, and outreach.

Museum: A non – profitmaking, permanent institution in the service of the society and its development, and open to the public, which acquires, researches, communicates and exhibits, for purposes of study, education and enjoyment, material evidence of the people and their environment (ICOM 2007).

Museum – based education: Education that utilizes museum resources in teaching and learning: It is in essence and in practice.

Museum education: A function in a museum which helps foster an informed appreciation of the rich and diverse world we live in, as symbolized by object collections on display in the museum. It encompasses all the policies and activities planned to make meaningful and informative visits to the museum.

Museum programming**:** The activity which, involves setting an order, and time for events, planned by a museum.

School programming: The activity which, involves setting an order, and time for events, planned by a school, in connection with an educational visit to the museum. It encompasses all the plans and activities designed to make meaningful and informative educational visits to the museum.

1.8 Importance of the Study

Technological advancement has compelled almost every institution to find new ways of doing business. More especially at a time that the desire and strategy of students, lecturers and researchers to access information continue to gravitate towards the use of virtual platforms. Universities all over have also had their share of this global reengineering. As information seeking behavior of people change institutions tend to customize their products and services to suit the exigencies of the time. Universities are leaving no stone unturned to craft new ways of making their services attractive. Universities which are endowed with rich cultural, scientific, historic and educational heritage are also trying to make their heritage accessible from identification, acquisition, preservation through to interpretation. As indicated, Kwame Nkrumah University of Science and Technology (KNUST) has a lot of historical, cultural, educational and aesthetical relics to curate for teaching, learning and research. The researcher is certain that the creation of a virtual museum is in line with the University Policy as she continues to chart the path leading to a paperless university.

In support of KNUST'S strategic objectives of achieving its vision to be globally recognized as the premier Centre of excellence in Africa for teaching in science and technology for development; producing high caliber graduates with knowledge and expertise to support the industrial and socioeconomic development of Ghana and

Africa, and the desire to go paperless as well as automating greater part of its services, is partly fulfilled with the creation of this virtual museum. The VM is an institutional platform for research while exhibiting past present and future inventions/artefacts of KNUST. Apart from meeting this need of user preference the project possesses the potential to improve teaching and learning. The Project is likely to shoot KNUST into fame and also better her position as far as global university ranking is concerned.

The more an educational institution becomes known the more it attracts student applicants. The enrolment of students continually contributes to the growth and development of educational institutions. One of the best ways to become popular is to page on the internet. Once on the internet the institution becomes accessible to the global world. Creating a virtual museum with quality contents, management, educational and promotional activities and hosting it online though with some form of encryption puts the institution to fame. This opportunity enables students and researchers to know more about the institution and its mandate, programmes and prospects. Armed with these students from all walks of life may want to enroll in the institution thereby making the institution an international oriented one. This popularity is accompanied with monetary gains because international students who enroll as students pay school fees in foreign currencies.

The creation of the advocated virtual museum has a trickling effect on similar institutions in Ghana which also have some number of relics that they can also curate for aesthetics, research and other utilitarian purposes. Libraries and Archival institutions in Ghana could also emulate the example of KNUST. Undoubtedly the massive accessibility of the virtual museum will precipitate further research into how virtualization could be integrated into other aspects of the educational curriculum. Since most artifacts possess historic and cultural information the patrons will be exposed to these and they could now appreciate better African Art and Culture.

As KNUST exhibit these collections, she will be indirectly preserving the cultural heritage of Ghana. The virtual exhibits created obviously becomes a good open educational resource for teaching and learning at KNUST and elsewhere. Once the value of museums is felt nationally, the needed attention that the Ghana Museums and

Monument Board, Ghana Tourist Board and the other allied boards require would be given. They will therefore be retooled to render effective and efficient services to reinvigorate African Arts and Culture back to its original magnificence.

Furthermore, the same ambience of curatorial services made possible via virtual platform will draw the attention of top management of the University that, museum operations require professional staff which include among others; curators, scientists, administrators, researchers, system analyst, software designers, network operators and computer programmers. A major guiding principle that will be highlighted is that whatever is shown virtually must have the manual replica in the institution or area earmarked as museum edifice.

The study provides a knowledge base for further research work in this and other related fields. It therefore contributes to the documentation of vital information as to the design, development and implementation of Virtual Museum in Ghana.

1.9 Organization of the Rest of the Text

The study commences with an introduction before reviewing related literature in chapter two. The philosophical foundation and the conceptual framework of the study are also expounded in chapter two where the theories underpinning the study are integrated. The methodology for the entire study is presented in chapter three. Chapter four analyses and discusses data collection while chapter five terminates the study with summary, conclusions and recommendations. The list of figures, sample interview protocols and questionnaires are all captured in the appendixes.

CHAPTER TWO

REVIEW OF RELATED LITERATURE

2.1 Overview

This chapter draws attention to the fact that the study under review is linked with related studies elsewhere. The motivation procedures and techniques of creating virtual

museums are highlighted. All these are juxtaposed with that of KNUST and how the present study is unique from the others are all demonstrated. The creation of a virtual museum is guided by an idiosyncratic conceptual framework that synchronizes three theories – semiotics, cultural heritage preservation and mutual inquiry. It is however anchored in axiological philosophy through the interpretivist spectacles. To expedite the review exercise, the following topics were reviewed

- Virtual Museum – Concept and Pioneering Work
- The Origin of Virtual Museum
- New Perspectives of Museum Virtualization
- Varieties of Virtual Museum
- Exhibition and Museological Activities
- Personalized Content of Virtual Museum
- Purpose of Establishing a Virtual Museum
- Web3D Exhibitions
- Capabilities of Virtual Museum
- Problems and Implications of Virtual Museum
- Future of Virtual Museums
- Virtual Museums Today
- Museum using Created Realities
- Developing Virtual Museums: Models and Future Directions
- Some Popular Virtual Museums
- Experiences from Some Foreign Tertiary Institutions
- Heritage
- Underpinning Philosophy
- Theoretical Foundation
- Conceptual Framework

2.2 Virtual Museum – Concept and Pioneering Work

Inferring from Huhtamo (2002) the idea of the virtual museum was first introduced by André Malraux in 1947. He put forward the concept of an imaginary museum (le musée imaginaire), a museum without walls, location or spatial boundaries, like a virtual museum, with its content and information surrounding the objects that might be made accessible across the planet. The main factor behind Malraux's questioning of the traditional role of the museum institution was the spreading of photography. The ever-present photographic reproductions of artworks made art accessible to audiences who would never have entered a museum. At the same time in the United States (but

unknown to Malraux) Vannevar Bush was theorizing about the Memex, a new non-linear system of storing and retrieving data. As well known, Memex was later recognized as the earliest model for hypertext. The ideas of Malraux and Bush combined take us to the gates of the virtual museum.

A virtual museum is: "a collection of digitally recorded images, sound files, text documents and other data of historical, scientific, or cultural interest that are accessed through electronic media". (*https://www.britannica.com/topic/virtual-museum).*
Andrews and Schweibenz (1998) on their part describes it as: "a logically related collection of digital objects composed in a variety of media, and, because of its capacity to provide connectedness and various points of access, it lends itself to transcending traditional methods of communicating and interacting with the visitors being flexible toward their needs and interests; it has no real place or space, its objects and the related information can be disseminated all over the world".

Another less rigid definition states that a virtual museum can be a digital collection that is presented either over the Web, or to an intranet, either via a personal computer (PC), an informative kiosk, a personal digital assistant (PDA), or even to a CD-ROM as an extension of a physical museum, or that it can be completely imaginary (Klein 2019). Furthermore, the abstract term virtual museum can take various forms depending on the application scenario and end-user. It can be a 3D reconstruction of the physical museum. Alternatively, it can be a completely imaginary environment, in the form of various rooms, in which the cultural artifacts are placed. The idea behind this phenomenon is to build a digital extension of the museum on the Internet, a museum without walls. Enthusiasts even think of establishing a world-wide virtual museum that might bring together digital objects from museum collections all over the world.
According to ICOM (2007), there are three categories of virtual museums on the Internet that are developed as extensions of physical museums: the brochure museum, the content museum and the learning museum. The brochure museum aims at informing future visitors about the museum and is mainly used as a marketing tool, with basic information such as location, opening hours, types of collection, contact details, and sometimes a calendar of events etc. in order to create motivation to visit the walled museum. Its goal is to inform potential visitors about the museum.

The content museum is a website created with the purpose of making information about the museum collections available and invites the virtual visitor to explore them online. It can be identified to a database containing detailed information about the museum collections, with the content presented in an object-oriented way. It is basically identical with the collection database and is more useful for experts than for laymen because the content is not didactically enhanced. The goal of this type of museum is to provide a detailed portrayal of the collections of the museum

The learning museum is a website, which offers different points of access to its virtual visitors, depending on their age, background and knowledge. The information is presented in a context-oriented, rather than object-oriented way. Moreover, the site is educationally enhanced and linked to additional information intended to motivate the virtual visitor to learn more about a subject of particular interest to them and to visit the site again. The goal of the learning museum is to make the virtual visitor come back and establish a personal relationship with the online-collection. Ideally, the virtual visitor will come to the museum to see the real objects.

2.3 The Origin of Virtual Museum

On the notion of the Virtual Museum, Huhtamo (2002) opines that, in recent years, the notion "virtual museum" has been evoked so often in cyber cultural discourse that it has lost all of its novelty value. The list of Web sites purportedly falling under this category is long, and growing. A recent search with Google for "virtual museum" brought up more than 141,000 hits. Such a "category" is understandably extremely vague, accommodating entries that have little to do with each other regarding both their institutional status and their interpretation of the word museum. There are "virtual museums" that might more conveniently be classified as libraries or archives, although the cyberspace definitions of these are not absolutely clear-cut either. If the "wired" virtual museums have a common denominator at all, it is a very general one, referring to almost any kind of collection of material (supposedly of "historical" or at least "cultural" value) put on general display on the Web.

There is no doubt that the vogue for virtual museums received a powerful impetus from the emergence of the World Wide Web and particularly from its transformation into a multimedia environment with the introduction of the Mosaic browser in 1993. Yet the idea did not originate with the WWW. The invention of the hypertext in the 1960s may, in the long term, have been a more decisive influence, pointing out the possibility of creating huge non-linear data-architectures.

Whether straightforward museum websites merit the title "virtual museum" is open to debate. As important as new software (HyperCard, QuickTime, and VRML) or new media (CD-ROM, and the World Wide Web) were for the emergence of the virtual museum, the topic was also grounded in wider cultural issues. In recent years, we have seen a massive amount of academic writing about the museum as an institution. This has received an impetus from a wave of post-modern theorizing about the impact of media on notions like authenticity and the original. With images and sounds reproduced in principle in unlimited numbers, and distributed, copied, mixed and manipulated at will by the media, the idea of temples dedicated to the cult of the authentic (or "auratic") objects seemed outdated to many. As prophesied by Walter Benjamin in 1936, the original was seen to be disappearing, replaced by an infinite number of copies.

Within KNUST, there abounds historic buildings which are fifty years and above but are now being rehabilitated to appear modern, beautiful and new. Their original components, looks and purposes for which they were built are gradually being erased. Examples of such buildings are Prempeh II Library (1959), the Great Hall (1963), Faculty of Agriculture Block (1959), Senior Staff Club (1965) and a host of others. To preserve these their images could be captured and curated virtually for appreciation by posterity. By so doing their historical significance could be conserved as the study considers as part of its justification. The (media) reality itself was turning into an allencompassing, albeit chaotic, museum available to anybody. Theorists and critics often felt they were standing, to quote the title of Douglas Crimp's well-known book, "on the museum's ruins". This attitude was influenced by André Malraux's famous idea about the imaginary museum without walls, presented in 1947.

2.4 New Perspectives of Museum (Virtualization)

In discussing museums and their new perspectives, Schweibenz (1998) defined "virtual museum" as a means to establish access, context, and outreach by using information technology. According to him the Internet opens the "virtual museum" to an interactive dialog with virtual visitors and invites them to make a virtual museum experience that is related to a real museum experience. Current research describes how the Internet can be used as a knowledge base and trends from surveys also show how museums and virtual visitors use the Internet as a communication tool. Schweibenz further indicates that the Internet has become a household word. Even institutions with more conservative attitudes towards information technology such as museums start to recognize the possibilities it offers for the dissemination of information to a worldwide public. The impact of the described situation was the result when KNUST tried to establish a physical museum. This happened at a time when the University Community was yearning for electronic information.

The interest in the application of interactivity and multimedia in the museum community was stated in the International Conferences on Hypermedia and Interactivity in Museums (ICHIM) which started in 1991. For a lot of museums, the next step was to establish a presence on the World Wide Web and bring their collections on the Information Highway. More and more museums are interested in using the Internet and in sharing their experiences. This is shown in the annual conference of Museums and the Web which was established in 1997. In this situation it is necessary to ask what new perspectives information technology can offer to museums for presenting objects and information and how the Internet can be used as a knowledge base and communication system.

2.5 Varieties of Virtual Museum

Antonaci, Ott and Pozzi (2013) writing on *Virtual Museums, Cultural Heritage Education and 21st Century skills*, assert that a wide variety of Virtual Museums (VMs) exist, which are different not only as to the contents, but also as to structure, objectives, implementation techniques, presentation methods, as well as interaction approaches.

Nowadays the educational potential of VMs is widely acknowledged, although their actual use for educational purposes is still very limited (at least in formal educational contexts). This is what emerges from a survey conducted by the authors among Italian teachers and students, showing that the adoption of VMs in schools is still infrequent and not fully integrated in the standard educational practice. In KNUST a few visual tutorials which have been prepared to enhance teaching learning and research are now being compiled to be used as open educational resources. The assemblage and exhibition of these could convey numerous thematic messages depending on how they are paraded for appreciation. Invariably their value goes a long way to support the core mandate of KNUST; thus teaching, learning and research.

The Authors continue in their paper, after defining the concept of VMs and giving the results of a survey conducted by the authors witnessing the limited use of these tools in formal educational contexts, a reflection is conducted on their educational potential: VMs, besides addressing cultural heritage education, can often contribute to enhance some of the "transversal" 21st Century skills, referred to as "social, cultural skills and citizenship", as well as communication, collaboration, digital literacy and creativity. They demonstrated the role that Virtual Museums (VMs) can play in education, with a specific attention to formal education that is interventions carried out in schools and other formal educational settings with the support of teachers and/or facilitators. In particular, they aim at discussing the impact of VMs not only on cultural heritage education, while referring to the educational use of VMs, highlights that teaching and learning in the field of arts and cultural heritage, being deeply intertwined and strongly linked to other disciplines (Van der Leeuw-Roord, 2004). They included that 21st skills also entail the development of other transversal skills that are widely recognized as "underpinning and informing" the learning processes, irrespectively of the different subject matters. Considering the intrinsic educational potential of VMs and taking into account the relevant educational opportunities given by the adoption of ICT-based innovative learning approaches (Ott & Pozzi, 2011). Their paper discusses the educational use of VMs. and report on the actual use of VMs in schools. Ultimately the authors argue that VMs should be considered not only for their capacity to support awareness raising in the field of cultural heritage itself, but also, they can contribute to

the development of some relevant 21st Century skills, that are key to live (and be lively actors) of the Knowledge Society

2.6 Exhibition and Museological Activities

In contrast to popular approaches, Charitos, et al (2000) used *exhibition* to describe museological activities. According to them an exhibition is a complex informational system and an organized event through which society and time interact in a predetermined museum space. The message of a museum is the medium through which the museum communicates information, produced by its collections, which consequently creates new information. The message of a museum is manifested through the form of the exhibited object and this manifestation takes place within a museum environment. The museum object and the collection are sources of two kinds of information: scientific and cultural. The museums, which participate in this project, belong to both categories. Their paper documents part of a research project titled:
"Virtual Museums"1. This project aims at creating a locally executed virtual reality environment as well as enabling participants to visit this museum via the web for the purpose of viewing and manipulating the museum's 3D exhibits.

A number of real museums participated in the project and provided 2D or 3D content to be digitized and included in a virtual museum. Malreaux (1953) has introduced the concept of museum without walls, as the context for exhibiting which became possible with the arrival of mechanical reproduction techniques and the consequent ability to reproduce images. This was a new kind of environment for viewing and presenting art. According to the technology of his era, Malreaux imagined a museum without walls comprising mainly of photographs, which could be included in printed media. Adding their opinions to the introduction of virtual museums Tsichritzis & Gibbs (1991) asserted that, current IT and communication technologies (digitization, internet, hypermedia and virtual reality) allow for the use of a wider selection of media for reproducing and exhibiting objects. It may also be suggested that via the WWW, a museum opens up to a global level of access. An on-line exhibition is accessible from anywhere in the world at any time. Thus, an on-line museum experience can be seen as a spatial experience of a personal as well as public character at the same time. The design of the "Virtual Museum" involved an analytical phase that aimed at creating the

theoretical basis for the design of activities taking place in the virtual museum, the setting where these activities take place and the rules that dictate interaction amongst the elements of this environment.

2.7 Personalized Content of Virtual Museum

On his part, Klaus (2008), stresses on content. He opines that presentation of content is an important aspect of today's virtual reality applications, especially in domains such as virtual museums. The large amount and variety of exhibits in such applications raise a need for adaptation and personalization of the environment. His paper presents a content personalization platform for Virtual Museums, which is based on a semantic description of content and on information implicitly collected about the users through their interactions with the museum. The proposed platform uses stereotypes to initialize user models, adapts user profiles dynamically and clusters users into similar interest groups. A science fiction museum has been set up as a case study for this platform and an evaluation has been carried out. He continued that, the advances in 3D graphics and in specialized Virtual Reality (VR) hardware during the last decade have enabled the development of novel interactive and immersive applications that emphasize on the realistic representation of content and present a satisfying and intuitive experience to the users.

An application area that is based on content presentation and can benefit from this emerging technology is Virtual Museums, i.e. computer-generated environments that present exhibit collections from real or fictional museums and aim to educate and entertain users by offering them an experience similar to an actual museum visit. The notion of virtual museums has been introduced by Tsichritzis and Gibbs (1991) as a means to overcome the limitations of real museums and to enhance user experience. A synthetic collection of artifacts, which incorporates multimedia and virtual reality technologies, alleviates the problem of storing, preserving and protecting the real artifacts and allows synthetic museums to present an unlimited number of exhibits, to which users have access at any time and from any place. Furthermore, it may introduce new forms of presentation and interactivity that stand beyond the passive viewing of the artifacts and reading the description text, which is typically the case with traditional museum visits. Digital artifacts may be presented using a combination of various forms

of media, such as 3D representations and rich hypermedia annotations and may also let the user interact with them in many intuitive and creative ways in order to learn and entertain themselves (Chittaro, Ranon and Leronutti 2003). Examples of rich interactive experiences could be the utilization, assembly and disassembly of mechanical artifacts in a science museum, or the inclusion of educational games that are thematically related to the museum collection. A number of Virtual Museum applications have been presented, which run standalone over the Internet. They serve either as complementary information source to existing museums or as individual approaches for the presentation of artifact collections. There is a great diversity in terms of visualization and user interactivity in the available approaches, as a multitude of different technologies has been employed. As per the presentation of artifacts, the approaches include simple images, panoramic views, video and hypermedia presentations, and detailed 3D models (Celentano and Pittarello 2004).

Virtual museums can be single-user or multi-user environments, and in some cases, they are presented as part of massive multi-user online worlds (Brogni et al 1999, Liarokapis et al 2004). It can be noted that most of these applications emphasize on the content and aim to the deeper understanding of entities and concepts through user navigation and interaction in 3D. However, the majority of them contain static collections arranged in predefined positions, and the design of the virtual space and its contents is based entirely on the author's point of view. As a result, Ciabatti et al (1998) assert that the user's role is limited to a passive observer and the presentation of a large amount of artifacts may fall into the obstacle of navigational difficulties in 3D environments compared to reality, e.g. due to the lack of visual cues of distance, movement, direction and binocular vision. This may eventually lead to the reduction of user interest and to the disability to explore and search for the desired content. As a way of averting such disinterestedness of users in linear appreciation of static objects, the study under review has designed the VIMU-KNUST as interactive as possible. The researcher plans to further configure the exhibits in 3D environment for thorough study by the virtual audience as evidenced in one of the DEMO evaluations features in chapter four.

Additionally, the complexity of designing static exhibitions increases as the number of exhibits grows. The problem of presenting and categorizing large quantities of content has been effectively addressed in Web and multimedia applications. In these cases, user modeling techniques have been employed in order to personalize the content presentation according to the users' own interests. The authors claim that virtual environments could also benefit from user modeling and adaptation methodologies, in order to make assumptions about user interests and intentions concerning the application, and to construct the virtual space accordingly. Such a personalized space is expected to reduce the navigational burden and still retain the metaphor of being immersed in a 3D environment.

2.8 Purpose of Establishing a Virtual Museum

The current interest in digitization is underscored by Styliania et al (2009) when they indicated that Museums are interested in the digitizing of their collections not only for the sake of preserving the cultural heritage, but to also make the information content accessible to the wider public in a manner that is attractive. Their findings continue to reveal that emerging technologies, such as VR, AR and Web3D are widely used to create virtual museum exhibitions both in a museum environment through informative kiosks and on the World Wide Web. Their paper surveys the field, and while it explores the various kinds of virtual museums in existence, it discusses the advantages and limitation involved with a presentation of old and new methods and of the tools used for their creation.

Along the same vein, Schweibenz (1998) states that 'museums are in many respects like other contemporary media. They entertain and inform; they tell stories and construct arguments; they aim to please and to educate; they define, consciously or unconsciously; effectively or ineffectively, an agenda; they translate the otherwise unfamiliar and inaccessible into the familiar and accessible'. An extensive research work and a survey of the European museum sector have shown that information technologies such as the World Wide Web (WWW) enhanced by three-dimensional visualization tools can provide valuable help to achieve the aims mentioned above.

On the use of the World Wide Web (www) Styliania et al (2009) indicates that their use by a wide range of cultural institutions, such as museums, has become easier due to an

ever-increasing development of interactive techniques and of new information technology software and hardware, accompanied by a decrease in cost. Information technologies provide solutions to issues of space limitation, of the considerable exhibitions cost and of curator's concerns concerning the fragility of some museum artefacts such as the ICHIM Conferences on Hypermedia and Interactivity in Museums started in 1991 and Museums and the Web.2 established in 1997, highlight the importance of introducing new technologies in museums. The utility and the potential benefits for museums of emerging technologies such as Virtual Reality (VR), Augmented Reality (AR) and Web technologies have been well documented by a number of researchers. In the 1980s, museums influenced by the New Museology and began to change the way they conveyed the context information of the exhibits to the wider public. There was a shift in the museology concept towards considering that the context of a cultural artefact was more important than the item itself. By means of innovative methods and tools and by taking advantage of the WWW potential as an information source, virtual museums were created. They have made the content and context of museum collections more accessible and attractive to the wide public and have enriched the museum experience. There is no official figure yet for the number of virtual museums presently existing worldwide but it is known that there are thousands of them and that their number is rapidly on the increase (Jackson R. et al 1998)

Again, using external sensors (i.e. inertia cube, accelerometers and digital compass) museum visitors can perceive virtual information about the artifacts in relation to their location inside the museum. According to the definition of the International Council of Museums ICOM (2008) about museums, "a museum is a non-profit making, permanent institution in the service of society and of its development, and open to the public, which acquires, conserves, researches, communicates and exhibits, for purposes of study, education and enjoyment, material evidence of people and their environment." Virtual museum enjoys the same functions of acquisition, storage, documentation, research, exhibition and communication as the 'brick and mortar' museums as set out by the above definition. They can, in addition, act in a complementary and auxiliary manner. A virtual museum website can provide worldwide publicity. Research has revealed that 70% of people visiting a museum website would subsequently be more likely to go and visit the 'real' museum. Museum curators can digitally preserve the artifacts of their

collections. The effective safeguarding of cultural artifacts can be achieved through the use of technological advances, by means of the comparison of different images across time to monitor their conservation. Furthermore, they provide the means to create digital representations of cultural artifacts and database technologies with which multimedia information about the virtual museum artifacts can be stored and retrieved whenever is needed. The digitized information can be re-used in a variety of ways, for different purposes and probably even by other cultural institutions.

More so, virtual museums allow museum curators to experiment with various arrangements of 3D objects inside the gallery, to test different designs before deciding on the presentation style of a temporary exhibition. They create and disseminate to the wider public virtual models of cultural artifacts that combine archaeological accuracy and reliability with aesthetic pleasure. Finally, they visualize the digital representation of the cultural objects via VR and AR interfaces, so as to make available to the wider audience more realistic and appealing virtual museum exhibitions that can be interactively and easily explored.

Furthermore, they can overcome limitations of space in respect of the number of objects accessible in the real museum (Sylaiou et al 2008) .The WWW is widely used by museums for putting their collections online, not only because it is very popular especially among young people, but also because it is in the hands of museum curators a powerful communication tool that can deliver in a fast, user-friendly and low-cost information about the museum to potential virtual visitors and provides museum curators with a great variety of opportunities in terms of museum data dissemination. As it has been already mentioned, virtual museums, through innovative technologies, provide unrestricted round-the-clock access to their visitors through the WWW. Virtual museums can provide access from any place and to anyone, including people with special needs (visual, acoustic, speech and motor disabilities and learning difficulties). The UN Convention on the Rights of Persons with Disabilities, the Americans with Disabilities Act of 1990 (ADA) (73-ADA 1990) and the Disability Discrimination Act (DDA) in the UK state that disabled people have equal rights of ‘access to goods, facilities and services’(DDA 1995) . It is therefore the responsibility of Cultural institutions, such as museums to find ways of providing access to the exhibitions to

people with disabilities. Digital museums take into account the need emphasized by the Resource Disability Action Plan and formed by the Council of Museums, Archives and Libraries for efficient ways of using new technologies which allow the access to museum exhibitions to all end-user groups including virtual access to disabled people using AR interfaces designed to operate on off-the shelf computer systems. The cultural artifacts that are exhibited in the physical environment of a museum are usually shown in display cases, where only a limited amount of information about them is available. In virtual museum exhibitions, museum artifacts can be digitized and visualized into a virtual interactive environment.

2.9 Web3D Exhibitions

Internet technologies have the tremendous potential of offering virtual visitors' ubiquitous access via the WWW to a virtual museum environment. Additionally, the increased efficiency of Internet connections (i.e. ADSL) makes it possible to transmit significant media files relating to the artefacts of virtual museum exhibitions. The most popular technology for the WWW visualization includes Web3D which offers tools such as VRML and X3D, which can be used for the creation of an interactive virtual museum. The Web3D consortium (2007) contains open standards for real-time 3D communication and the most important standards include: VRML97 and X3D and are presented below. Many museum applications based on VRML have been developed for the web. As from 4 April 1997, VRML97 has stood for Virtual Reality Modeling Language. Technically speaking, VRML is neither VR, nor a modelling language, but a 3D interchange format which defines most of the commonly used semantics found in today's 3D applications such as hierarchical transformations, light sources, viewpoints, geometry, animation, fog, material properties, and texture mapping. Another definition states that VRML serves as a simple, multi-platform language for publishing 3D Web pages as well as for providing the necessary technology to integrate three dimensions, two dimensions, text, and multimedia into a coherent model. "When these media types are combined with scripting languages and

Internet capabilities, an entirely new genre of interactive applications is possible" (The Annotated VRML 1997). This is due to the fact that some information is best experienced in three-dimensional form, such as the information of virtual museums (White et al, 2004: Liarokapis et al., 2004). However, VRML can be excessively

labour-intensive, time consuming and expensive. QuickTime VR (QTVR) and panoramas that allow animation and provide dynamic and continuous 360 ◦views might represent an alternative solution for museums such as in Benaki Museum, in Athens. As with VRML, the image allows panning and high-quality zooming. Furthermore, hotspots that connect the QTVR and panoramas with other files can be added like what happens at Rembrandt House Museum, in Amsterdam. In contrast, X3D is an Open Standards XML-enabled 3D file format offering real-time communication of 3D data across all applications and network applications.

Although, X3D is sometimes considered as an Application Programming Inter-face (API) or a file format for geometry interchange, its main characteristic is that it combines both geometry and runtime behavioral descriptions into a single file alone. Moreover, X3D is considered to be the next revision of the VRML97 ISO specification, incorporating the latest advances in commercial graphics hardware features, as well as improvements based on years of feedback from the VRML97 development community. For a virtual museum, making possible the presentation of virtual exhibitions, the visualization usually consists of dynamic Web pages embedded with 3D VRML models (Liarokapis, et al 2004). This can be enhanced with other multimedia information (i.e. movie clips, sound) and used remotely over web protocols (i.e. HTTP).

A more 3D graphics format is Collaborative Design Activity (COLLADA) - *an interchange file format for interactive 3D applications. It is managed by the nonprofit technology consortium, the Khronos Group, and has been adopted by ISO as a publicly available specification, ISO/PAS 17506)* which, defines an open standard XML schema for exchanging digital assets among various graphics software applications that might otherwise store their assets in incompatible formats. One of the main advantages of COLLADA is that is includes more advanced physics functionality such as collision detection and friction (which Web3D does not support). Moreover, more powerful technologies that have been used in museum environments include Open Scene Graph and a variety of 3D game engines (QuakeDev, 2009, OSG is an open source multi-platform high performance 3D graphics toolkit, used by museums (Looser, et al 2006, : Calori, L. et al 2005) to generate more powerful VR applications, especially in terms of immersion and interactivity since it supports text, video, audio and 3D scenes into a

single 3D environment. On the other hand, 3D games engines are also very powerful and they provide superior visualization and physics support. Serious games are a new concept and allows for collaborative use of 3D spaces which are used for learning and educational purposes in a number of educational domains. The main strengths of serious gaming applications could be generalized as being in the areas of communication, visual expression of information, collaboration mechanisms, interactivity and entertainment. Both technologies (OSG and 3D game engines) compared to VRML and X3D can provide very realistic and immersive museum environments but they have two main drawbacks. First, they require advanced programming skills in order to design and implement custom applications.

Secondly, they do not have support for mobile devices such as PDAs and 3G phones. 3.3. Virtual reality exhibitions VR is a simulation of a real or imaginary environment generated in 3D by digital technologies that is experienced visually and provides the illusion of reality. Over the past few years, modeling software has become affordable and the cost of building virtual environments has fallen considerably, thus fueling new application domains such as virtual heritage. For example, low cost and highly interactive VR experiences for museum visitors can be created on the basis of standard hardware components (a relatively low cost PC with cheap graphics accelerator, a touch screen and a sensor device, e.g. an inertia cube), some application software and suitable browser plug-ins. VR applications can be used by distributed groups of large numbers of players, and are immersive and interactive. In a VR environment participant get immersed into a completely artificial world but there are various types of VR systems, which provide different levels of immersion and interaction. Heim believes that weak VR can be characterized by the appearance of a 3D environment on a 2D screen (Heim, 1993).

In contrast, strong VR is the total sensory immersion, which includes immersion displays, tracking and sensing technologies. Common visualization displays include head-mounted displays and 3D polarizing stereoscopic glasses while inertia and magnetic trackers are the most popular positional and orientation devices. As far as sensing is considered, 3D mouse and gloves can be used to create a feeling of control of an actual space. An example of a high immersion VR environment is Kivotos, a VR

environment that uses the CAVE ®system, in a room of 3 meters by 3 meters, where the walls and the floor act as projection screens and in which visitors take off on a journey.

As mentioned earlier, virtual exhibitions can be visualized in the Web browser in the form of 3D galleries, but they can also be used as a stand-alone interface (i.e. not within the web browser). In addition, a number of commercial VR software tools and libraries exist, such as Cortona, which can be used to generate fast and effectively virtual museum environments. However, the cost of creating and storing the content (i.e. 3D galleries) is considerably high for the medium and small sized museums that represent the majority of cultural heritage institutions. An overview of the tools and methods available to visitors visualizing a virtual museum has been already carried out (Kowon 2003). Augmented reality exhibitions in addition to the VR exhibitions, museum visitors can enjoy an enhanced experience by visualizing, interacting and navigating into museum collections (i.e. artifacts), or even by creating museum galleries in an AR environment. The virtual visitors can position virtual artifacts anywhere in the real environment by using either sophisticated software methods (i.e. computer vision techniques) or specialized tracking devices (i.e. Inertia Cube).

Although the AR exhibition is harder to achieve, it offers more advantages to museum visitors as compared to Web3D and VR exhibitions. Specifically, in an AR museum exhibition, virtual information (usually 3D objects but it can also be any type of multimedia information, such as textual or pictorial information) is overplayed upon video frames captured by a camera, giving users an impression that the virtual cultural artifacts actually exist in the real environment. Through human–computer interaction techniques users can examine thoroughly the virtual artifacts through tactile manipulation of fiducials (i.e. markers) or sensor devices (i.e. pinch-gloves). This ‘augmentation’ of the real-world environment can lead to an intuitive access to the Museum information and enhance the impact of the museum exhibition on virtual visitors. One of the earliest examples of an interactive virtual exhibition is an automated tour guide system that uses AR techniques (Bederson 2003). It can superimpose meaningful audio on the real world on the basis of the location of the user, offering the advantage of enriching visitors’ experiences.

Also, the Meta-Museum guide system (Mase, Kadobayashi and Nakatsu 1996) is based on AR and artificial intelligence technologies and provides a communication environment between the real world and cyberspace to maximize the utilization of a museum's archives and knowledge base. Furthermore, AR has been experimentally applied to make it possible to visualize incomplete or broken real objects as they were in their original state by superimposition of the missing parts (Liarokapis and White 2005). Finally, the ARCO system (White et al 2004) provides customized tools for virtual museum environments, ranging from the digitization of museum collections to the tangible visualization of both museum galleries and artifacts.

ARCO developed tangible interfaces that allow museum visitors to visualize virtual museums in Web3D, VR and AR environments sequentially. A major benefit of an AR-based interface resides in the fact that carefully designed applications can themselves provide novel and intuitive interaction without the need for expensive input devices. Finally, mixed reality (MR) relies on a combination of VR, AR and the real environment. According to Milgram and Kishino (1994) virtuality-continuum, real world and virtual world objects are presented together on a single display with visual representation of real and virtual space. An example of the use of MR techniques in a museum environment is the Situating Hybrid Assemblies in Public Environments (SHAPE) project (Hall et al 2001) that uses hybrid reality technology to enhance users' social experience and learning in museum and other exhibition environments, with regard to cultural artifacts and to their related contexts. It proposes the use of a sophisticated device called the periscope (it is now called the Augurscope), which is a portable mixed reality interface, inside museum environments to support visitor's interaction and visualization of artifacts (Hughes et al 2005).

2.10 Capabilities of Virtual Museum

Emerging tools and technologies used by virtual museums and advances that have emerged as areas of crucial interest are making it possible to use sophisticated tools to provide customized interfaces for the generation of virtual museums, to design a virtual museum exhibition in a number of ways and to get used as conveyors of information for knowledge construction, acquisition and integration. New types of interfaces, interaction techniques and tracking devices are developing at a rapid pace and can be integrated into multimodal interactive VR and AR interfaces. A virtual exhibit can

contain information that a physical exhibit in a museum showcase cannot. Thus, museum curators are given the opportunity to offer a more rewarding experience like rich multimedia context information data about the objects, in comparison to artifacts that are locked in a museum glass case with a simple description on a card. In these virtual exhibitions, users may explore exhibits in an interactive and more flexible way. Virtual museum exhibitions provide the experience of allowing virtual visitors to observe and examine an object from all angles. AR exhibitions can also involve physical interfaces (i.e. marker-cards), which are used as the link between real and virtual worlds. Physical interfaces allow museum visitors to pick up and manipulate virtual cultural objects and examine them within the display system in their hands (i.e. flat screen)

Additionally, a virtual museum gives the user the control of the virtual tour, because it may provide 3D views of a museum and a floor plan. Virtual visitors can orient themselves; know in which room of the virtual exhibition the exhibits are found and to which group of the exhibits an object belongs. The exhibits themselves can convey their meaning, when they are examined in conjunction with the other exhibits of the room and through a narrative that connects the objects and their context and 'brings to life the potential dynamism of objects and their stories'. The communities targeted by virtual museums are the museum curators and the end-users. The second category can be divided into three subcategories: the specialists, the students and the tourists (Filippini-Fantoni 2003: Bowen and Filippini-Fantoni 2004). Virtual museum exhibitions can contain a great amount and depth of information, meant to broaden perspectives, satisfy needs and encourage a deeper understanding of virtual visitors of any of the above profiles. They can fulfill the need for "basic and distinguishing information' of simple tourists (Parteno and Mancini 2005) and they do not need any additional help to deciphering the concepts and the ideas behind museum objects (Hooper-Greenhill 1992, p. 210)

Virtual museums are also capable of providing information to a degree of detail that is sufficient for various kinds of visitors; while it may assist the specialized research needs including the comparative study requirements of specialists and students, by providing access not only to one, but to multiple museum collections. Furthermore, creative

websites may attract audiences that 'would not normally use libraries or museums' and do not have prior knowledge of or interest in the subject of the museum exhibition (Economou 1998). The visitors of virtual museum exhibitions are not passive nor do they lack opportunities to develop their critical skills. A virtual museum can provide visitors with the freedom to explore, to exercise autonomy and to be active participants as they create their own virtual tour and paths. Additionally, the digital tools provided are used as cognitive technologies that help the virtual visitors transcend the limitations of the human mind, such as memory or problemsolving limitations (Pea 1985) and construct their own knowledge. A representative example of the above is the ability provided to virtual museum visitors for creating a

personal online exhibition of digitized material, a 'gallery' that corresponds to their interests and they can share it with others.

In a virtual museum environment, there are more learning opportunities via educational games than in a physical museum (Mokre 1998), as cited by (Bernier 2002). Most of the virtual museums have been designed by taking into account the constructivist principles of learning through construction and learning through play (Hein 1991: Falk and Dierking 2000) and they involve interaction, experiencing and learning at the same time. In a virtual museum environment, the visitor is not an observer but s/he interacts with the learning objects and s/he constructs her/himself the knowledge. Museum visitors use and interact with the virtual museum environment via a constructive dialogue that provide them with access to thematic information and explanations about the museum objects' context with the level of information and the amount of detail they prefer (Liarokapis, Sylaiou and Mountain 2008). Learning is an active process and the end-users are engaged in hands-on involvement in an engaging experience that enhances the understanding, fosters fruitful learning interactions, awakens and keeps the interest alive and enriches aesthetic sensitivities. Most of the time, virtual visitors do not want to 'learn something' but rather to engage in an 'experience of learning' or 'learning for fun' that can be 'important and enjoyable in its own right' (Packer 2006)

2.11 Problems and Implications of Virtual Museum

New technologies provide new possibilities and impose new restrictions (Sylaiou and Patias 2004). Despite significant advantages, a virtual museum also presents drawbacks. The forms these take will now be examined. 'VR' (an oxymoron) cannot

have the complexity of the real objects. Virtual museum comes from Greek dynaton (gr.δυνατόν=possible) and it means "that in potential" (Aristotle, Analitici primi) and exists in potential form and not in reality (Forte 2000) The problem is that advanced graphic systems that are used for computer reconstructions adopted by virtual museums may sometimes be too realistic. They are based on partial evidence, but they suggest an impression of good knowledge of the past. Sometimes advanced graphic systems present the 'image' as true, giving the sense of misleading accuracy (Miller and Richards 1995: Ryan 1996). When the reconstructed item has a lot of missing elements then – obviously – scientists must use their imagination or rely on ethnohistorical information on how similar cases might have looked like, in order to reconstruct it.

However, in these cases, the result will not be an explanation of the past, but a personal and subjective way of seeing it. A good 'image' can give the impression to the viewer that museologists know more than they actually do. Some products of computer reconstructions can be considered as scientifically accurate, because they seem to be accurate. The term "user" is used for virtual museum visitors, because, in order to retrieve information on virtual exhibits, computer skills are required (Bernier 2002). This means that the computer illiterate are automatically excluded and a lot of visitors encounter difficulties with understanding the use of plug-ins and other applications that need to be downloaded from the Internet and installed in order to retrieve information from sophisticated virtual museum exhibitions. The idea of the ambiguity between reality and virtuality can be first traced in the Metaphor of the Cave in The Republic of Plato, where people take as real a fact that is an illusion (Bederson 2003). Prisoners that have been chained and held immobile can only see at a wall in front of them. Behind them, there is a fire and between them and the fire there is a walkway with shadows of moving things and creatures. So, they consider the shadows and the echoes as the only 'reality' and the reflections of objects more important than the objects themselves. When it comes to building virtual reconstructions, even if there is a degree of accuracy, the one-sided view of the reconstructed site is still wrong. Computer reconstructions that offer only one aspect of the subject they examine and do not provide any alternative reconstructions, contradict the fact that there are many ways to examine the Past. In virtual reconstructions there is only one aspect of the subject that has been reconstructed and no alternative reconstructions have been created.

Some high-quality and sophisticated virtual museums involve collaborations between museologists and computer experts. The study under review was carried out in collaboration with the University Information and Technology Services, the Library, the College of Art and Built Environment. The many parts of the virtual museum – VIMU-KNUST orchestrated the synergy of the mentioned group of professionals in order to analyze, design, develop, implement and evaluate the created resource. In such cases, communication problems often arise between those with theoretical knowledge in museology and those with practical knowledge of computers. In most circumstances, the software itself used by virtual museums is not accessible to museologists and computer scientists stand between them and the data. In some cases, it is probable that the Past is both misinterpreted and misrepresented. The visualization results are impressive, thus fulfilling a primary goal, more specifically general public consumption, but without, in turn, serving the museum goals. Virtual museums may provide users with fragmented museum related information that often bear no obvious information with each other or refer to a useful context. In addition to this, some virtual museums suffer from the lack of clearly identified purposes. Their design must be carried out according to their raison d'être and the information provided must be organized in order to construct a narrative (Bonnett 2004) A virtual museum has to define its target community, content and how this will be structured and delivered. Throughout all the creation phases of the virtual museum, evaluation studies that involve real users must be undertaken, in order to identify the parts of the program that need further improvement (Sylaiou et al 2008).

The benefits of virtual museums are noteworthy as far as museum curators are concerned and in terms of documentation, conservation, research and exhibition. The virtual museums have the potential to both preserve and disseminate the cultural information in an effectively and at a low-cost through innovative methods and tools. They are an engaging medium with great appeal to a variety of groups of visitors and can promote the 'real sites' by providing information about museum exhibitions and offer an enhanced display of museum artifacts through emerging technologies. Various groups of end-users such as tourists, students and specialists can take advantage of them and satisfy their learning and entertainment needs. The visit of virtual museums can be an enjoyable and productive experience that draws the user into involvement and

participation and help the promotion of real museums (Jackson et al 2008). The virtual museums enrich the museum experience by allowing an intuitive interaction with the virtual museum artifacts.

A comparison between real and virtual museums indicates that there still are important issues for virtual museums to solve. Good collaboration must be ensured between cultural heritage specialists (museum curators, historians, archaeologists, etc.) and information science specialists to achieve optimal results and in order to avoid dependence on market-produced software and to promote open-source software that may be produced with the aid of cultural heritage specialists. Virtual museums cannot and do not intend to replace the walled museums. They can be characterized as 'digital reflections' of physical museums that do not exist per se, but act complementarily to become an extension of physical museum's exhibition halls and the ubiquitous vehicle of the ideas, concepts and 'messages' of the real museum. Their primary aim is (or should be) to investigate and propose models for the exploration of the real purpose and conceptual orientation of a museum.

2.12 Future of Virtual Museums

The face of virtual on-line museums is entering another period of change. While the emphasis has been on expanding access to museums via the use of interactive webbased presentation, the next generation of virtual on-line museums will seek to create immersive environments that place the museum patron in a representation of the museum, not just viewing information about the collection. The use of state-of-the-art real-time rendering software on low-cost personal computers and next generation console game systems that support Internet access will allow students and instructors to have a 'lean-forward' seamless educational museum experience. (Jones 2002) It is believed that the future of on-line virtual museums will be on-line immersive 3D rendered environments that place the museum patron in the actual space of a current or past exhibit. The created realities methodology takes current commercial approaches to provide contextually accurate software-derived 3D environments. This interface creates a true immersive environment that places the patron in the museum space while providing necessary access to information on the presented collection. With the addition of collaborative tools such as chat, audio, overheads, and whiteboard interfaces

on-line presentations can range from real-time tours and discussions to pre-programed self-guided tours. Instead of accessing a twodimensional Web site that may feature three-dimensional objects or QTVR, imagine a system that would allow visitors to experience a truly immersive 3D experience. Their experience would feel as if they were actually visiting the museum in person.

A visitor to a new virtual museum could walk into a replica of the museum building and then select how halls might be configured based on previous exhibits. With a more advanced system, the museum patron could perform a meta-search on the collection(s) and have a virtual space tailored to their visit. Add to that the ability that other patrons or museum employees can be on-line and in the virtual space at the same time to interact or discuss topics or artifacts. We can take this experience one step further by programming an Artificial Intelligence to take visitors on a tour of the exhibit. Unlike an audiotape tour, the amount of information the visitor might wish to review or access could be custom-tailored depending on their interest level.

2.13 Virtual Museums Today

Virtual museums today are principally offered using the World Wide Web and HTML technology through a personal computer-based web browser such as Netscape or Internet Explorer over the Internet. The degree of technology and information presentation varies greatly. It can range from simple hyper-linked text with graphics to more advanced use of multi-media clips, animations, audio, and interfaces requiring the user to have high-speed Internet access via cable modem or DSL. The approaches are similar in that museums and virtual libraries are seeking ways to expand access of their collections to a wider audience that cannot otherwise travel to the museum during the short interval of showings.

One example of a basic site that also includes QuickTime Virtual Reality (QTVR) segments to enrich the presentation of the materials is the Virtual Tour of the National Museum of the American Indian Exhibitions; ‘Creation’s Journey, all roads are good’. This Virtual Tour was the result of collaboration between the Smithsonian Institution's National Museum of the American Indian -NMAI (2002), the Four

Directions project, and the US Department of Interior Bureau of Indian Affairs. The National Museum of the American Indian is an education and research institution that consists of three physical facilities: the George Gustav Heye Center in New York City, the Museum on the Mall in Washington D.C., and the Cultural Resources Center in Suitland, Maryland. The NMAI identified a "fourth virtual museum which exists outside the walls of the three physical museum buildings, serving those who would benefit from the knowledge and experiences the museum can offer, but are unable to visit the New York City or Washington, D. C. museums".

The NMAI project is an excellent example of the type of outreach being done by museums. The project was different in that students from Indian schools participated actively in the creation of the content and added their own first-hand knowledge of the artifacts. A QTVR studio was set up at the museum and students recorded virtual objects of items they had selected from the exhibition catalogs, recorded virtual panoramic spaces in the exhibition halls, and researched their artifacts for their accompanying essays in the museum's resource center library.

2.14 Museum using Created Realities

This is not science fiction. The technology to implement the above vision is available today and can be deployed for use on most personal computers. It is possible to deliver this because of two factors - lower cost of better performing personal computers and better access to the Internet. In the last two years, the price/performance plateau has been reached on a personal computer that supports the required technology that the average consumer purchases. In 2001, personal computers with the required 3D video graphics cards were shipped in over 70% of all new personal computers sold (NT and Windows). Both of these trends will continue and will make the technology for presenting a virtual museum in this manner even more compelling. However, personal computers are not the only method for presenting virtual museums. By the end of 2002, low-cost gaming consoles will support Internet capabilities. These game consoles, like Sony's PlayStation2 or Microsoft's X-box, are designed to render high quality 3D graphic environments and with the addition of Internet access will make it possible to deliver virtual museum tours on systems that cost a fraction of a personal computer. Personal computers are the largest providers of web-based virtual museums. However,

with the introduction of new game consoles with Internet capability, a shift will begin to occur such that game consoles will be the primary means of accessing on-line virtual environments and not personal computers. By using created realities technology, virtual museums can be supported on both platforms. Many of the latest web-enhanced presentations are geared toward users and institutions that can access the newer and higher bandwidth Internet connection. The Virtual Smithsonian is a good example of such a museum space that is aimed at these newer high-speed connections. It is estimated there will be 20 million broadband customers in the United States by 2004 (RHK, 2001). The importance of this information is that a majority of citizens in the United States will have problems gaining access to these new higher speed Internet connections in the future. As computer technology and networking become increasingly important to economic and social success, many people in inner cities and isolated rural areas are failing to acquire the new technology as rapidly as their more affluent neighbors. This is commonly referred to as the Digital Divide (Benton Foundation, 2001). The benefit of creating the virtual museum in a 3D rendered environment is that it is highly bandwidth efficient. Since the museum is rendered and not retransmitted the initial bandwidth is minimum supporting those without access to faster Internet connection, but can grow to accommodate higher-bandwidth and more multi-media objects as access to faster Internet occurs over time. Users can view environments in real-time using a 28.8k modem connection to the Internet. This is possible because a rendered textured geometry of an object is much smaller than a high-resolution photo or QTVR. Thus, fast performance over thin-client Internet connection is ensured by small file sizes and incremental rendering that only renders active visible areas on the visitor's screen.

2.15 Developing Virtual Museums: Models and Future Directions

Museums in a Virtual Environment As a result of the Internet and computer technology the form and function of museums is currently being renegotiated. The extension of physical museum space into networked virtual space allows for increased interaction between museum and audience. As a result, museums will need to rethink their traditional role and evolve into an information resource that links into an expansive, multifaceted network with other institutions. "Rather than thinking of ourselves as isolated institutions, we need to think of museums and our audience as nodes in a net

of connections" (Semper 2002, 3). This will mean redefining the boundaries of the traditional museum and creating alliances and relationships with other institutions. Going to a museum won't need to be a special trip; it is something that can be done every day. The virtual museum can be a meeting place, a virtual community, for people. Semper (2003) in his words says "What is needed is the free and open space that allows for people to construct and contextualize meanings...through the community-building process of dialogue". But in doing this, museums will have to relinquish their claim to be the sole authoritative interpreter of the collections and will become a set of shared relations as opposed to distinct institutions.

Virtual museums can help people understand society and their place in it. "Virtual environments are a specific form of interactive communications environment, and they help effect a changing perception of our embodied relationship with the world" (Hillis 1999, xx). The Internet gives museums the opportunity to link text, images, sound and video to present objects in a new context, allowing the audience to structure media in a way meaningful to the individual. Spatiality of the Internet Extending, and perhaps even deconstructing, the metaphors of architecture to virtual as well as physical places becomes increasingly necessary in the digital age. The no deconstructing, the metaphors of architecture to virtual as well as physical places becomes increasingly necessary in the digital age. "The idea of becoming virtual, might not be a pleasant one for some museums, but this development is inevitable because of the increasing digitization of cultural heritage and the demand to make collections more accessible" (Schweibenz 1998). On the development of virtual museum Schweibenz thinks that it is still under construction. The following are his remarks:

> "Virtual museums on the Internet have been under construction for some ten years now. This is a short time compared to the long tradition of brick and mortar museums. Hence the virtual museum still lacks a generally accepted definition. It is called an on-line museum, electronic museum, hyper museum, digital museum, cyber museum or a Web museum depending on the backgrounds of the practitioners and researchers working in this field. Enthusiasts even think of establishing

a world-wide virtual museum that might bring together digital objects from museum collections all over the world."

This is the implementation of André Malraux's vision of the "museum without walls. Eventually, these trends will blur the differences between cultural heritage institutions, and in the long run these institutions will merge into one memory institution. A memory institution combines digital surrogates of the collections of archives, libraries and museums in rich interactive environments and allows access to the content regardless of the nature of the institution. The goal of the memory institution is to preserve this content for future generations and support its use and management over time. The virtual museum is no competitor or danger for the "brick and mortar" museum because, by its digital nature, it cannot offer real objects to its visitors, as the traditional museum does. But it can extend the ideas and concepts of collections into the digital space and in this way reveal the essential nature of the museum. At the same time the virtual museum will reach out to *Virtual Visitors*, who might never be able to visit a certain museum in person.

2.16 Some Popular Virtual Museums

While it's hard to beat the experience of seeing a seminal piece of fine art or important historical artifact with your own two eyes, one could easily spend a lifetime traveling the world in search of all of them. Fortunately, the digital age has made it possible—easy, even—to visit some of the world's most famous museums from the comfort of your own home. Here is a dozen of them

Plate 2.1: The louvre

Source: www.viator.com

The Louvre is not only one of the world's largest art museums, but it's also one of Paris' most iconic historic monuments. The museum offers free online tours of some of its most important and popular exhibits, such as its Egyptian Antiquities. One can take a 360-degree look at the museum, and click around the rare artifacts to get additional information on their histories.

Plate 2.2: Solomon R. Guggenheim Museum

Source: http://archive.org/details/artofth00solo

While the architecture of the Guggenheim's building itself, designed by Frank Lloyd Wright, is quite impressive, one doesn't have to visit the Big Apple to get an up-close view of some of the priceless pieces of artwork inside. The museum makes some of its collection and exhibits available online for people and students who want to get a taste of what the museum can offer, including works from Franz Marc, Piet Mondrian, Pablo Picasso, and Jeff Koons.

Plate 2.3: National Gallery of Art

Source: http://www.nga.gov

Founded in 1937, National Gallery of Art is free and open to the general public. For those who aren't in Washington D.C., it also provides virtual tours of its gallery and exhibits, including "Van Gogh's: Masterpieces from the Van Gogh Museum, Amsterdam" and "Sculpture of Angkor and Ancient Cambodia: Millennium of Glory."

Plate 2.4: British Museum

Source: http://www.britishmuseum.org

With a collection that totals more than eight million objects, London's British Museum makes some of its pieces viewable online, including "Kanga: Textiles from Africa" and "Objects from The Roman Cities of Pompeii and Herculaneum." The museum also teamed up with the Google Cultural Institute to offer virtual tours using Google Street View technology

Plate 2.5: Smithsonian National Museum of Natural History

Source : http://www.si.edu/museums/natural-history-museum

Washington D.C.'s National Museum of Natural History, one of the most visited museums in the world, offers a peek at its wonderful treasures with an online virtual tour of the entire grounds. Viewers are welcomed into its rotunda and are greeted with

a comprehensive room-by-room, 360-degree walking tour of all its exceptional exhibits, including the Hall of Mammals, Insect Zoo, and Dinosaurs and Hall of Paleobiology.

Plate2.6: The Metropolitan Museum of Art

Source: http://www.metmuseum.org

The Met is home to over two million works of fine art, but one doesn't have to be in New York City to enjoy them. The museum's website features an online collection and virtual tours of some of its most impressive pieces, including works from Vincent van Gogh, Jackson Pollock, and Giotto di Bondone. In addition, The Met also works with the Google Cultural Institute to make even more artwork (that's not featured in its own online collection) available for view.

Plate 2.7: Dalí Theatre-Museum

Source: http://www.salvador-dali.org/en/museums

Located in the town of Figueres in Catalonia, Spain, the Dalí Theatre-Museum is completely dedicated to the artwork of Salvador Dalí. It features many rooms and exhibits surrounding every era of Dalí's life and career, and the artist himself is buried here. The museum offers virtual tours of the grounds and a few exhibits, such as the surreal display of Mae West's Face.

Plate 2.8: NASA

Source : http://www.nasa.gov/earoresearch/resources/museum-in-a-box

NASA offers free virtual tours of its Space Center in Houston, with a wise-cracking animated robot named “Audima” as your tour guide.

Plate 2.9: Vatican Museums

Source: www.museivaticani.va/

The Vatican Museums feature an extensive collection of important art and classical sculptures curated by the Popes over many centuries. You can take a virtual tour of the museum grounds and iconic exhibits, including Michelangelo’s ceiling of ‘The Sistine Chapel.’

Plate 2.10: National Women's History Museum

Source: http://www.womenhistory.org/

The mission statement of the National Women's History Museum in Alexandria, Virginia is to educate, inspire, empower, and shape the future "by integrating women's distinctive history and culture in the United States." Part of that mission is delivered through well – curated online exhibits, including exhibits surrounding women in World War II and the rights of women throughout American history.

Plate 2.11: National Museum of the United States Air Force

Source : http://www.nationalmuseum.af.mil/

The National Museum of the United States Air Force is the official museum of the United States Air Force and centered on Wright-Patterson Air Force Base in Dayton, Ohio. It houses a wide array of military weapons and aircrafts, including the presidential airplanes of Franklin D. Roosevelt, Harry Truman, Dwight D. Eisenhower, John F. Kennedy, and Richard Nixon. The museum also offers free virtual tours of its entire grounds, such as decommissioned aircrafts from World War II, Vietnam, and the Korean War.

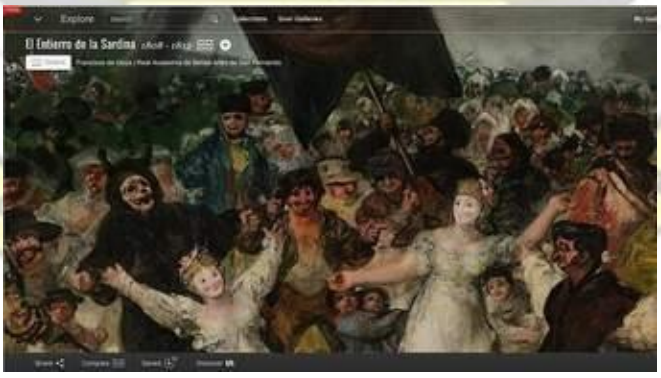


Plate 2. 12: Google Art Project

Source: http://artandculture.google.com/project/

To help its users discover and view important artworks online in high resolution and detail, Google partnered with more than 60 museums and galleries from around the world to archive and document priceless pieces of art and to provide virtual tours of museums using Google Street View technology. The Google Art Project features fine art from the White House, the Museum of Islamic Art in Qatar, and even São Paulo street art from Brazil.

2.17 Experiences from Some Foreign Tertiary Institutions

University of Michigan

Source: http://umich.edu/~umvm/Crisp%20Pages/crisp.html

The Virtual Museum Project began as a Museum Studies Program collaboration at the University of Michigan. Two graduate students, Alice Goff and Jennifer Beyer were given the task of creating a "virtual exhibit" focused on the history of IT at Michigan. But project's sponsor, John King, Vice Provost of Academic Information allowed Jennifer and Alice to define on what exactly a "virtual museum" should be. The result of the initial collaboration was a proposal describing the Virtual Museum as a conceptual space, combing the best of the "virtual" with the best of the "museum." Further research began in May of 2008 and has continued with support of the Provost's Office. The Virtual Museum present stories from the history of information technology at Michigan in which the University has shown unique strength, and which demonstrate the impact of technological innovation within the IT community both nationally and internationally. Rather than providing a comprehensive survey of the history of IT, it offers exhibits devoted to specific events and subject areas, organized into broad themes. Similar to this is the study under review which is being advocated by a PhD student of KNUST. Upon the acceptance of this advocacy as a working document by KNUST, the thoughts and processes expressed would all be translated into reality and

gradually become an informative resource like the Michigan example. The Museum objectives are:

- ***To remind.*** Making tacit knowledge explicit
- ***To teach.*** Educate about the University's role in making IT History

To commemorate. Preserve & memorialize memories.

The Virtual Museum Project is working to creating a "museum" that collects and exhibits the histories of information technology at the University of Michigan. The Museum exists to inspire students, faculty, staff and IT professionals to continue developing empowering technologies, despite the risks and uncertainties of working at the threshold of knowledge. The Project has been divided into three *–mind and machine, mechanisms of learning and communication and collaboration* (The University of Michigan Friars. 2010).

2.17.1 Mind & Machine

This module focuses on the computer as mechanical object. The target audience of this module is current and prospective University of Michigan IT developers and researchers, although technology consumers, interested in history, are also part. *Mind & Machine* deals with the ways in which IT developers worked to make dearly analog computing processes emulate human thought, laying the groundwork for digital computers that are used today. It also details advancements in interface design, moving from interfaces requiring expert knowledge to more user-friendly systems that are now commonplace. The movement from abstract functions, conceived by IT developers, to useful technological tools, accessible to consumers is at the core of this module. Being at the forefront of IT development has placed Michigan in a role where developers had little notion of how their advancements would eventually be applied. Content is conveyed through oral histories of IT developers and users of merging technologies. Additionally, access to physical objects and documentation gives visitors a feel for the scale of early computers, and the expertise required to interact with them. Collections chosen to be acquired for an interpreted in this module provides examples of the computer's transition from mechanical object to digital device, and the Michigan contributors to such advancements.

2.17.2 Mechanisms of Learning

This module focuses on the initiatives that have resulted from the University's commitment to developing technologies to facilitate learning. The primarily audience of this module are current University students, both in IT and in other academic disciplines, and University alumnus. Secondary interest comes from the larger University consortium interested in developments that originated at Michigan. *Mechanisms of Learning* deals with instances where the University has created technologies to enhance the student experience—both on and off campus. It is not limited to advancements in technologies for the classroom, but also encompass technologies that enhance access to information or resources that have supported students in navigating the University environment. The University has a long history of commitments to developing technologies with students. Often, major technological advancements have their origins in student coursework. Professors who led such courses did so to develop future leaders in IT, demonstrating a vested interest in developing not just technologies, but technology leaders. Learning technologies, both for a and by student, have also enhanced academic accomplishments, giving them improved access to collections at University Libraries, access to course information, and numerous conveniences to enrich study. Stories and experiences in this module come from students who both helped to design technologies and who were end-users. Each contribution demonstrates how the University has engaged students with technology, and how such technologies have had impacts beyond the campus setting. (Hinsdale &, Demmon, (1906 -Ed.).

2.17.3 Communication & Collaboration

This module highlights instances where Michigan has been a leader in transitioning the computer from computational device to communication device. The module further describes how Michigan has been a continual presence in technology dialogue. *Communication and Collaboration* module investigates the University's role in vastly expanding the capabilities of technology. While many though, only recognizes the computational value of the computer, leaders at Michigan were developing technologies that would allow for some of the first digital collaborations.

The target audience for this module is the University consortium, as Michigan's contributions are most significant and most often under-represented in this area. Developers who helped make this significant change in computing have a vested interest in this module. Capturing and preserving instances where communication initiatives begun at Michigan have grown into other significant advancements is central to the exhibits. Communication technologies grow rapidly often leaving little evidence of their past, and they have been developed in a highly collaborative nature. Therefore, to establish Michigan as one of the leaders in future communication development it is important to collect examples of past contribution—without them, there is no reference point for being on the technology "frontier." Another essential component of this module is to sue the model of communication technology to build a community of exhibit patrons and contributors. Each story and experience within this module will originate from within the IT community, and will portray the significance of Michigan's collaborative contributions to the continuing communication technology legacy. (Hinsdale &, Demmon, (1906 -Ed.).

University of Barcelona

Source: http://www.ub.edu/museuvirtual/index_en.php

The Brochure of Museu Virtual Universitat De Barcelona (2013), indicates that, University of Barcelona Virtual Museum offers the visitor a rich and varied collection of picture galleries and comprises works of art, a series of remarkable old books and science exhibits including instruments of different kinds and origins, plant and mineral samples, and taxi dermic specimens. The following collections can be viewed:

- Art (a gallery with examples of the UB's artistic and architectural heritage);
- the Animal Biodiversity Resource Centre Collection (CRBA);
- the Pavelló de la República Library Collection;
- the Sabater Pi Collection;
- the Rare Book and Manuscript Library;

- the Herbarium BCN (CeDocBiV);
- Scientific Instruments;
- the Faculty of Geology Mineral Collection; the Catalan Pharmacy Museum.

The Virtual Museum of the University of Barcelona holds a new virtual exhibition entitled *Lux Lucis –Knowledge Is Light.* It shows the many possibilities of analyzing and understanding the phenomenon of light with multi-disciplinary approaches, such as physics, religion, astronomy or philosophy. It shows a wide range of objects coming from the heritage of the University of Barcelona: from photographs, books, paintings, to scientific tools or plants. With this material the exhibition explores the different traits of the light, and how arts, science and nature have studied, transformed and promoted it. The exhibition starts with the coat of arms of the University of Barcelona, which includes the representation of the sun together with the motto *Libertas Perfundet Omnia Luce*, which means "freedom lightens everything with its light". There are also minerals from the Faculty of Geology, pictures from the Museum of Catalan Pharmacy, and works by contemporary authors from the collection of the Faculty of Fine Arts, old scientific tools, and objects from the collection of the Animal Biodiversity Resource Center (CRBA). Lots of the exhibited documents were already seen in 2016 in the exhibition by the Vice-Rector's Office of
Institutional Relations and Culture in collaboration with Museu d'Història de
Catalunya (Museum of History of Catalonia) "Treasures of knowledge. *Arbor Scientiae*", which explained the work of the University of Barcelona regarding creation and transfer of knowledge. This exhibition was part of an agreement signed between the University and the MHC, which expects to organize an annual exhibition on the UB artistic and cultural heritage until 2019. Therefore, in 2017, the Museu d'Història de Catalunya (MHC) will exhibit some of the works that are now in this virtual exhibition. (Museu Virtual Universitat De Barcelona 2013)

The Smithsonian Museum of Natural History

Source https://naturalhistory.si.edu/vt3

The National Museum of Natural History (NMNH) is part of the Smithsonian Institution, the world's preeminent museum and research complex. The Museum is dedicated to inspiring curiosity, discovery, and learning about the natural world through its unparalleled research, collections, exhibitions, and education outreach programs. Opened in 1910, the green-domed museum on the National Mall was among the first Smithsonian building constructed exclusively to house the national collections and research facilities. Whether looking at the history and cultures of Africa, describing our earliest Mammalian ancestor or primate diversity around the world, examining ancient life forms including the ever popular dinosaurs, or exploring the beauty of rare gemstones such as uniquely colored diamonds, the Museum's temporary and permanent exhibitions serve to educate, enlighten and entertain millions of visitors each year. The main building on the National Mall contains 1.5 million square feet of space overall and 325,000 square feet of exhibition and public space; altogether the Museum is the size of 18 football fields, and houses over 1000 employees. With a growing network of interactive websites, the Museum is transforming itself into a hub for national and international electronic education, accessible to anyone with access to the internet. At the center of the
Museum's exhibition and research programs are its expertly documented collections: more than 126 million natural science specimens and cultural artifacts.

Just to name a few of our museum holdings, the collections include 30 million insects carefully pinned into tiny boxes; 4½ million plants pressed onto sheets of paper in the Museum's herbarium; 7 million fish in liquid-filled jars; and 2 million cultural artifacts, including 400,000 photographs housed in the National Anthropological Archives. Over 3½ million specimens are out on loan each year; over 15,000 visitor days are spent in the collections; and there are almost 600,000 additional visits to collection data bases available on the Web. The Museum includes a state-of-the-art collections storage facility in Suitland, Maryland; a marine science research facility in Ft. Pierce, Florida; and field stations as far away as Belize, Alaska, and Kenya. Research activities are organized into seven departments, and a number of affiliated U.S. government agencies on-site contribute

to the Museum's strength, including the Department of the Interior (U.S. Geological Survey Biological Resources Division), the Department of Agriculture (Systematic Entomology Laboratory), the Department of Commerce (National Marine Fisheries Service Systematics Laboratory), and the Department of Defense (Walter Reed Biosystematics Unit). Through its research, collections, education and exhibition programs, NMNH serves as one of the world's great repositories of scientific and cultural heritage as well as a source of tremendous pride for all Americans. (The Smithsonian Museum of Natural History 2011)

University of Chicago

Source: https://oi.uchicago.edu/museum-exhibits

The Oriental Institute was founded in 1919 by James Henry Breasted with the financial support of John D. Rockefeller Jr., and was originally envisaged as a research laboratory for the investigation of the early human career that would trace humankind's progress from the most ancient days of the Middle East. The goal of the Oriental Institute is to be the world's leading center for the study of ancient Near Eastern civilizations by combining innovation in theory, methodology, and significant empirical discovery with the highest standards of rigorous scholarship. The Oriental Institute Museum was opened to the public in 1931. The majority of the collections of the Oriental Institute came from its expeditions in the Middle East during the 1920s, 1930s, and 1940s. A major reinstallation of the Museum, including the construction of a climate-controlled wing for housing collections and archives, took place in the 1990s and early 2000s.

The Voting Members of the Oriental Institute meet quarterly and approve changes to the Mission Statement of the Oriental Institute Museum. The Oriental Institute is a unit within the University of Chicago and the name of the corporation is "The

University of Chicago." The corporation was originally incorporated on September 10, 1890. The corporation has not changed its name since its original date of incorporation. Within the Oriental Institute, the Oriental Institute Museum and Department of Public Education and Outreach promote interest in and understanding of ancient civilizations of the Middle East, and their connections to the modern world, for a broad and diverse audience. In order to tell the story of the rise of civilizations, communicate the excitement of archaeological, linguistic, and historical discovery, enhance understanding and appreciation of cultural similarities and differences, show connections between the ancient and modern worlds, and highlight the research of the Oriental Institute:

- The Oriental Institute (OI) preserves collections and information
- It facilitates and conducts research related to the collections
- The OI educates the general and scholarly audiences through informative and engaging exhibits, programs, publications and website.

The Museum is a world-renowned showcase for the history, art, and archaeology of the ancient Near East. The museum displays objects recovered by Oriental Institute excavations in permanent galleries devoted to ancient Egypt, Nubia, Persia, Mesopotamia, Syria, Anatolia, and the ancient site of Megiddo, as well as rotating special exhibits. The Oriental Institute's comprehensive collections, including artifacts, photographs, excavation records, administrative documents, and publications, serve the public in exhibits and online, as well as being an extremely rich resource for scholars. Management of the materials that comprise the Oriental Institute's collections is organized into five units: Museum Registration, Tablet Collection, Archives, Conservation, and the Research Library. Additionally, individual faculty and research projects also maintain materials such as study collections; project materials in process, such as current excavation drawings, records, and notes; and other unpublished materials which have not yet been turned over to the Institute.

The Oriental Institute Museum and Department of Public Education and Outreach, are major units of the Oriental Institute, of the University of Chicago, which is an interdisciplinary research center that integrates archaeological, textual, linguistic, and art historical data to understand the development and functioning of ancient

civilizations of the Middle East from the earliest Holocene through the medieval period. The Institute achieves this by conducting archaeological excavations, textbased research, artifact analyses, new research methodologies, the stewardship of systematic archival and museum collections as research resources, and the development of fundamental research tools such as dictionaries of ancient languages.

The Oriental Institute Museum provides free admission and serves the communities that immediately surround the University of Chicago, those who live and work in the area of the University itself (Hyde Park), and the metropolitan area of Chicago. It also attracts regional, domestic and international audiences. The Museum and Department of Public Education and Outreach connect with their audiences through a variety of programs for all age groups, socio-economic and ethnic backgrounds, and strives to increase its visitation to include the rich diversity found in the Chicago area including the surrounding Latino and African American communities. Approximately 55,00060,000 people visit the museum annually, and over 1,000,000 unique visitors come to our web site each year. Local and international visitors range from scholars, university students, families, K-12 teachers and students, 21st century adult learners, and volunteers. (The University of Chicago Virtual Museum 2014)

2.18 Heritage

Heritage is the full range of inherited traditions, monuments, objects, and culture. Most important, it is the range of contemporary activities, meanings, and behaviors that are drawn from them. It includes, but is much more than preserving, excavating, displaying, or restoring a collection of old things. It is both tangible and intangible, in the sense that ideas and memories--of songs, recipes, language, dances, and many other elements of which humanity identifies itself is as important as historical buildings and archaeological sites. Heritage is, or should be, the subject of active public reflection, debate, and discussion. What is worth saving? What should and should not be forgotten? What memories can be enjoyed, regretted, or learnt? Who owns "The Past" and who is entitled to speak for past generations? These and other questions are very crucial issues that need to be addressed. Active public discussion about material and intangible heritage of individuals, groups, communities, and nations is a valuable facet of public life in multicultural worlds. Heritage is a contemporary activity with far-reaching effects. It can be an element of far-sighted urban and regional planning. It

can be the platform for political recognition, a medium for intercultural dialogue, a means of ethical reflection, and the potential basis for local economic development. It is simultaneously local and particular, global and shared. Heritage is important in understanding the story of a country – its history, identity and its people. ... The retention and management of heritage places has an important role to play in protecting the environment, creating vibrant communities and sustaining local economies. In historical terms it can be a place or remnant that belongs to a civilization or empire and has an architectural, historical, natural, or cultural value.
(ICOMOS, 2002).

2.19 Underpinning Philosophy

All investigations are rooted in some form of beliefs and assumptions. The outcome of the investigation be it the development of knowledge or the devising of solutions are all anchored in beliefs and assumptions of the researcher (Burrell and Morgan 1979). These are the research philosophies that underpin all forms of investigations. The beliefs and assumptions that bother on human knowledge are epistemological, those that cover the realities of life are ontological and the extent to which values and ethics influences investigations are axiological. These beliefs and assumptions mostly determine what problems to tackle, the methods to use and how to analyze collected data (Crotty 1998). It is possible to triangulate these assumptions depending on the nature of the problem at hand.

The study under review "virtualization of KNUST's heritage: an alternative media to enhance access" of which the subject matter is MUSEUM demands the blend of philosophies. The reason is that museum as a discipline is multifaceted and interdisciplinary and therefore requires traces of knowledge from its affiliates – social sciences, natural sciences, applied sciences and humanities. Whichever philosophy that one embraces, one has to be objective or subjective.

The Objectivist view social and physical phenomena as existing independently, being universal and enduring in character (Niglas 2010). Therefore, social and physical phenomena have to be studied like the same way that a natural scientist would study nature. Thus, when dealing with knowledge, realities, values and ethics, the objectivist

would discover these through the medium of observable measurable facts from which law-like generalizations could be drawn about the universality of truth. These groups of philosophers resonate towards the positivist and realist points of view that discard human influences in quantitative deductive empirical investigations.

The subjectivist on the other hand incorporates assumptions of the arts and humanities – asserting that social reality is made from the perceptions and consequent actions of social actors therefore they believe in change, relativity and diversity of phenomena. They therefore tend to align with interpretivist/constructivist who believes that reality, value and knowledge are constructed through social interaction in which social actors create meanings and realities. This is usually what takes place in the social sciences and humanities circles. Over there, emphasis is placed on quality instead of quantity; meaning instead of facts; practice instead of theory.

2.19.1 Axiological Perspective

The tenets of the subjectivist philosophic stance relate well with the study under review because the epistemological issues contained and the ontological ramifications inherent would all be analyzed axiologically. The reason is that the extent to which values and ethics influences the creation of a virtual museum to enhance access to information cannot be overlooked (Cunliffe 2003). Thus, the virtual audiences' understandings and preferences as far as the content, preservation, exhibition and interpretation of artifacts are concerned is key to determine the trustworthiness of the proposed virtual museum.

Besides, the choice of KNUST as the sole unit of analysis (case study) also qualified the study as emanating from a constructivist/interpretivist perspective because they usually employ ethnography, grounded theory, phenomenology, narratives and case studies when conducting professional and scholarly investigations. It therefore suffices to indicate here that the study under review was predicated more on axiological perspective through the constructivist spectacles. However, due to the pragmatic nature of the problem, the researcher did not hesitate to triangulate research approaches and paradigms; for that yielded the most appropriate results.

2.19.2 Research Paradigms

A research paradigm is an approach or a research model to conducting a research that has been verified by the research community for long and that has been in practice for hundreds of years. In pure sciences, quantitative research methodology is clearly the most favored approach to conducting the research; at the same time, the term has been used in social science research in about 3-4 different ways. Thus, a paradigm could mean *a worldview*; *an epistemological stance; a set of shared beliefs among members of a specialty area* and, *as a model example of research* (Morgan, 2007). Examples of three major paradigms in research are positivism, interpretivism, and critical theory. The research under review employed the interpretivist paradigm.

2.19.2.1 Interpretivism

Interpretivism, also known as interpretivist requires researchers to interpret elements of the study, thus interpretivism integrates human interest into a study. The study relied heavily on the interest of KNUST, surrounding communities and other beneficiaries of the University. The proposed virtual museum is being created to satisfy institutional need and interest. The beneficiaries determined what was suitable to them and therefore contributed data willingly towards the creation of the virtual museum. Thus, the virtual audiences' understandings and preferences as far as the content, preservation, exhibition and interpretation of artifacts were concerned were the keys to determine the trustworthiness of the proposed virtual museum.

Accordingly, "interpretive researchers assume that access to reality (given or socially constructed) is only through social constructions such as language, consciousness, shared meanings, and instruments" (Myers, 2008) Development of interpretivist philosophy is based on the critique of positivism in social sciences. Interpretivism is "associated with the philosophical position of idealism, and is used to group together diverse approaches, including social constructivism, phenomenology and hermeneutics; approaches that reject the objectivist view that meaning resides within the world independently of consciousness" (Collins, 2010). According to interpretivist approach, it is important for the researcher as a social actor to appreciate differences between people (Saunders, Lewis, & Thornhill, 2012). Moreover, interpretivism studies usually focus on meaning and may employ multiple methods in order to reflect different aspects of the issue.

Main disadvantages associated with interpretivism relate to subjective nature of this approach and great room for bias on behalf of researcher. Primary data generated in interpretivist studies cannot be generalized since data is heavily impacted by personal viewpoint and values. Therefore, reliability and representativeness of data is undermined to a certain extent as well. On the positive side, adoption of interpretivism, qualitative research areas such as cross-cultural differences in organizations, issues of ethics, leadership and analysis of factors impacting leadership etc. can be studied in a great level of depth. Primary data generated via Interpretivism studies might be associated with a high level of validity because data in such studies tends to be trustworthy and honest. Besides the epistemological considerations of this study, the ontological implications do not warrant generalization thereby making the paradigm chosen more appropriate.

2.19.2.2 Pragmatism

Scheffler (1986), view *Pragmatism*, as a branch of philosophy that emphasizes on action, experimentation, and a concern with what "works" in human experience. It was first conceived in the final decade of the nineteenth century. Philosophic pragmatism was initially intended to provide an alternative to foundationalism, i.e., the view that there are innate and indubitable beliefs upon which knowledge must be based. Traditional pragmatists, such as William James, Charles Pierce, John Dewey, Josiah Royce, and George Herbert Mead, viewed all human understanding as intrinsically fallible; they saw knowing as an open-ended quest for greater certainty, grounded in practical experience, and motivated by a desire for successful actions (Susan and Robert 2006).

Relating this principle to this study it became obvious that the advocated creation of a virtual museum was an open –ended quest for greater certainty which was grounded in what had worked elsewhere and it was motivated by the researcher's desire for successful action by KNUST. Pragmatism rejects the idea that the function of thought is to describe, represent, or mirror reality. Instead, pragmatists consider thought an instrument or tool for prediction, problem solving and action. Pragmatists contend that most philosophical topics—such as the nature of knowledge, language, concepts,

meaning, belief, and science—are all best viewed in terms of their practical uses and successes. The philosophy of pragmatism emphasizes the practical application of ideas by acting on them to actually test them in human experiences. Pragmatism focuses on a changing universe rather than an unchanging one as the Idealists, Realists and Thomists had claimed.

In conformity to this principle the initial design of the advocated virtual museum was submitted to KNUST for criticism. Thus, a purposively sampled population was selected to ascertain the viability and profitability of the anticipated project after watching. Their views and comments were then incorporated to refine the DEMO to meet the taste and preferences of KNUST. Before this exercise, a survey to find out the preference rate of KNUST had been conducted. All these were done to ensure that the crafted virtual museum was capable of enhancing access to KNUST's heritage.

2.20 Theoretical Foundation

The entire project is firmed up by three interconnected relevant theories. Each contributes to the creation of a component of the project while complementing each other towards the final creation of the advocated Virtual Museum. These Theories are *Semiotics, Cultural Theory of Heritage Preservation* and *Mutual Inquiry*.

2.20.1 Semiotics

Semiotics is the theory of the production and interpretation of meaning. Its basic principle is that meaning is made by the deployment of acts and objects which function as "signs" in relation to other signs. Systems of signs are constituted by the complex meaning-relations that can exist between one sign and another, primarily relations of contrast and super ordination/subordination (e.g. class/member, whole/part). Signs are deployed in space and time to produce "texts", whose meanings are construed by the mutually contextualizing relations among their signs (Baudrillard & Poster 1988). The employment of this theory enables the assignment of meaning to the collections that form the entire content of the virtual museum. Semiotics, translated as the science of signification, is often said to derive from two sources: F. de Saussure (Swiss-French, 1857-1913) and C.S. Peirce (Anglo-American, 18391914). Some other researchers

known for their work in semiotics are Noam Chomsky, Umberto Eco, R. Barthes and Jean Baudrillard.

There are two major traditions in European semiotics: F. de Saussure, semiology; and C.S. Peirce, semiotics. Saussure's approach was a generalization of formal, structuralist linguistics; where he argued that the meaning of a sign is arbitrary and variable. In Saussure's terms, any sign consists of a signifier (the sound a word makes, its physical shape on the page) and a signified (the word's content). In Saussure's theory of linguistics, the signifier is the sound and the signified is the thought. The linguistic sign is neither conceptual nor phonic, neither thought nor sound. Rather, it is the whole of the link that unites sound and idea, signifier and signified. At face value, Saussure's "speech circuit" model represents an early and underdeveloped model of communication. In each case, the sign can be broken into two parts, the signifier and the signified. The signifier is the thing, item, or code that is 'read' – like a drawing, a word, or a photo. Each signifier has a signified, the idea or meaning being expressed by that signifier. Only together do they form a sign. The signifier is what is called something (the word "tree" for tree), whereas the signified is the concept of the thing itself, and all other related concepts: all iterations of "tree," plus "bush" and "shrub" and anything else tree-like. Simply put, the signifier is the sound associated with or image of something (e.g., a tree), the signified is the idea or concept of the thing (e.g., the idea of a tree), and the sign is the object that combines the signifier and the signified into a meaningful unit.

Peirce's was an extension of reasoning and logic in the natural sciences. (Eco 1976). General Semiotics tends to be formalistic, abstracting signs from the contexts of use; Social Semiotics takes the meaning-making process, "semiosis", to be more fundamental than the system of meaning-relations among signs, which are considered only the resources to be deployed in making meaning. (Barthes 1967). Multimedia semiotics is based on the principle that all meaning-making, because it is a material process as well as a semiotic practice, necessarily overflows the analytical boundaries between distinct, idealized semiotic resource systems such as language, gesture, depiction, action, etc. Every material act and sign can be, and usually is, construed in relation to more than one system of sign relations (e.g. a written word is both a linguistic

sign and a visual orthographic one; a spoken word is also construed in relation to its non-linguistic acoustical qualities; an image is interpreted both visually and usually also linguistically; etc.). Therefore, it becomes important to study how different sign-systems are physically and semiotically integrated in texts and multimedia productions of various kinds. (Saussure 1983).

Baudrillard developed his concept of simulation and symbolic exchange in L'Echange Symbolique et la mort (1976) where he claims that a structural revolution of value has abolished and surpassed Saussure's and Max's laws of value. He explains the social and historical mutations leading to his new era of simulation in a well- known model of the three orders of simulacra. In La Transparence du mal (1990), written fourteen years later he adds a fourth order. Simulacra emerged from the annihilation and subsequent higher order reproductions of reference to the real in a pure structural system whose terms commutate indeterminably among themselves. Each order has a law – a dominant form displays certain semiotic features despite Baudrillard's critique of systems of value suggest the successive predominance of different types of semiotic processes (corrupt symbol, icon, linguistic sign index). The sure and referential symbols of an endogamous society were complete by the emergence in the Renaissance of arbitrary signs freed from their referential obligation. These exogamous signs counterfeited in extra systemic referent as they played together democratically. With the industrial revolution, the extermination of reference made possible the machinic replication of serial signs. These iconic simulacra of one another were dull, repetitive and operational.

Relating this theory to the thesis, the signifiers are the images resulting from the conversion of manual objects through photography. These were the KNUST's Logo, some historic buildings and some interesting sites. The signified in these were the meanings expressed by the images as demonstrated:

Image – something – signifier (sound)

Logo – concept – signified (idea)

The actual photo of the logo in the sign, that is the object that combines the signifier (image – something – sound) and the signified (logo – concept – idea) into a meaningful unit. The actual objects that combine the signifier and the signified into a meaningful

unit in virtual museum – are the images. Examples of these are those shown in the thesis such as the KNUST Logo, historic buildings and interesting sites. It is possible to have different meanings from the same object or image. For this thesis, the same meaning that is semiotically assigned to an object is maintained when the object is converted into digital image. In other words, the change in form and media of presentation does not affect the assigned meaning of the object or image. The virtualization is to provide audience the same experience in the brick and mortar museum. However, the virtual platform offers larger spaces for curating many objects at a time and access to such content is also wider as compared to the manual platform. In a way, the physical objects are simulated and recognized as such as postulated by

Saussure and Baudrillard when espousing on 'signs' through 'signifiers' and the 'signified'. The thesis is therefore further undergirded by the philosophy and theories of signs as examined in both Saussurean and Piercean semiotics.

Social semiotics examines semiotic practices, specific to a culture and community, for the making of various kinds of texts and meanings in various situational contexts and contexts of culturally meaningful activity. Social semiotics therefore makes no radical separation between theoretical and applied semiotics and is more closely associated with discourse analysis, multimedia analysis, educational research, cultural anthropology, political sociology, etc.

2.20.2 Cultural Theory of Heritage Preservation

This theory supported the idea that information ought to be preserved based on cultural, environmental and linguistic relativities (Schofield 2008). This theory seeks to place African cultural heritage studies and conservation practices in the modern context by bringing out modern topics around its use in the contemporary world. Cultural heritage resources in Africa and the developing world are facing a challenge of being roped into multiple platforms in a reactive and/or haphazard manner that does not account for their sustainable use. General resources conservation has been taking place in multiple facets for time immemorial. Cultural heritage resources management field, however, is new in Africa and among African stakeholders. Cultural heritage resources management is a process of organizing the use of cultural resources amongst multiple stakeholders such as people, institutions, governments, regions and the world (Arends 2009). To organize cultural resources conservation ideas, a conceptual framework (theory) built from

observed stakeholders' relationship with the resources (practice) through time is needed. The Theory also discusses its point of departure in relation to African cultural heritage management. It also introduces an underlying make-up of contents in the field of African cultural heritage conservation and management.

The conservation-restoration of cultural heritage focuses on protection and care of tangible cultural heritage, including artworks, architecture, archaeology, and museum collections. Conservation activities include preventive conservation, examination, documentation, research, treatment, and education (Smith and Waterton 2010). This field is closely allied with conservation science, curators and registrars. Conservation of cultural heritage involves protection and restoration using any methods that prove effective in keeping that property in as close to its original condition as possible for as long as possible. Conservation of cultural heritage is often associated with art collections and museums and involves collection care and management through tracking, examination, documentation, exhibition, storage, preventative conservation, and restoration. The scope has widened from art conservation, involving protection and care of artwork and architecture, to conservation of cultural heritage, also including protection and care of a broad set of other cultural and historical works.
Conservation of cultural heritage can be described as a type of ethical stewardship

2.20.3 Mutual Inquiry

Mutual Inquiry stipulates that students must be allowed to learn by themselves through self-discovery activities (Greeno: Collins: Resnick 1996). The virtual museum being advocated for also expects its audience to construct meaning of the artifacts by themselves. It is this theoretical requirement that is compelling the researcher to make the system friendly and interactive. Inquiry-based/Mutual learning is a form of active learning that starts by posing questions, problems or scenarios— rather than simply presenting established facts or portraying a smooth path to knowledge. The process is often assisted by a facilitator **(**Brunner 1961**).** Inquirers will identify research issues and questions to develop their knowledge or solutions. Inquiry-based learning includes problem-based learning, and is generally used in small scale investigations and projects, as well as research. The inquiry-based instruction is principally very closely related to the development and practice of thinking skills.

Inquiry-based learning is primarily a pedagogical method, developed during the discovery learning movement of the 1960s as a response to traditional forms of instruction—where people were required to memorize information from instructional materials (Gomez: Gordon: Carlson 1995). The philosophy of inquiry-based learning finds its antecedents in constructivist learning theories, such as the work of Piaget, Dewey, Vygotsky and Freire among others, and can be considered a constructivist philosophy. Generating information and making meaning of it based on personal or societal experience is referred to as constructivism. Dewey's experiential learning pedagogy (that is, learning through experiences) comprises the learner actively participating in personal or authentic experiences to make meaning from it. Inquiry can be conducted through experiential learning because inquiry values the same concepts, which include engaging with the content/material in questioning, as well as investigating and collaborating to make meaning. Vygotsky approached constructivism as learning from an experience that is influenced by society and the facilitator. The meaning constructed from an experience can be concluded as an individual or within a group.

In the 1960s, Joseph Schwab called for inquiry to be divided into four distinct levels. This was later formalized by Marshall Herron in 1971, who developed the Herron Scale to evaluate the amount of inquiry within a particular lab exercise. Since then, there have been a number of revisions proposed and inquiry can take various forms. There is a spectrum of inquiry-based teaching methods available.

Banchi and Bell (2008) explain that teachers should begin their inquiry instruction at the lower levels and work their way to open inquiry in order to effectively develop students' inquiry skills. Open inquiry activities are only successful if students are motivated by intrinsic interests and if they are equipped with the skills to conduct their own research study. An important aspect of inquiry-based learning (and science) is the use of open learning, as evidence suggests that only utilizing lower level inquiry is not enough to develop critical and scientific thinking to the full potential. Open learning has no prescribed target or result that people have to achieve. There is an emphasis on the individual manipulating information and creating meaning from a set of given materials or circumstances. In many conventional and structured learning

environments, people are told what the outcome is expected to be, and then they are simply expected to 'confirm' or show evidence that this is the case.

Open learning has many benefits. It means students do not simply perform experiments in a routine like fashion, but actually think about the results they collect and what they mean. With traditional non-open lessons there is a tendency for students to say that the experiment 'went wrong' when they collect results contrary to what they are told to expect. In open learning there are no wrong results, and students have to evaluate the strengths and weaknesses of the results they collect themselves and decide their value.

2.21 Conceptual Framework

The construction of a virtual museum for KNUST is built basically on the traditional functions of a museum – collect, preserve and display. In order to getting a single theory that gets all the three traditional functions of a museum together, the described single theories were inter -connectedly used. The caveat was that, because the traditional functions follow a special sequence and are also connected to each other, the chosen single theories (*semiotics, cultural theory of heritage preservation and mutual inquiry*) were also connected in order to create the virtual museum. The adaptation and synthesis of these theories culminated in the design of the idiosyncratic conceptual framework illustrated bellow.

CONCEPTUAL FRAMEWORK

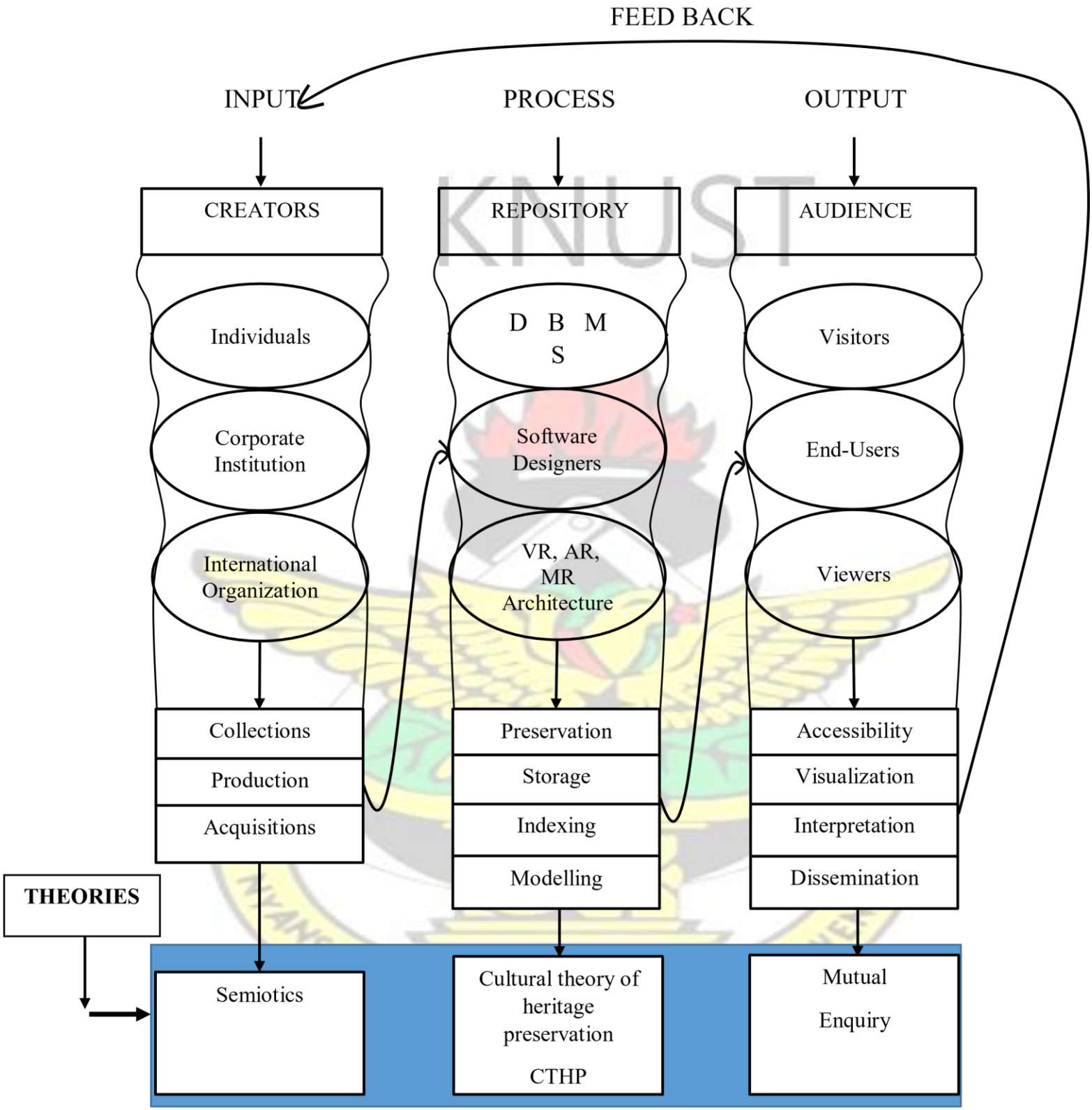


Figure 2.1: Conceptual Framework

Source: Researcher's Own Construct 2017

2.21.1 Explanation of Conceptual Framework Variables

Creators within the framework comprises among others, curators, collection managers (collectors of digital images) as well as innovators of varied artifacts intended for the virtual museum. In this project, the curator, the collection manager and the innovator is KNUST as an institution. The Institution determines what to gather, when to collect, where to source for collectibles, and why the collected relics are of much importance to anticipated virtual audience. The collections in relation to this advocacy will provide a quick idea of the tangible heritage of KNUST - all with the view to showcase KNUST as an institution of excellence; committed to the advancement of knowledge in Science and Technology for sustainable development in Africa and beyond. The Project is dubbed *KNUST's Heritage-the genesis*. Thus, for a start, exhibitions are displayed in three galleries *–artifacts corner, historic buildings and some interesting sites*. As to how to collect the needed artifacts, the services of various digital technologists are required. The digital images collected by the creators determine the stock of the virtual museum. What needs to be understood is that the collection exercise continues unabated as long as the virtual museum exists. The collections are updated at periodic intervals. The acquisition of the collectibles could come in numerous forms such as donations, legal deposits, field collecting, purchasing, exchanges, bequests just to mention a few. The Creators' job is fundamental to the entire system because without their inputs the system cannot start running.

The crucial part of the creator's work is the assigning of meaning and interpretation to the collected artifacts through textual inscriptions and oral narratives. This is made possible with the application of semiotic theory to deriving meaning for each artifact. The detailed description of semiotic theory follows this section.

2.21.1.1 The Repository Preserving Artifacts

It is the duty of the repository under the watch of the creators to index, classify, arrange and store the artifacts in such a way that they could be easily retrieved. This is where appropriate storage and data capturing technologies are employed. These may include infrared reflectography – x' ray imaging, 3D laser scanning, image-based rendering and modeling techniques (IBMR), QuickTime virtual reality (QTVR) and other photogrammetric soft wares such as 3DF Zephyr, Metashape (former photoscan),

Photosynth, Pix4Dmapper, Reality Capture and SOCET SET. In preserving these logically collected digital images, the repository is guided by C*ultural Theory of Heritage Preservation.* – This theory has been explained subsequently at the appropriate section.

2.21.1.2 Audience Interacting with the Final Display

The processed artifacts are made available to the virtual audience in the display portion. This is where the visitors experience the ambience of museum services - how to personalize the experience, how interactive the system is and the richness of the content is all appraised here by the audience. The smooth navigation of the site, the picture and colour quality, the clarity of sounds and the accompanying narrations are all adjudged by the audience. The Project under review is being designed to serve KNUST community members, alumni and partners of the university, Ghanaians, local and international tourists and all worldwide virtual visitors who may be potential or actual audience. Access to virtual content has no barrier therefore the facility would be accessible to all those who have access to the internet. The system should be able to satisfy the aesthetic, research, education and entertainment needs of the visitors. Over here the relevance of the chosen theory – *mutual inquiry* is brought to bear on the virtual visitors. The visitors learn by themselves; they construct their own meaning from their interaction with the system – an exercise required by *mutual theory* (self-learning). In situations where the audience could make inputs, the system should be encrypted such that the logical arrangement of artifacts would not be altered.

2.21.2 The Relationship between Theories and Conceptual Framework Variables

2.21.2.1 Semiotics and the collection of artifacts

Semiotic Theory is related to what definition is given to the sign. Therefore, a sign is not a natural production: it exists in the social world and produces meanings related to social and cultural context. Most studies of contemporary semiotics draw from the theory of sign systems started in the work of the Swiss Linguist Ferdinand de Saussure and develop by French philosopher and Linguist Roland Barthes. Both Saussure's and Barthe's semiotics are not only analysis of the linguistic meanings but can tackle many aspects of cultural studies such as museology. A number of museum studies has applied

the concept of semiotics to analyze an artifact as a sign and symbol that convey meaning. Examples of these could be found in the works of Lidchi (1997); Pearce (1990, 1992, 1995). More so, the interpretation of the meaning and historical and cultural significance of artifacts is an important aspect of creating a virtual museum. An object bears some objective message in its physical presence that is obvious and intelligible at first sight. However, the difficult task of a museum is in expressing the broader meanings of the objects to visitors. The meaning of a museum object contains various layers of information related to its signifier, contextual elements, aesthetic value and historical context. The physical presence of an object, besides cannot guarantee its decoding at the level of meaning. The meanings of objects are never intrinsic or constant: it is culturally constructed and changes from one historical context to another depending on what system of classification is used (Lidchi, 1997)

In order to analyze an object as a symbol and as a sign, its relationship to a complex of historical context and cultural meanings is involved. There are several semiotic studies in museology employing linguistic analysis of communication through both Saussarian and Barthe's semiotics as the analytic technique to convey concepts of an artifact as evidenced in Pearce (1990, 1992). A semiotic approach in a museum exhibition is a way of viewing that involves interpretation of the meaning of an artifact using a range of relevant explanatory material and other artifacts in the surrounding exhibition. Pearce (1990) suggested that the use of semiotic approach may shed some useful light on the analysis of meaning in the communication process. From this aspect of interpreting the meanings of objects as the signified it is possible to use the semiotic concept to shed some light on the significance of collections of artifacts. In his opinion, Hooper-Greenhill (2000) indicated that "if individual objects are complex in relation to meanings, exhibitions – groups of objects combined with words and images are more complex still".

A number of studies in museology have adapted theoretical frameworks based on the analysis of semiotics to interpret meanings of objects and knowledge related to objects on display in the exhibition for communication. Pearce (1990) explains that museum exhibition is an element in the chain of the communication process, interpreting meaning and knowledge of objects and using the idea of implicit performance of the

artifacts in bearing a metaphorical relationship. With the current technologies, repositories of physical artifacts can migrate into the realm of a virtual museum through digitally recorded imaging. This notion of the adoption of digital images of collections of objects has transformed the nature of museum collections online to the public. The obvious controversy here is whether the digital reproduction of the original artifacts can directly represent their intrinsic meanings, cultural essences and historical context as well as in a traditional museum; although a greater depth of contextual information can be given when viewing them through a computer screen.

There are two key questions related to the migration of repository of physical artifacts into the realm of virtual environment: how meanings of a physical object are conveyed and interpreted in a virtual museum and what type of representational system are used to communicate information on cultural materials in a web based virtual museum. Tang (2005) states that, current digital museum projects reveal a wide variety of cultural materials as well as representational schemes adopted for their online display. Tang categorized these representational schemes into three semiotic modes as narrative-centered, object-centered and information-centered as displayed below:

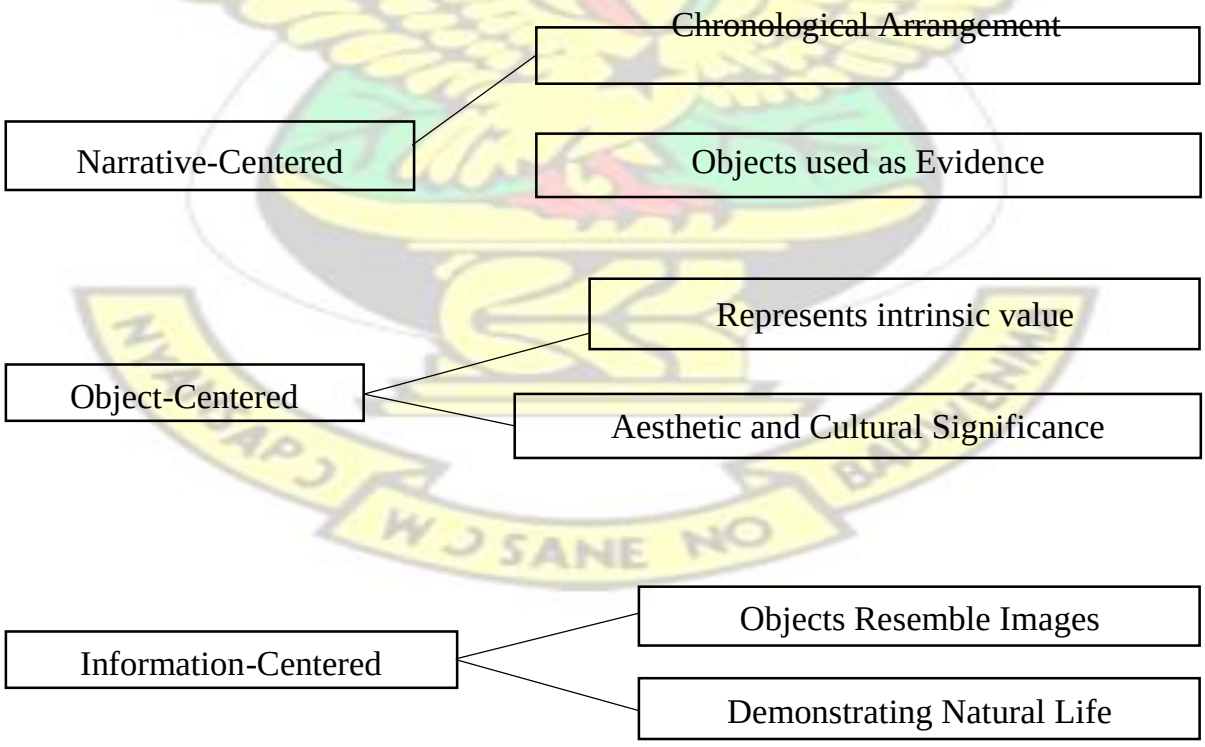


Figure 2.2: Representational Scheme of Web Based Museums

Source: adopted from Tang 2005

2.21.2.2 Cultural Theory of Heritage Preservation and the preservation of artifacts

In preserving artifacts, attention must be paid to the sources and environment from which the artifacts originated. This must reflect in the narratives and interpretation that accompany the artifacts (Faye 2003). Faye (2003), opines that it should be realized that, Western Models and Practices are not always effective for use in nonwestern cultural context. Kwame Nkrumah University of Science and Technology (KNUST) is situated in a peculiar environment. Even though the digital images are virtualized the cultural context must reflect in the way and manner in which they are preserved. The same principles must affect the rules of engagement.

2.21.2.3 Mutual Inquiry and virtual audience visits

The described type of learning is exactly what takes place in a virtual museum experience. The virtual visitor interacts with the system and through that constructs meaning for himself. Thus, the system allows virtual audience to discover knowledge by themselves out of their own curiosity (Werner and Myers 2008). The right-hand side of the diagram below provides insight as to what type of learning- takes place in the virtual museum as the audience visit. As they discover the exhibits by themselves, they as well construct meaning by themselves. Discovery learning subscribes to positivist belief about knowledge but it takes a dramatically different view about how this knowledge is acquired. Proponents of this position argue that people construct knowledge themselves; they come to realize concepts and ideas as they build them up using personal, mental constructions. Thus, they also can acquire misconceptions. Proponents of discovery learning believe that in order to learn, students need to have experience; they need to do and see rather than to be told. Rather than organize the subject matter based on its logical structure, from the simplest to the more complex, the teacher organizes it so that it can be experienced

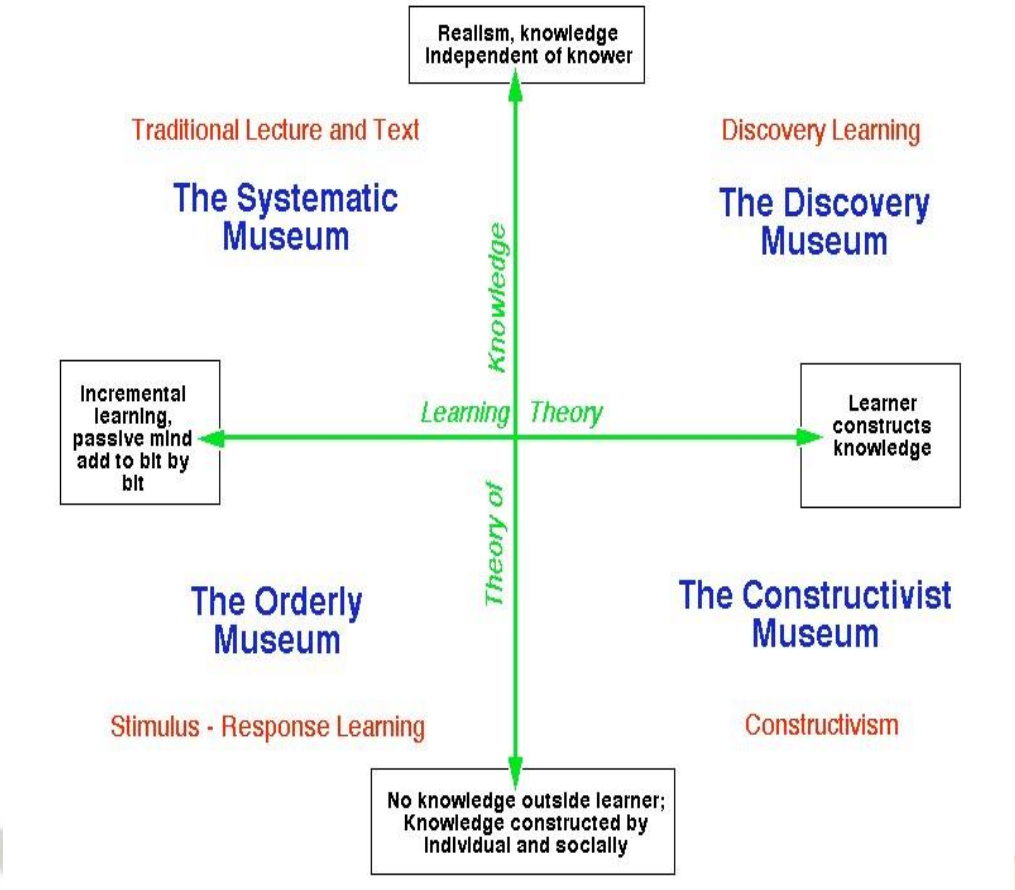


Figure 2.3: Learning Theory in the Museum

Source: Adopted from Hein G.E 1998

Pedagogic simplicity takes on a practical aspect rather than an intellectual one. But the purpose of this hand on approach is still for the student to comprehend ideas and concepts that are independent of the learner. Through experience, misconceptions will be replaced by correct conceptions.

'Constructivism' in the bottom right-hand corner, represents still another quadrant of the diagram. Constructivism argues that both knowledge and the way it is obtained are dependent on the mind of the learner as intimated by (Hein 1995). This view is based on idealist epistemology as well as developmental psychology, and in recent years supported by research in cognitive psychology. It comes as a shock to those who wish to preserve the idea of knowledge as independent of individual learners or communities of learners. It has been called radical constructivism. Proponents of constructivism argue that learners construct knowledge as they learn; they don't simply add new facts to what is known, but constantly reorganize and create both understanding and the

ability to learn as they interact with the world. Further, the knowledge that is constructed through this process is individual or social, but has no ontological status outside the mind of the knower.

CHAPTER THREE

METHODOLOGY

3.1 Overview

The study is pragmatic – inclined; an action research geared towards solving an institutional problem. Since the solutions of this study are based on what works, usefulness, satisfaction and reality, it did not hesitate to employ both categorical (qualitative) and numerical (quantitative) analysis of data when the need arose. It is situated in the advocacy type of research and focuses on KNUST as its main unit of analysis. Though, a quasi-proposal advocating for participation and action, the path to follow and the conviction of success have all been demonstrated. The study employed both induction and deduction throughout as it focused on KNUST as its sole case (case study). There is no intention to generalize as the study evolves from the I*nterpretivist* scheme of operation. Issues discussed in this chapter are research design, the 'ADDIE'

model, research approaches, research types, population, instrumentation - (data gathering instruments), how the data gathered was analyzed, justification of choices and ethical considerations

3.2 Research Design

A Research Design is sometimes described as a plan to collect and analyze data (Bell 1999). At other times, it is described as the framework for conducting research (Creswell 2012). In considering the semantics of the two concepts put together – *research*, and *design* one can say that it is a systematic and deliberate outline crafted to guide and direct resources and procedures during research investigations. The type of research design might depend on among other things the nature of the problem (s) to be investigated, the philosophy underpinning the research as well as the perspective with which the research activity is emanating from. This therefore suggests in totality that a research design could have basic common components such as philosophy, paradigm/perspectives, approaches, instrumentation, population and data analysis. The study under review is no exception and therefore has all the components enumerated above. The employment of each component has been justified at wherever they occur with the accompanying ethical considerations.

3.3 Support of the 'ADDIE' Model

The ADDIE Model is an instructional design methodology built around the steps of *analysis, design, development, implementation* and *evaluation.* It is similar to the 'Kirkpatrick' model in that it uses a structured process to evaluate training programs. While the concept of ISD has been around since the early 1950s, ADDIE first appeared in 1975. It was created by the Center for Educational Technology at Florida State University for the U.S. Army and then quickly adapted by all the U.S. Armed Forces (Branson, Rayner, Cox, Furman, King, Hannum, 1975; Watson, 1981). The analysis phase is the most important phase in the ADDIE model. It identifies areas requiring or needing training taking into account views of subject matter experts, the target audience, and the ultimate objectives and goals of the training. The procedures that were followed when creating the VIMU-KNUST for targeted audience were similar to those adhered to when others are creating training programmes, applications software and other web-based programmes. In each of the cases, the 'ADDIE' model serves as

a guide. As a standard procedure for creating new technologies and other software technologies, this model provided the technological guide within the conceptual framework throughout the creation of the VIMUKNUST. In brief, the analysis phase ushered in the beginning of the project. The definition of the targeted audience, what relics to assemble for demonstration and what type of virtual museum to create were all arrived at with the information gathered from the *analysis* phase as enjoined in the 'ADDIE' model. Requirements within the *design* phase guided the Technical Team to device the appropriate application to accommodate the collections. In order to fulfill the *developmental* stage, the selected relics were converted into images through photography. These were indexed, processed and arranged meticulously for viewing; just as is required by the *implementation* stage of the 'ADDIE' model. The created DEMO (VIMUKNUST) was then exposed to some purposively selected beneficiaries to interact with and give their comment as to the suitability of the facility in meeting their need. The comments expressed after *evaluation* provided a rich feedback to refine VIMUKNUST.

3.4 Research Approaches - (Mixed)

An approach is a way of dealing with something or somebody. A method is the process used or the steps taken to deal with an issue or a person. Research approach is a plan and procedure that consists of the steps of broad assumptions to detailed method of data collection, analysis and interpretation. It is therefore, based on the nature of the research problem being addressed, approach of data collection and approach of data analysis or reasoning. The most popular research approaches in research literature are quantitative, qualitative and mixed. Research problems can be dealt with by using any of these world views or a triangulation of the approaches in a single study. This advocacy research employed the mixed method. By definition, mixed method is a procedure for collecting, analyzing, and "mixing" or integrating both quantitative and qualitative data at some stage of the research process within a single study for the purpose of gaining a better understanding of the research problem (Tashakkori and Teddlie 2003). The rationale for mixing both kinds of data within one study is grounded in the fact that neither quantitative nor qualitative methods are sufficient, by themselves, to capture the design, development, implementation and evaluation of the virtual museum (VIMU-KNUST) being advocated for. When used in combination, quantitative and qualitative methods

complement each other and allow for a more robust analysis, taking advantage of the strengths of each (Green, Caracelli, and Graham 1989; Miles and Huberman 1994).

As intimated, the study is a research advocating for a project; a pragmatic study intended to solve an institutional challenge; a type of research which is action oriented. Such studies usually require the collection of both qualitative and quantitative data. This is what the researcher employed in order to create a virtual museum that meets the needs of anticipated beneficiaries. Regarding the relevance, knowledge and techniques required to create the *VIMU-KNUST* the researcher resorted to interviewing in order to ascertain these qualities. Themes in the preceding interview responses were used to design questionnaires to solicit for beneficiaries' preferences of the advocated virtual museum. The most appropriate research approach therefore is the *Sequential Exploratory Design;* as has been diagrammatically represented below.

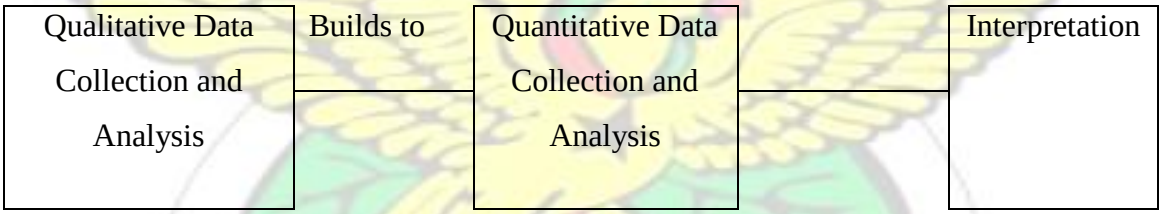


Figure 3.1: Sequential Exploratory Design.

Source: Terrell 2016

This design, implies collecting and analyzing qualitative and then quantitative data in two consecutive phases within one study. Such issues include deciding on the priority or weight given to the quantitative and qualitative data collection and analysis in the study, the sequence of the data collection and analysis, and the stage/stages in the research process at which the quantitative and qualitative data are connected and the results are integrated (Terrell 2016) Thus:

Qualitative and quantitative strands interact

Qualitative strand takes precedence

Qualitative strand precedes quantitative strand

The strands are mixed during data collection

This means that emphasis is placed on qualitative data that is collected first in the sequence of events and this qualitative data feeds into the design of questions to solicit for quantitative data. Cresswell (2014) has recommended that, in *Sequential Exploratory Design* quantitative data from random sampling should be created from the same purposive sample. However, Teddlie and Yu (2007) assert that it may be permissible, or desirable to take samples from different populations. The researcher therefore obtained qualitative and quantitative data from the same population.
Quantitative data was needed to explain qualitative data.

3.5 Why Premium is placed on Qualitative Approach

Stemming from an interest in thorough understanding of human behaviour, social scientists tend to use qualitative research aiming to accumulate a detailed account of human behaviour and beliefs within the contexts they occur in (Rubin & Rubin, 2005). Furthermore, with the use of non-numerical data, this line of research seeks to explore and describe the 'quality' and 'nature' of how people behave experience and understand. Further to linking people's actions to their beliefs, Brown (2005: 485) adds that "one of the great strengths often cited for qualitative research is its potential for forming hypotheses". As noted by Dörnyei, (2007: 132), qualitative data are 'most often' collected by researchers through interviews and questionnaires.

This is exactly what the researcher did in order to achieve Objective one which was to analyze stakeholder's perspectives on museum services in KNUST. The opinions, understanding, impressions and perceptions of the sampled respondents were the very data needed to address objective one. However, interviews -compared to questionnaires- are more powerful in eliciting narrative data. As a result, the interviews allowed the researcher to investigate respondents' views in greater depth (Kvale, 1996; 2003). In a similar vein, Cohen *et al* (2007: 29) add that interviewing is "a valuable method for exploring the construction and negotiation of meanings in a natural setting" This approach was followed in order to ascertain the interest and thinking of the sampled population to be able to create the best virtual museum for KNUST which in itself is a natural setting

3.6 Why the support of Quantitative Approach

From Babbie (2010) quantitative research focuses on gathering numerical data and generalizing it across groups of people or to explain a particular phenomenon. The process of measurement is central to quantitative research because it provides the fundamental connection between empirical observation and mathematical expression of quantitative relationships. In relation to the study, this approach enabled the researcher to determine the representativeness of the percentage population of registered students and staff at post that preferred the advocated *VIMU-KNUST*. This quantitative data complemented the interview responses which invariably explained why KNUST needed the virtual museum. The preference was based on the relevance of the virtual museum. Interpretation of the overall data gathered was generated from the synchronization of interview responses, questionnaire responses and observations of the Researcher.

3.7 Research Types

Apart from the broad categorization of research into two – basic and applied, research activity could be categorized based on among others, the aims, collection and analysis of data and sampling. Classification of research into types therefore depends upon the focus of the researcher. Categorizing research into types, focusing on aim could result in a basic or an applied investigation while the basic research's' aim is to develop knowledge, theories and predictions, applied research aims to develop techniques, products and procedures - all to either expand scientific understanding or solve a practical problem respectively. On the other hand, if the investigation seeks to find out how much is known about the research problem then the resultant type could be exploratory or explanatory. In that case, the exploratory will explore the main aspect of the research problem whiles explanatory will explain the causes and consequences of a well-defined problem. Again, if the aim is to examine exact theories to either develop new ones or test the existing ones, the resultant types of research could be inductive or deductive. When the emphasis is on new or old data collection, the research can be classified into primary or secondary, if the emphasis is on the analysis of collected data then one is likely to have qualitative or quantitative research type. While qualitative focuses on the interpretation of words and meanings, Quantitative focuses on the measurement of numbers and statistics. These two can be combined to arrive at a mixed research type like the study under review. More so,

when the emphasis is on the nature and behaviour of the variables, the research could be classified into descriptive or experimental. Descriptive identifies characteristics, patterns and correlations whiles experimental tests causal relationships between variables. Examples of Descriptive Research types include ethnography, phenomenology, grounded theory and case studies like the study under review. The common examples of Experimental or Analytic Research types include correlational, causal, comparative and action researches. As partially intimated early on the analysis, design, development, implementation and evaluation of a virtual museum (VIMU KNUST) requires the blend of research types in order to create a usercentered facility. This was the justification for the adoption of a mixed method focusing on the Sequential Exploratory Model.

3.7.1 Case study

Yin (1984:23), defines the case study research method "as an empirical inquiry that investigates a contemporary phenomenon within its real-life context; when the boundaries between phenomenon and context are not clearly evident; and in which multiple sources of evidence are used." Similarly, the present study is being investigated as a real-life situation at KNUST and multiple sources of evidence would be utilized in due course. Case study method enables a researcher to closely examine the data within a specific context. In most cases, a case study method selects a small geographical area or a very limited number of individuals as the subjects of study. As is evident in this particular study the geographical area is KNUST main campus. Case studies, in their true essence, explore and investigate contemporary real-life phenomenon through detailed contextual analysis of a limited number of events or conditions, and their relationships. The creation of a virtual museum is a quasiexploration and investigation of the contemporary need of KNUST through detail contextual analysis of a limited number of events or conditions and their relationships. The phenomenon being worked on now is a real problem in KNUST that needs to be solved. Although case study methods remain a controversial approach to data collection, they are widely recognized in many social science studies especially when in-depth explanations of a social behaviour are sought after. Case study research, through reports of past studies, allows the exploration and understanding of complex issues. It can be considered a robust research method particularly when a holistic, indepth investigation is required. Recognized as a tool in many social science studies,

the role of case study method in research becomes more prominent when issues with regard to education (Gulsecen and Kubat 2006), sociology (Grassel and Schirmer 2006) and community-based problems (Johnson, 2006), such as poverty, unemployment, drug addiction, illiteracy, etc. were raised. One of the reasons for the recognition of case study as a research method is that researchers were becoming more concerned about the limitations of quantitative methods in providing holistic and in-depth explanations of the social and behavioural problems in question. With the use of KNUST as a case, the researcher was able to go beyond the quantitative statistical results and understand the opinions of registered students and staff at post. By including both quantitative and qualitative data, the case study helped in explaining both the process and outcome of the advocated *VIMO-KNUST* through complete observation, reconstruction and analysis of the beneficiary's responses (Tellis, 1997).

Since case study method receives criticism in terms of its lack of robustness as a research tool, crafting the design of case studies is of paramount importance. Researchers can adopt either a single-case or multiple-case design depending on the issue in question. In relation to the study under review, the single case method has been adopted because there are no other cases available in KNUST for replication. However, the drawback of a single-case design is its inability to provide a generalizing conclusion, in particular when the events are rare. This drawback has no effect on this present study because the researcher has no intention of generalizing the outcome of the creation of a virtual museum. One way of overcoming this is by triangulating the study with other methods in order to confirm the validity of the process.

3.7.2 Advocacy

Advocacy Research is carried out with the intention of providing evidence and arguments that can be used to support a particular cause or position. Similarly, the entire study is to convince KNUST to create a virtual museum. Advocacy research is commonly carried out by pressure groups, lobby groups and interest groups (such as trade unions) and, occasionally, by political parties, journalists and academics (Catherine Hakim, Research Design, 2000). It could mean an activity by an individual or group which aims to influence decisions within political, economic, and social systems and institutions. Unlike medical research which is conducted to advance

knowledge of medical conditions and creates treatments. Advocacy research is conducted among others to learn new facts about something. An example is the demonstration of the fact that the creation of a virtual museum is not only an alternative strategy to exhibit KNUST's heritage but also an open educational resource for teaching, learning and research. The researcher is partly affected by the institutional problem under review and waiting feverishly for the translation of the advocacy into reality by the institution (KNUST).

3.8 Population

A research population is generally a large collection of individuals or objects that is the main focus of a scientific query. It is also known as a well-defined collection of individuals or objects known to have similar characteristics. (Polit and Hungler 1999: 37). All individuals or objects within a certain population usually have a common, binding characteristic or trait. It is for the benefit of the population that researches are done. Registered Students and Staff in KNUST main campus constituted the population for this study. As at writing - (2017/2018) academic year, the total population of KNUST was 49,022. This comprises registered 45,537 students and at post 3,485 staff.

3.9 Target Population

Target population refers to the entire group of individuals or objects to which researchers are interested in generalizing the conclusions (The Denver Foundation Report 2003). It was purposively selected. Target population usually has varying characteristics and it is also known as the theoretical population. For the study under review the target population was selected from the composition of the given total population. The target population of Students' consisted of 38,348 undergraduates and 7,189 post-graduates. The staff population comprised of 1,193 senior members, 1,269 senior staff and 1,023 junior staff. (KNUST: Facts and Figures 2018). The justification is that, KNUST was used as a case study. From Krejcie and Morgan's Formula, the summation figures are the representative sample from the targeted population. Those were the very numbers the researcher could reach. That is why it is being tagged as accessible population for want of a better word.

3.10 Accessible Population

The accessible population is the population in research to which the researchers can apply their conclusions. This population is a subset of the target population and is also known as the study population. It is from the accessible population that researchers draw their samples. All the respondents who were reached out either purposively or through convenience constituted the accessible population. Thus, students were 382 and the staff were 290 as could be seen from the Krejcie and Morgan sample derivation formular.

3.11 Sample and Sampling Techniques

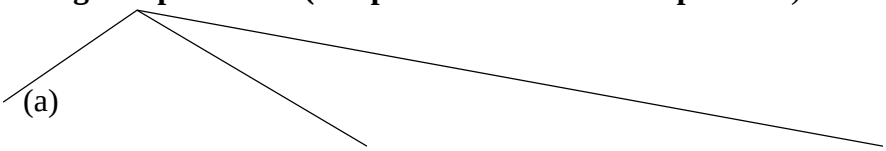
A sample is simply a subset of the population. The concept of sample arises from the inability of the researcher to test all the individuals in a given population. The main function of the sample is to allow the researcher to conduct the study to individuals from the population so that the results of their study can be used to derive conclusions that will apply to the entire population The study employed the mixed method approach; specifically using the *Sequential Exploratory Design* which has its own requirements. Cresswell (2014) has recommended that, in Sequential Exploratory Design quantitative data from random sampling should be created from the same purposive sample. However, Teddlie and Yu (2007) asserted that it may be permissible, or desirable to take samples from different populations. The researcher therefore obtained qualitative and quantitative data from different samples. Quantitative data was needed to explain qualitative data. The purposive sampling was adhered to in order to get relevant information for the study while the other respondents were reached out through convenience. Representative samples were derived from the components of the given population using *Krejcie and Morgan's Determination of Sample Formula.* This Method was used because the researcher had a given population to work with as illustrated below:

STUDENTS

Given Total Population

45537

Target Population – (components of the total Population)



(a) Undergraduates (38348) | (b) Masters (7189) | (c) Doctoral (534)

Sample derivation from a given population $\left(\frac{GP \times S}{N}\right)$

GP- Given Population

N- Population size

S- Sample size (Ranges gotten from the table)

(Source: The NEA Research Bulletin, Vol. 38 (December, 1960), p. 99)

Therefore:

a. Undergraduate $= \frac{3834 \times 381}{45537}$

Accessible Population = 321

b. Masters $= \frac{7189 \times 367}{45537}$

Accessible Population = 58

c. Doctoral $= \frac{534 \times 226}{45537}$

Accessible Population = 3

Summation of Accessible Population for Student is

a + b + c

321 + 58 + 3

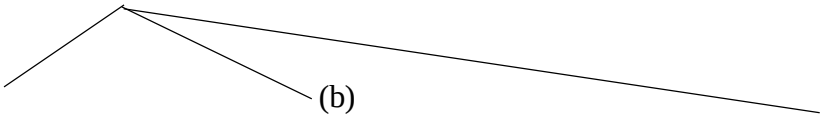
= 382

STAFF

Given Total Population

3498

Target Population – Components of Given Total Population



(b)	(a) (c)
Senior Members (1192)	Senior Staff (1269)	Junior Staff (1023)

Sample derivation from a given population $\left(\frac{GP \times S}{N}\right)$

Therefore:

(a)Senior Members

$$1193 \times 2911023$$

$$34983498$$

= 99

(b) Senior Staff

$$\frac{1269 \times 297}{3498} \times 285$$

= 108

(c) Junior Staff

= 83

Summation of Accessible Population for Staff is

(a) 99 + (b) 108 + (c) 83 = 290

3.12 Data Gathering Instruments and administration

Data refers to any kind of information researchers obtain on the subjects, respondents or participants of the study. In research, data are collected and used to answer the research questions or objectives of the study. Data collection is the process of gathering and measuring information on variables of interest, in an established systematic fashion that enables one to answer stated research questions, test hypotheses, and evaluate outcomes. It enables a person or organization to answer relevant questions, evaluate outcomes and make predictions about future probabilities and trends. Different methods are used in qualitative research. The most common are interviews, focus group discussions, observational methods and document analysis. Combining two or more data collections methods, for instance interviews as well as focus groups ('data triangulation') enhances the credibility of the study. Methods of quantitative data collection and analysis include questionnaires with closed-ended questions, methods of correlation and regression, mean, mode and median and others. For the study under

review, both qualitative and quantitative methods were needed to complement each other to enhance the credibility of the study as a feature of data triangulation (Yin, 2014). More especially, as KNUST was used as a case study, the investigations required multiple data collection techniques and data were collected from multiple sources as evident in subsequent descriptions.

3.12.1 Interviews

Interviewing, Dörnyei (2007) argues, is 'a natural and socially acceptable' way of collecting data as it can be used in various situations covering a variety of topics. In line with this, as recommended by various researchers (e.g. Bell, 1987; Kvale, 1996; Berg, 2007), interviewing should be adopted as a tool for social research as it facilitates obtaining 'direct' explanations for human actions through a comprehensive speech interaction. Accumulating such meanings can be done in various ways, of which one-on-one interviews are the most common. The usefulness of interviews has long been recognized. In a similar vein, Kvale (1996) interestingly points out that, as such events are not often directly 'observable'; talking to people would be one of the most effective methods for attaining and exploring such constructs. More specifically, as interviews are interactive, interviewers can press for complete, clear answers and can probe into any emerging topics. Hence, interviewing is expected to broaden the scope of understanding investigated phenomena, as it is a more naturalistic and less structured data collection tool. Interviewing has 'usually' been thought of as a key factor in research design (Weiss, 1994). Guided by this characteristic of interview, some purposively sampled administrators of KNUST, and randomly sampled students and lecturers were interviewed at the same time. This was done because the researcher intended to have an in-depth information about the perception of administrators, students and lecturers on the existing museum services in KNUST of whose outcome necessitated the advocacy for the creation of a virtual museum (*VIMO-KNUST*) for KNUST. The structured interview was used to ascertain opinions on the existing museum services in KNUST. Respondents answered the same questions in the same order. The researcher was guided by the following themes: category of respondents; awareness of KNUST museum; and probable causes of low patronage and relevance of the museum (***as could be referred to from the interview guide in appendix A.4***)

3.12.2 Questionnaire

McLeod (2014) indicated that questionnaires can be thought of as a kind of written interview. They can be carried out face to face, by telephone or post. Questions have been used to research type A personality (e.g. Friedman & Rosenman, 1974), and also to assess life events which may cause stress (Holmes & Rahe, 1967). Questionnaires provide a relatively cheap, quick and efficient way of obtaining large amounts of information from a large sample of people. This is however not the intent of this study rather the questionnaire was used to supplement data from other sources. Data can be collected relatively quickly because the researcher would not need to be present when the questionnaires were completed. This is useful for large populations when interviews would be impractical. However, a problem with questionnaire is that respondents may lie due to social desirability. Most people want to present a positive image of themselves and so may lie or bend the truth to look good. Questionnaires can be an effective means of measuring the behaviour, attitudes, preferences, opinions and intentions of relatively large numbers of subjects more cheaply and quickly than other methods. Informed by these elements in questionnaire administration, the Researcher administered the questionnaires randomly to Students but distributed the rest to purposively selected Staff. The questionnaire had both close and open-ended questions. The closed questions were intended to solicit definite answers. They restricted respondents to quantities and technical information. The open – ended ones allowed respondents to express their own opinions freely. The respondents needed to express their opinions well enough towards the proposed project. The open-ended questions provided respondents the opportunity to do just that. What this meant was that both quantitative and qualitative data were obtained in the long run. A postscreening questionnaire was further administered on the purposively selected staff. The pre-screening questionnaire covered the demography of respondents, knowledge on virtual museum, preference for virtual museum and reasons for their choices (***as found in appendix A.1-A.3***).

With some questionnaires suffering from a response rate as low as 5% it is essential that a questionnaire is well designed. Against this backdrop the researcher made sure that all questions asked addressed the aims of the research. The questions were short clear and straight to the point in order to make them appealing. The researcher run a small-scale practice study to ensure respondents understood the questions. They were

accompanied with professional, clear and concise instructions. Respondents were assured that their responses would be kept confidential. Again, some UITS staff verified the suitability of the questions before their administration.

3.12.3 Observation

Observation is the systematic look, recording, description, analysis and interpretation of people's behavior (Bernard 1998). This method can be loosely or tightly structured with precise coding methods of behavior patterns. It is good at explaining what is going on in particular social situation, and is particularly useful for researchers working within their own organizations. As has been indicated already the researcher is part of the organization and therefore could not afford to overlook this useful data gathering tool. Besides, this data gathering instrument afforded the researcher the opportunity to experience for real the emotions of those who would be beneficiaries of the proposed project. Haven monitored the efforts made by the KNUST to establish a museum, following the disinterestedness shown by students and staff in the once established museum, and looking at the trend of information seeking behavior of students and staff in the libraries of KNUST; as a librarian, the researcher became convinced that students and staff prefer electronic information to manual types. Practically, within the KNUST, students and staff rely heavily on electronic information. As part of meeting such a need as a university the researcher envisages that a virtual museum could be one of the best ways to meet such a demand. This observed situation provided the researcher the impetus to strongly advocate for the creation of a virtual museum to enhance access of KNUST's heritage. The researcher observed the described situation from afar, the participants were not aware that they were being observed.

3.13 Informed Consent

Informed Consent is a voluntary agreement to participate in research. It is not merely a form that is signed but is a process, in which the subject has an understanding of the research and its risks. Informed consent is essential before enrolling a participant for a research study. Informed Consent must be obtained for all types of human subjects in research including; diagnostic, therapeutic, interventional, social and behavioral studies, and for research conducted domestically or abroad. Obtaining consent involves informing the subject about his or her rights, the purpose of the study, the procedures

to be undergone, and the potential risks and benefits of participation. Subjects in the study must participate willingly. Vulnerable populations like Prisoners, children and pregnant women, must receive extra protections. The legal rights of subjects may not be waived and subjects may not be asked to release or appear to release the investigator, the sponsor, the institution or its agents from liability for negligence (Office for the Protection of Research Subjects (OPRS –USC 2013). For the study under review, series of permission were sought especially before some pictures were taken. The purpose of questioning and interviewing were all explained to the respondents before execution. Neither was any participant forced nor coerced to participate in the study.

3.14 Confidentiality

Confidentiality is the protection of personal information. Confidentiality means keeping a client's information as secret as possible and not telling others including coworkers, friends, family, etc. Confidentiality is important for several reasons. One of the most important elements of confidentiality is that it helps to build and develop trust. It potentially allows for the free flow of information between the client and worker and acknowledges that a client's personal life and all the issues and problems that they have belong to them **(**Polit, and Hungler, 1999). This was the same principle that was applied during the research. In order to provide anonymity for all respondents, their names were not solicited in any of the interaction. Even where their opinions were reported in the text, their identities were shielded. Respect for respondents' confidentiality and staff personal information was treated as a high priority throughout the investigations (Protecting Confidentiality and Anonymity/Institutional Review Board 2017)

3.15 Types of Data

Primary Data encompassed data from interviews, questionnaires, observation, designed 'demo' photographs and video recordings. Secondary Data included information gathered from magazines, journals, and text – books, KNUST Annual Reports, Newspaper and Internet resources.

3.16 Data Analysis

Data from both primary and secondary sources were assembled, analyzed, interpreted and conclusions drawn from them. Thus, per the demands of the research design

chosen, thematic and descriptive analysis of data were triangulated as and when the need arose. Thematic/Content analysis concentrated on data derived from observations and interviews. These were grouped into common themes and were further synthesizes to determine patterns and meaning- all based on the context within which they were used. Analyzing data from museum assessment responses was done thematically, unlike data from DEMO review responses, which was done descriptively. As mentioned, descriptive statistics was employed on data derived from survey responses. These were converted into numbers and further translated into simple frequencies and percentages to elicit meaning and outcomes. As a way of knowing some measures of central tendencies their mean and standard deviation were also derived. For better clarification and understanding, these were graphically represented in Pie Chats and Bar Graphs.

3.17 Validation and reliability of instruments

Key indicators of the quality of a measuring instrument are the reliability and validity of the measures. The process of developing and validating an instrument is in large part focused on reducing error in the measurement process. Reliability estimates and evaluates the stability of measures, internal consistency of measurement instruments, and interrater reliability of instrument scores. Validity is the extent to which the interpretations of the results of a test are warranted, which depends on the particular use the test is intended to serve (Kimberlin and Winterstein 2008). Prior to the administration of questionnaires for this project, selected personnel from KNUST Information Technology Services (UITS) were consulted to vet the questions to ensure that all the queries were accurate. They also scrutinized the DEMO Review Questions to certify that they were consistent with what pertains elsewhere. All these were done to ensure that information obtained from the data gathering instruments were valid and reliable. Undertaken such an exercise is a crucial component of research quality.

3.18 Appropriateness of Research Methodology

The nature of the research problem under review was such that both qualitative and quantitative data were needed to complement each other to create a virtual museum that meets the needs of anticipated beneficiaries. Since participants and the beneficiaries were not independent during the study and the fact that equal emphasis was not placed

on the two types of data collected, the use of the convergent design method was not appropriate. The most appropriate method however was the Sequential exploratory design. This was because emphasis was placed on qualitative data that was collected first in the sequence of events and the fact that qualitative data fed into the design of questions to solicit for quantitative data. Such designs are usually employed when the nature of the problem is such that mixing research approaches becomes unavoidable. Moreover, the pragmatic nature of the research permits such triangulation of methods.

CHAPTER FOUR

PRESENTATION AND DISCUSSION OF FINDINGS

4.1 Overview

This chapter presents and discusses the findings from data gathered from the various data-gathering instruments mentioned below. These were meant to achieve the three objectives that drove the entire study. Thus, analyzing the state of museum services in KNUST, designing, developing, implementing and evaluating the suitability of *VIMU-KNUST* to enhance access to KNUST's heritage. The investigations required reviewing past documents on the state of KNUST Museum, measuring the responses of purposively selected respondents to questionnaires, conducting additional survey on sampled students and staff to confirm initial survey results for pragmatic purposes, soliciting opinions through interviews, scrutinizing published information and buttressing all with the researcher's own past and present observation. The Procedures followed lent its support from the 'ADDIE' model.

4.2 Objective 1: Analysis of Stakeholder's Perspectives on Museum Services in KNUST

KNUST since its establishment in 1952 has created and continue to create a number of artifacts worthy of global appreciation. These have originated from the six colleges of the university of which the College of Art and Built Environment, College of Engineering, the College of Agriculture and Natural Resources have made unsurpassed contributions. The remaining three colleges – Colleges of Science, Health Sciences, Humanities and Social Sciences have also made appreciable inputs to the repertoire of

artifacts created in the University. The University has tried, but to no avail, to assemble some of these collections at one place and exhibit them to the public.

KNUST had a vision to build a state –of –the – arts museum to host past, present and future inventions of the University. This was completed and commissioned in 2006 as evidenced in ***Plate 4.1***

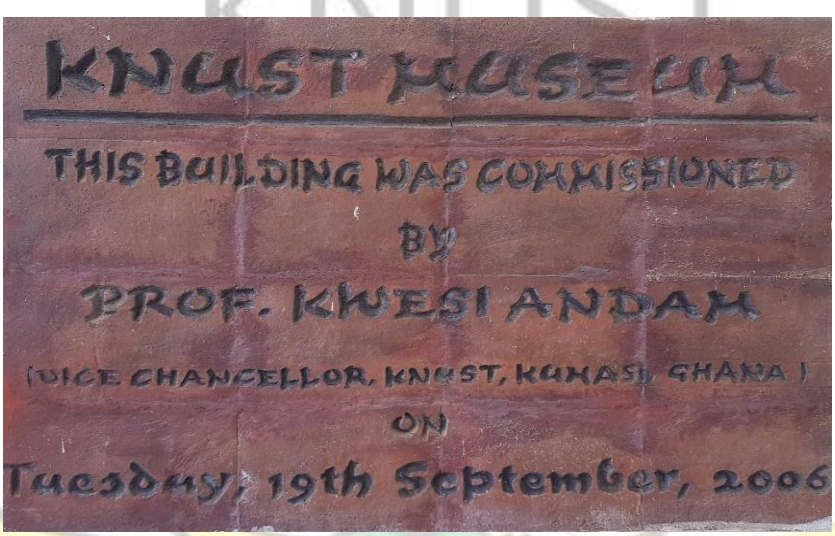


Plate 4.1: The Commissioning Plaque - Opoku Ware II Museum

Source: Photographed by the Researcher 2018

After seven years of hanging it finally folded up and since 2012 half of the edifice is being used as business incubator as can be seen from ***Plate 4.2***.

Plate 4.2. The New Museum Block - Opoku Ware II Museum, frontal view

Source: Photographed by the Researcher 2016

The concern here is that, the initial strategic planning, the efforts of assembling artifacts and the huge financial investment made so far should not go down the drains. As asserted by Schweibenz (2004), apart from monitory gains, projection of institutional excellence, preservation of institutional heritage, the contribution of a museum to teaching, learning and research can also not be overemphasized. A re-look at the Project was therefore an imperative.

4.2.1 Assessment Strategies on Museum Services at KNUST

The assessment employed documentary reviews, structured interviews, observation and the administration of questionnaire.

4.2.1.1 Observations

Upon a visit to the old museum block in 2016, it was observed that - the dedicated building was dilapidated and surrounded by overgrown weeds; the place had been closed down for a couple of years. The roof had caved in, most of the louvre blades had broken and there was this old automobile: made by KNUST competing with weeds for space beside the old museum block.

Plate 4. 3a: Exterior view of the automobile Plate 4.3b Interior view of the automobile

Source: Photographed by the Researcher 2016

Surprisingly, the situation at the new museum block -OPOKU WARE II MUSEUM was also nothing good to write home about. Half of the Block had also been rented out for Business Incubation; the remaining half accommodated some exhibits, which were in disarray and were deteriorating at a faster rate; the exhibits in the galleries were haphazard; the galleries were unkempt; and there was nobody around to talk to meanwhile the galleries were not locked. The site is strategic, the building is beautiful,

the architecture of the galleries is exquisite but the place had not been visited by patrons for couple of months.

4.2.1.2 Documentary Review

4.2.1.2.1 Introduction

The futile efforts made so far by KNUST in her bid to establish a museum was ascertained from the strategic framework documents. These documents were retrieved from KNUST Official Museum File No.108 in May 2017. A thorough study of the document indicated that a Committee was empaneled to craft a strategic framework for the project. The Committee started collecting artifacts in the dedicated building pending the completion of a new state –of –the – arts museum. The envisioned edifice; OPOKU WARE II MUSEUM was completed and commissioned in 19th September 2006. Attempts were made to transfer the few collections from the old museum building to the new edifice but nothing was done again to operationalize the project. Successive administration could not continue the project. The names of Committee Members tasked to undertake the project are withheld for ethical considerations. The content of these documents is being paraphrased here for the sake of analysis.

4.2.1.2.2 Draft Statement of Intent

This statement specifies inter alia that the KNUST Museum is being established to fulfill a core responsibility to educate and create awareness about the significance of and the need to conserve and preserve the natural and cultural heritage of KNUST and its immediate environment (Ashanti Region), the nation Ghana and also the African Continent. The Museum was going to be housed in the now completed edifice located in the prime area (The Commercial Hub of KNUST) main campus. It was going to be accessed by community members as well as visitors from outside KNUST. The Museum planned to establish satellite preservation and conservation labs/sites within the various colleges, faculties and departments of KNUST. The Museum sought collaboration with UNESCO, ICOM and Tropenmuseum-Netherlands

In brief the Framework included the proposed museum's vision statement; mission statement; core values; objectives; activities (collections, exhibitions and outreach); management; finance; performance measurement and reporting commitment to achieve intent. The following background information to the draft statement was obtained that:

- KNUST Museum Board was inaugurated on November 6, 2004.
- The Board was replaced with an interim committee which was inaugurated in December 2, 2005.
- The Interim Committee prepared the grounds for a permanent board to be established to manage the KNUST Museum which was under construction.
- A Team was constituted to brainstorm on the essential things required for the operationalization of the Museum.

4.2.1.2.3 The Nature and Activities of the Museum

The document specified that: the KNUST Museum was going to be a Museum of Art, Science and Technology. It was going to be a Regional Centre for the preservation and conservation of antiquities for Africa (Regional Laboratory). It was going to be on its own and be centrally managed independent of any college department or faculty. Colleges, Faculties and Departments could have their own satellite museums where they could keep and display their collections. The activities of the museum, were all going to be based on c*ollections* (from KNUST, Ashanti Region, Ghana and Africa. It will cover the Past, Present and Future), *exhibitions* (These would be organized at the museum. It will be an annual affair. Faculties and Departments interested would be required to mount their exhibitions) and *outreach* (Informative, Educational and Entertainment Programmes for schools and communities within its catchment area would be organized)

4.2.1.2.4 The Management Structure of the Museum

The management structure specified that, the Museum was going to be regarded as multi-disciplinary and intercollegiate academic unit seen as the third component of the KNUST Intellectual Repository – (Library, museum and future Archives. It was going to have two-tier management structure; KNUST Museum Board and KNUST Museum Management Committee. The Board will be responsible for external linkage, policy

formulation and providing strategic direction for the Museum. The Management Committee will be in charge of the general administration, operations of the Museum programmes and acquisitions, fund-raising, budgeting, staff development and programme development.

The proposed composition of the Board and the Management Committee were as follows

- The Chairman to be appointed by the V.C
- The Director of the Museum
- Two representatives from academic board
- Representative from National Commission on Culture
- Representative from National Museum and Management Board
- Representative from National Museum and Monuments
- Two representatives from the community
- The Collections Manager in attendance and Secretary from general administration

4.2.1.2.5 International Partnerships

The document further proposed that friends of the Museum should be formed to support the programmes and fund-raising activities of the Museum. As far as international partnerships were concerned, the Museum was going to collaborate with *ICOM*- for technical support*; TROPICAL Museum* for Technical support and *UNESCO* for capacity-building Programmes. The Following staff were needed to start the project - *Director* to coordinate the proposed four sections; to be headed by Senior Assistant Curators/Conservators; The Heads would be assisted by two assistant curators each. The proposed sections were; (a) Art, Science and Technology (b) Natural History (c) Archeology and Education (d) Administration/Technical. However, because of resource constraints, it was recommended that the following core staff should be immediately appointed to kick-start the operations of the museum: *Collections Manager, Administrative Assistant, Accounts Clerk, and a Messenger/Cleaner.*

4.2.1.3 Interviews

In trying to find out why the museum project failed, some administrators, postgraduates, lecturers and other staff were purposively sampled for interviews. The conversation

covered the causes of the low patronage of the museum and the relevance of the museum; *(See interview guide in appendices A4).* Their responses provided an insight as to why the project crumpled within the shortest possible time; thus from 2006-2011. The analysis of their responses revealed these common themes as represented here. Below are a few transcriptions of the interviews:

4.2.1.3.1 Sampled Transcriptions

Three of the administrators who were interviewed had these to say when they were asked:

Why was the museum not operating after its establishment?

Admin 1:

"*I remember in 2006 when the then Vice Chancellor, Professor Kwesi Andam mentioned during congregation that KNUST will soon have a state- of – the-art-museum. I never heard anything about it again until I saw a new building being erected for that purpose. In fact, information about it was not widespread and I guess the trend of accessing electronic information these days by students and staff also might have accounted for its less patronage*."

Admin 2:

"These days, people want to sit by their computer and do everything they want to do. They want to shop, book reservations and even visit museums, libraries and archives online."

Admin 3:

"If you bundle data on your smart phone, there is nowhere in the world that you cannot visit. Even students and staffs could watch international football matches live online how much more visiting a museum. In any case, how many people can the building accommodate at a time? The world is moving towards electronic age and the University is bringing the world back to the manual age."

Three Postgraduate Students had these to say upon answering the same question of KNUST Museum.

Postgraduate 1:

"I have heard about KNUST Museum but I do not know where it is. Ah! Is it there? I am not sure it was completed. Anyway, I will not be surprised if it was established and users did not visit the place. They may as well not be aware like myself."

Postgraduate 2:

"We are doing everything with our laptops and mobile phones and would wish that the University helps us in that direction."

Postgraduate 3:

"Yeah! Yeah! I've seen the place and I've been there once but there was nothing there to appreciate."

Researcher: When was this?

"I don't remember but it was around 2015/2016. We enjoy appreciating traditional and older objects online than the manual visit where you would have to travel some distance and also pay some money."

Three of the lecturers had these to say upon answering the same question:

Lecturer 1:

"I don't know how they were operating. I for instance could only visit on Sundays or Saturdays after church and funerals respectively. My week days are so packed, how much were they charging? But couldn't they digitize the artefacts and upload them on the University website for us so we could access the exhibitions online?"

Lecturer 2:

"In this day and age, you don't expect people to be moving up and down to appreciate artefacts. How could the operators transport the plaque sited at the main entrance of the University? This object that serves as a Logo / Emblem of KNUST? It is too heavy, but an image of it could be captured and pasted on the KNUST website for appreciation."

Lecturer 3:

"*I heard about it and was waiting for further announcements as to the opening and closing hours as well as its fees."*

Other Staff members also had these to say:

Staff 1:

"If the University wants its members to patronize the museum, then, it should publicize it well like how they inform prospective students about new programmes. Some facilities do not need any advertisement like the hospital but a recreational centre needs it."

Staff 2:

"It's all about management. If they had managed it well it will still be functioning. I thought it was still functioning if you had not told me is folded up."

Staff 3:

"I think they are still there. Museums are not like financial institutions where people throng there in their numbers. May be occasionally the place will be busy. However, the University can make its members aware of the existence of such a facility and even provide some days that one can visit free of charge."

When the question on relevance was posed, two of the administrators expressed the following:

Admin 1:

> *"The collection of relics in a way determines the identity of an institution or a nation that is why all countries are building museums so the University is in the right direction*."

Admin 2:

> *"In order to keep the properties of the University for a longer period to show them to up-coming generations they need to be preserved."*

Upon answering the same question on relevance, two postgraduate students reiterated as follows: Postgraduate 1:

> *"The museum will conserve the items so that they don't spoil."*

Postgraduate 2:

> *"I know that, each item has a story attached to it and these stories tell something about the University. So, the history of the University for example will not be lost."*

While others were considering the preservation of the KNUST 's heritage, the lecturers were looking at the income-generation (though not a mandate of museums) potential of the Museum. They also saw the assemblage of items as a good teaching and learning materials which can be transformed as open educational resources (OER's). The other staff members also alluded to the monetary gain that the museum can provide. According to majority of them, the University will lose the initial investment if it does not sustain the service.

The responses were scrutinized and pervasive ideas were identified as themes that are common to the respondents. These were selected as common reasons for low patronage or common reasons for the relevance of the museum.

Table 4.1: Summary of Interview Responses

CATEGORY	NUMBER OF RESPONDENTS	DELAYED 0PERATIONS	RELEVANCE, COMMON REASON
Administrators	33	Prefer digital to manual Inadequate advertisement	Response to current trends in collections and preservation of local heritage of institutions and countries
Post graduate	19	Prefer digital to manual Poor management	Preservation of heritage
Lecturers	11	Operations hours results low Prefers digital to manual	Internally generate funds Open Educational Resource for Teaching, Learning & Research
Other staff	21	Inadequate Advertisements Poor management	Financial loss to KNUST if it is discontinued
Total	**84**		

Source: Generated from Interview Responses, 2018

4.3 Discussion of Findings

The following inferences upon reflections on the wobbling state of the museum could be made, that, probably, the operators were not given the needed funds to procure, assemble, compensate and install the required logistics to support the operations of the museum (Dierking J.F and Lynn D. 1992). The usual expectation of a running project is that, it must get better as the years go by; but this project remained dormant as the years passed. This situation warranted the hiring out of a part of the building for business incubation. This may suggest a lack of interest by successive administration as to the operation and sustenance of the project. It can also be conjectured that if the

beneficiaries had seen the value of the museum they would have advocated for its operation. As at reporting, the ground floor of the newly constructed museum edifice still bore the name OPOKU WARE II MUSEUM. Meanwhile there was no corresponding activity as such. The other floor which was hired out as Business Incubator was functioning briskly. Because the building is by the roadside, often than not community members especially foreigners are attracted by the name but they are deceived whenever they enter the edifice.

It was refreshing to note lately around September 2019 that, the right wing of the ground and first floor had been functioning. The place was even opened to the public before the Baffour Memorial Lectures in 2019. Official re-commissioning was to be held just before the COVID-19 pandemic. Furthermore, a committee was set up by the then Vice Chancellor: Professor Kwasi Obiri-Danso with the former Pro-Vice Chancellor: Reverend Professor Charles Ansah as Chair to look into revamping and expanding the museum. The Committee included representatives from the Development Office and recommendations were made to the University. The

Museum was hosting Peggy Appiah's collection donated by KNUST in the early 2000's. Two exhibitions had also been held. Again, a new and expanded designed has been proposed. The Museum also planned to relocate the Business Incubator when it becomes fully operational.

A critical review of the enclosed framework indicates that, the preparations made were solid, technical and administrative. The rationale for establishment was perfectly spelt out –thus to educate and create awareness on the importance of preserving natural and cultural heritage of KNUST. Targeted patrons had been identified, professional staff had also been earmarked, a state of- the- art museum edifice had been constructed and collaboration had been sought for, and a two- tier management structure had been created to manage it. The three main functions of the Museum of Art, Science and Technology –collections, exhibitions and outreach had all been enshrined in the strategic framework. What was left; was for the museum to start operations; but all these notwithstanding the museum project was yet to fulfill the aspirations of the planners. Juxtaposing the issues outlined in the strategic framework with best global practices one can say that as far as plans and policies and managerial considerations

were concerned, the framework was up to the task. However, the framework was silent about location, visitor access and building considerations which are also very crucial in the delivery of museum services (ICOMOS 2002).

Regarding the dormancy of the museum, and with reference to **Table 4.1**, the common reasons given by 33 administrators during the interviews were inadequate advertisement and the fact that the project type did not suit the preference of students and lecturers who are attune to digital information than manual type. Postgraduate students also alluded to the preference of digital information but added poor management as another reason. The common reason that permeated the responses of 11 lecturers were that the operational hours were not known and the manual type was not their preferred one. The 21 other junior staff interviewed reechoed inadequate advertisement and poor management as their common reasons. On the relevance of the museum, while the administrators viewed it as a response to current trends in collections and preservation of local heritage by institutions and countries, postgraduate students considered it as an avenue to preserve institutional heritage as advocated by Filippini-Fantoni 2003: Bowen and Filippini-Fantoni 2004. On the part of lecturers, it was a potential project to internally generate funds for KNUST. Again, it could have served as an open educational resource for teaching, learning and research. The other staff on the other hand opined that it is a financial loss to KNUST if it is discontinued.

As revealed from the analysis, the preference for a virtual museum stood tall among the various reasons expressed. “The idea of becoming virtual, might not be a pleasant one for some museums, but this development is inevitable because of the increasing digitization of cultural heritage and the demand to make collections more accessible (Schweibenz 2004)” This situation epitomizes exactly the preference of the respondents as seen from the table. As a result of the Internet and computer technology the form and function of museums is currently being renegotiated. The extension of physical museum space into networked virtual space allows for increased interaction between museum and audience. As a result, museums will need to rethink their traditional role and evolve into an information resource that links into an expansive, multifaceted network with other institutions. “Rather than thinking of ourselves as isolated institutions, we need to think of museums and our audience as nodes in a net of

connections" (Semper 2002, 3). This will mean redefining the boundaries of the traditional museum and creating alliances and relationships with other institutions.

The development and maintenance of a virtual museum is an ideal way to provide a student-centered constructivist learning environment. It allows students to make choices about what they want to study and provides meaningful topics that incorporate academics and culture while providing a way to get families and the community involved in their education (Parent, A. 1999). There are many examples on the Web today that demonstrate this powerful mixture of on-line technology and student learning. Virtual museums can be used to collaborate between classrooms, grade levels and even schools, since the Created Realities system is designed to support collaborative learning interactions. It could be possible to generate virtual museums using cultural artifacts or items and allow visiting students from other parts of the world to compare and contrast aspects of their research, heritage, or culture depending on the focus of the researcher.

4.4 Students and Staff Preference for a Virtual Museum

In order to confirm the conclusion arrived at from the assessment of museum services - for pragmatic purposes, a subsequent survey was conducted on randomly sampled staff and students on the preference of a virtual museum and the following were the results.

STUDENTS

Table 4.2: Academic Levels of Students

LEVEL	NUMBER
Undergraduates	299
Master Students	43
Doctoral Students	18
TOTAL	**360**

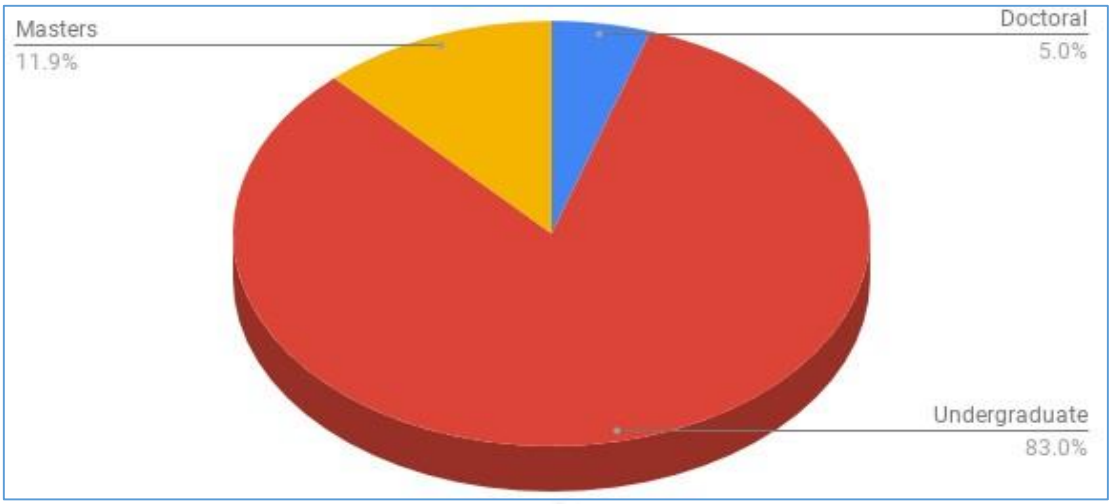


Figure 4.1: Academic Levels of Students

Source: Generated from Questionnaire Reponses 2018

The students were identified in three groups; Doctoral, Masters and Undergraduates to ensure homogeneity of analysis. As shown in **Figure 4.1** 299 undergraduates representing 83.0% of the population responded to the questionnaire while 43 master and 18 doctoral students representing 11.9% and 5.0% also responded to the questionnaire respectively. The fact on the ground is that undergraduate population usually exceeds the master students' population which in turn also outnumber doctoral students' population as exemplified here. These population differences are what has reflected in the percentages in the Pie Chart.

Table 4.3 Colleges of Students

COLLEGE	**NUMBER**
CoHSS	25
CABE	23
CoHS	23
CANR	124
CoE	124
CoS	41
TOTAL	**360**

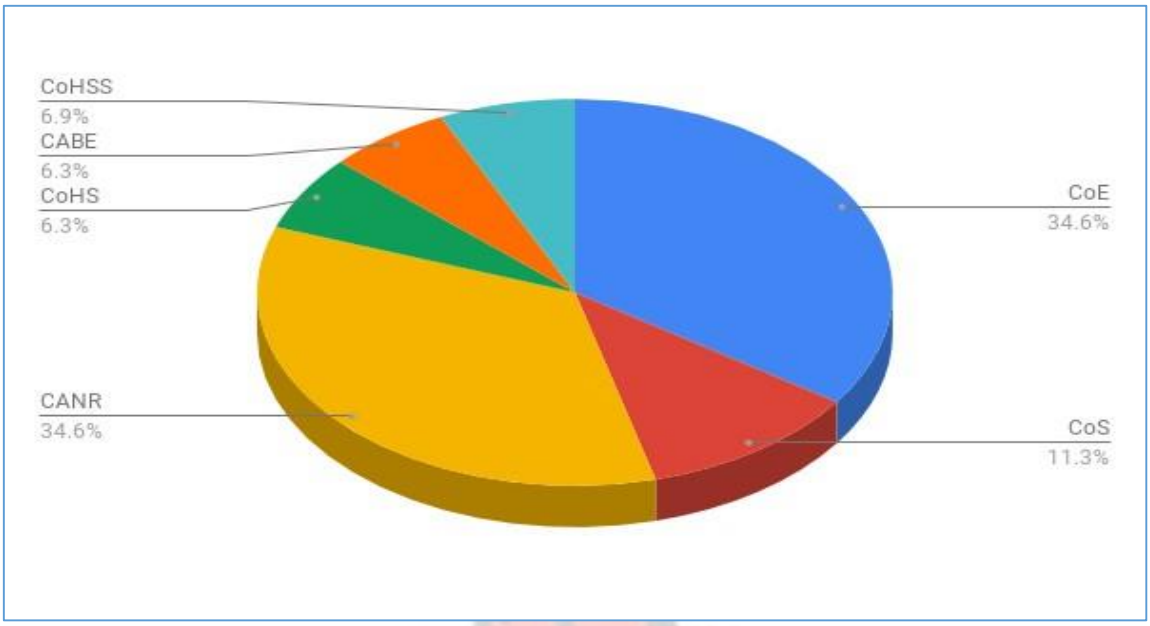


Figure 4.2: Colleges of Students

Source: Generated from Questionnaire Reponses 2018

Out of these, 124 students each representing 34.6% came from College of Agriculture and Natural Resources (CANR) and College of Engineering (CoE) respectively. The higher number of respondents registered at CANR and CoE may be attributed to the fact that, the questionnaires were randomly distributed to the respondents while in the libraries unlike the rest who responded to the questionnaires in the open. This is what reflected in the above Pie Chart. The idea behind this is that, students from each of the colleges partook in the survey even though they were not equally represented as evidenced in **figure 4.2**

Table 4.4 Student's Knowledge on Virtual Museum

YES	140
N/A	220
TOTAL	**360**

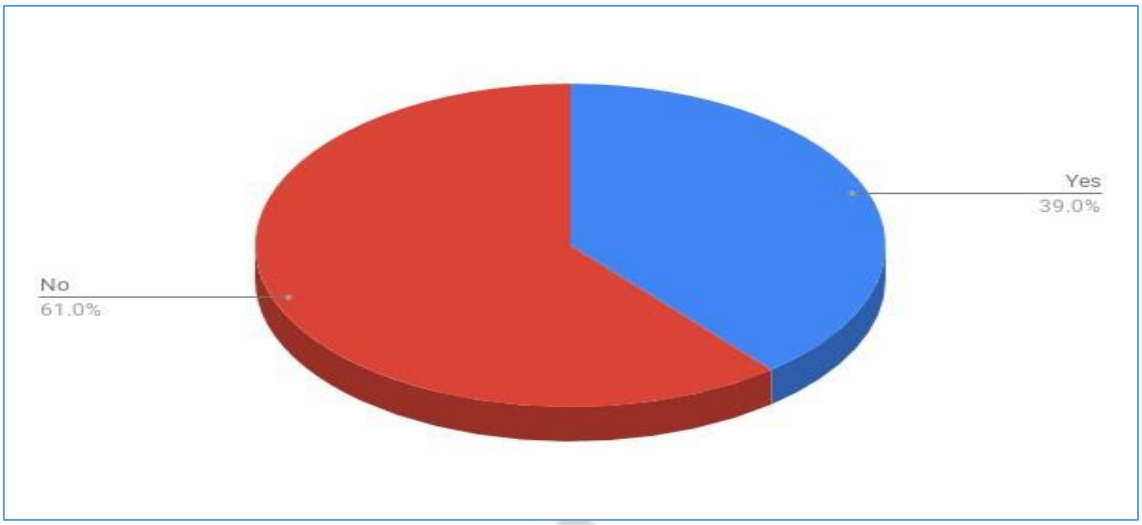


Figure 4.3: Students' Knowledge on Virtual Museum

Source: Generated from Questionnaire Reponses 2018

Logically one cannot recommend or give approval of anything for use if he/she does not have any knowledge about it. Virtual Museum being recent phenomenon and the fact that its use is not common in Ghana, it was not surprise that 220 students, representing 61.0% of the total population indicated their unawareness about such a resource. The questions that were posed (*See appendices A2&A3*) were such that if one had no idea or knowledge about a virtual museum, he/she could not answer the subsequent questions. The assumption was that once the person had no idea, he/she could logically not recommend it. Therefore, their responses were excluded from the analysis. It was only those who affirmed their knowledge about virtual museums who were permitted to answer all questions.

Table 4.5 Student's Preference for Virtual Museum

YES	140
N/A	220
TOTAL	**360**

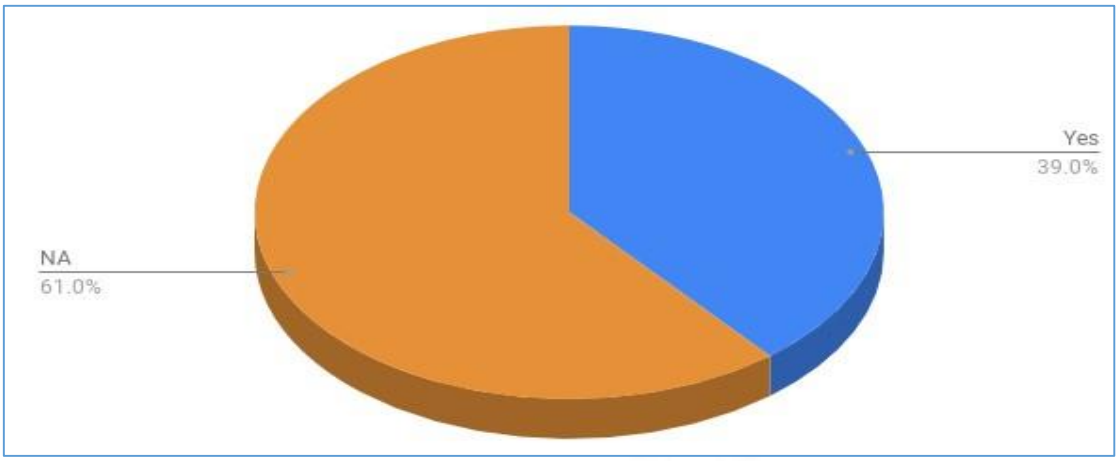


Figure 4.4: Students' Preference for Virtual Museum

Source: Generated from Questionnaire Reponses 2018

Amazingly and as shown **in Figure 4.3**, all 140 students (100%) who had knowledge about virtual museum "Yes" – (39%) recommended it for KNUST as confirmed in **Figure 4.4** with the following reasons.

Table 4.6: Reason for Students' Choices

Themes	**No. of Respondents**
Easy and quick access to information	8
Entertainment	10
Increase visibility of KNUST	20
N/A	97
Novelty of KNUST	4
OER for teaching, learning and research	36
Preservation of culture & heritage	18
Release pressure on traditional museum	2
Response to current technology.	10
Sources of income & employment	16
Total	**221**

Source: Generated from Questionnaire Reponses 2018

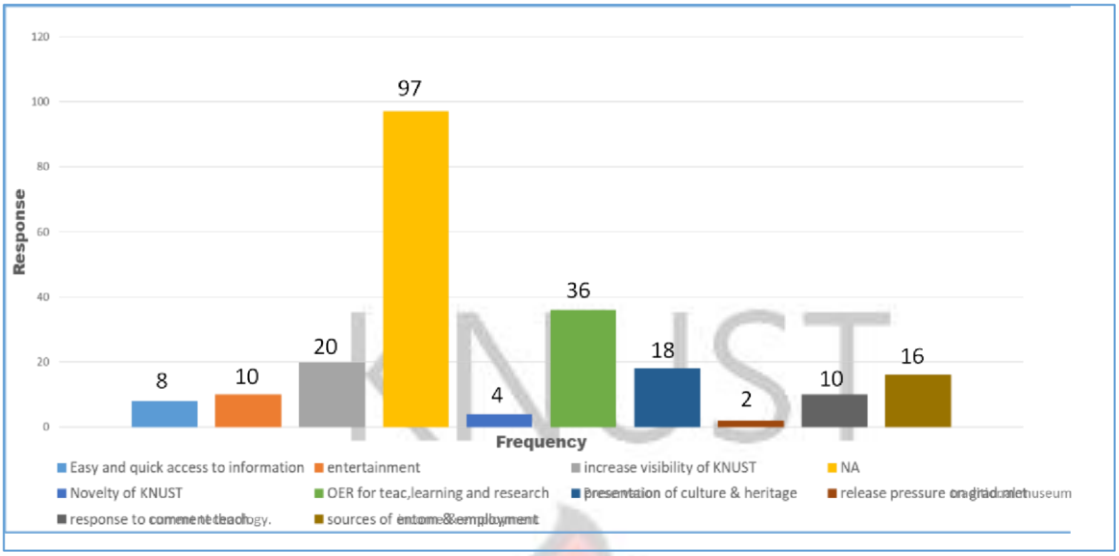


Figure 4.5: Reasons for Students' Choices

Source: Generated from Table 4.5 2018

As evidenced from the **Table 4.3 and its accompanying graph**, the most pervasive reason was that, the Virtual Museum will benefit KNUST as an Open Educational Resource (OER) for teaching, learning and research. Thus from 62 respondents out of 159 who had some knowledge about virtual museums, 18 of them shared the same opinion. Ten (10) respondents out of the 62 also opinionated that such a resource will increase the visibility of KNUST. The third most common reason given was that, the Virtual Museum will preserve the cultural heritage of KNUST. This opinionated benefit ties in well with Jackson et al., (2008) when they asserted that,

"The benefits of virtual museums are noteworthy as far as museum curators are concerned and in terms of documentation, conservation, research and exhibition. The virtual museums have the potential to both preserve and disseminate the cultural information in an effectively and at a low-cost through innovative methods and tools".

Majority of the respondents (97) had no knowledge about virtual museums and therefore were restricted from providing reasons for its acceptance in KNUST.

STAFF

Table 4.7: Staff Categories

CATEGORY	NUMBER
Junior Staff	80
Senior Staff	150
Senior Members	130
TOTAL	**360**

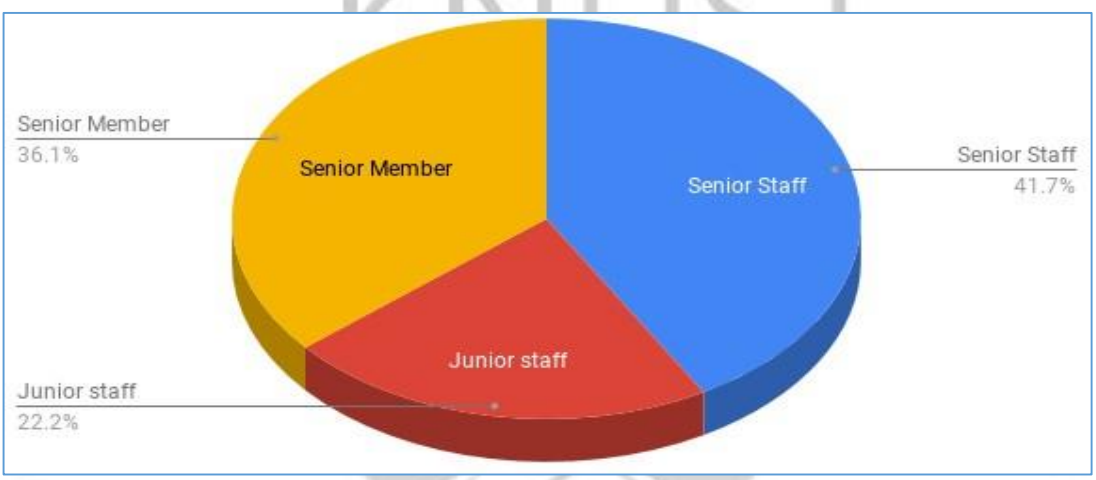


Figure 4.6: Staff Categories

Source: Generated from Questionnaire Reponses 2018

The Staff of KNUST are heterogeneous in nature – cleaners, security, drivers, caterers, nurses, doctors, laboratory technicians, lecturers, librarians, administrators, accountants, architects, lawyers, artists just to mention a few. In spite of the variety of the categories, and how many they are, each member belongs to one of the three broad stratifications; Senior Member, Senior Staff or a Junior Staff. It is possible for a member to move from one category to the other through promotion. In taking general university-wide decisions, the University does not gloss over the inputs from all categories. No transaction in the University can begin and end without the inter-play of the categories. It was therefore imperative to solicit their opinions as to whether the advocated resource (VIMU-KNUST) would be preferred by especially those who had some or deep knowledge of virtual museums.

Table 4.8: Staff Status

STATUS	NUMBER
Teaching	30
Non-teaching	330
TOTAL	**360**

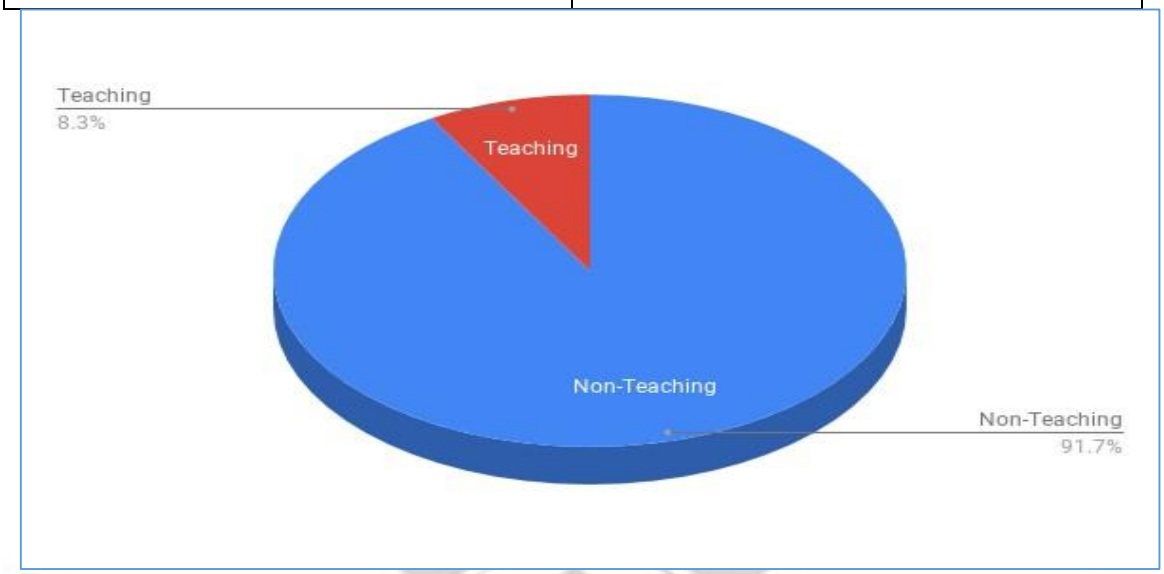


Figure 4.7: Staffs Job Status. (Source: Field Work, 2018)

Source: Generated from Questionnaire Reponses 2018

As described, the categories of workers are many but there was the need to homogenize them for data collection and analysis. As a result, all duties and functions were reduced to two statuses; *Teaching* and *Non-Teaching*. With this an opinion expressed could be related to the interest of one of them. As shown in the statistics, Senior Members are in the minority and most of the members who teach come from the same group; therefore, forming a small percentage 8.3% of the selected staff.

Table 4.9: Staffs Knowledge of Virtual Museum

YES	150
N/A	210
TOTAL	**360**

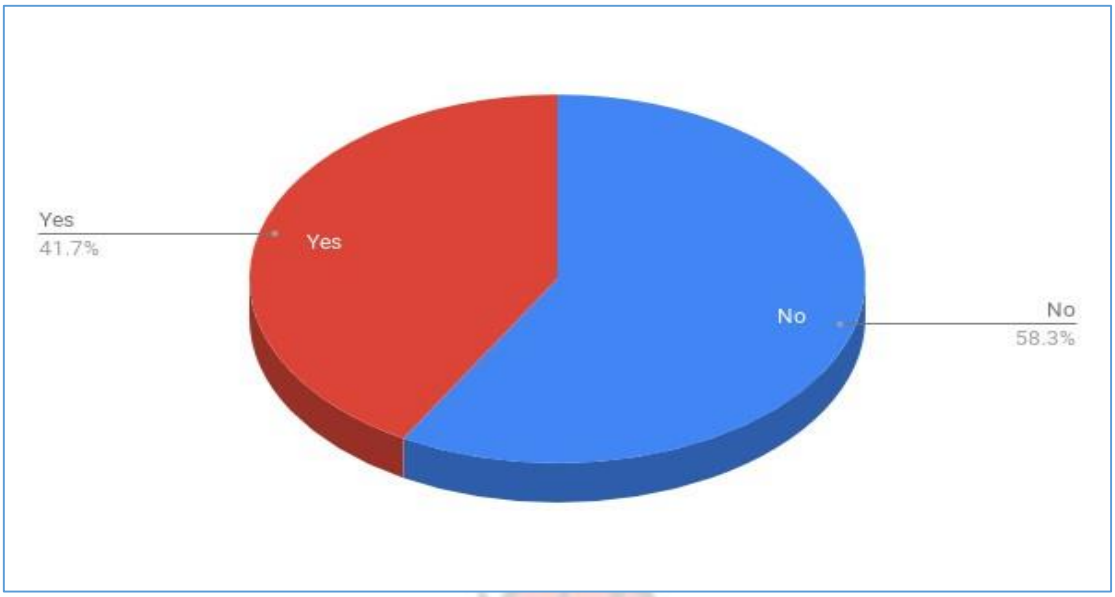


Figure 4.8: Staffs Knowledge of Virtual Museum.

(Source: Field Work, 2018)

Source: Generated from Questionnaire Reponses 2018

As recent a phenomenon, a virtual museum is, yet 41% of those sampled registered their awareness of the resource while 58.3% had no knowledge of it. This portrays a similar picture with the students though with slight percentage differences. A further enquiry at the back-stage revealed that those who were aware of virtual museums got the knowledge from either through reading or an encounter during electronic searches. To continue the survey a respondent had to be aware of the resource

Table 4.10: Staffs Preference of Virtual Museum

YES	150
N/A	210
TOTAL	**360**

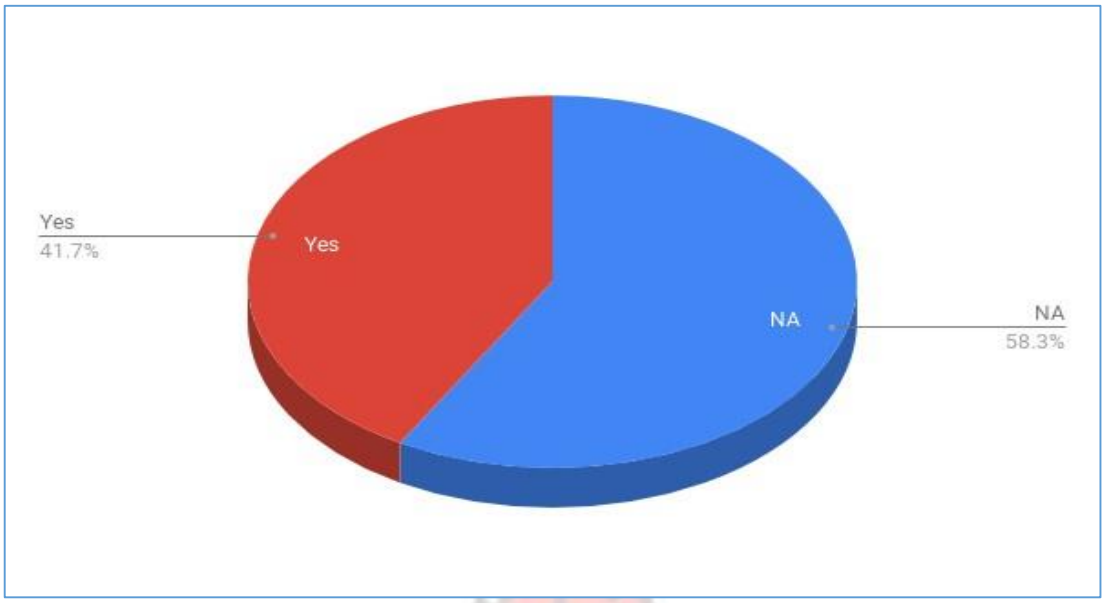


Figure 4.9: Staffs' Preference to Virtual Museum.

(Source: Field Work, 2018)

Source: Generated from Questionnaire Reponses 2018

Just like the Students pattern of choice, all staff who were aware of virtual museums – 41.7% commended it for KNUST and the reasons they gave are as follows:

Table 4.11: Reason for Staffs' Choices

Themes	**Number of Responses**
NA	14
Response to current technology	5
OER for teaching, learning & research	20
Easy & quick access to information	20
Sources of income, employment &tourism	25
Increase visibility of KNUST	30
Preservation of cultural heritage	5
Total	**119**

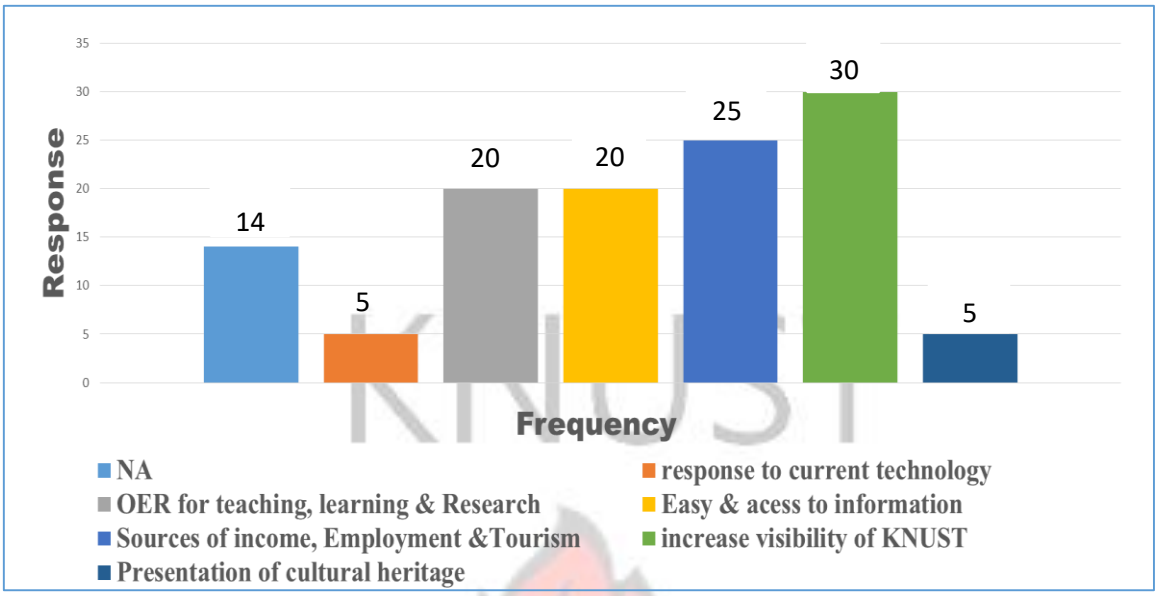


Figure 4.10: Staffs' Choices

Source: Generated from Table 4.9 2018

4.5 Discussion of Findings

Even though majority of the staff were aware and had recommended the acceptance of the virtual museum (VIMU-KNUST) they did not provide any reason for their choices. However, 36 of them indicated their reasons. Out of the 36 who provided reasons, 6 of them were of the opinion that the advocated resource will increase the visibility of KNUST while 5 saw the resource as a source of income, employment and Tourism Avenue for KNUST. Four (4) people each opined that the virtual museum will serve as an Open Educational Resource (OER) for teaching, learning and research and also for easy and quick access to information. As could be recollected from the review of related literature, these benefits synchronize well with Schweibenz (1998) when he defined "virtual museum" as a means to establish access, context, and outreach by using information technology. According to him the Internet opens the "virtual museum" to an interactive dialogue with virtual visitors and invites them to make a virtual museum experience that is related to a real museum experience.

Again, the Virtual Museum preserving cultural heritage was re-echoed. The other reasons given were that, it would be a response to current technology. This reason corroborates well with Styliania et al (2009), when they indicated that Museums are interested in the digitization of their collections not only for the sake of preserving the

cultural heritage, but to also make the information content accessible to the wider public in a manner that is attractive.

A critical look at the reasons provided by both students and staff reveal that they all agree to the same reasons because they all expressed the same reasons. The only odd reasons given were the fact that the resource would be a novelty for KNUST and release pressure on traditional materials. As revealed, the outcome of the assessment of museum services in KNUST, corroborated well with the subsequent preference survey from selected students and staff for a virtual museum. This situation provided the impetus to tackle objective 2.

4.6 Objective 2: Design, Development and Implementation of 'VIMU-KNUST' In order for these relics to be accommodated in a virtual space, they were converted into digital images through photographing. Assistance was then sought from professionals who designed, developed and implemented interactive application that can display the collected images in an organized multimedia formats to enhance access such that the audience could feel the same experience in physical museums if they visited the (*VIMU – KNUST*) site**.** As suggestive from the topic under review,
'*Virtualization of KNUST's Heritage: An Alternative medium To Enhance Access'* the emphasis is on virtual museum enhancing access to KNUST heritage. Even though enhancing access partly depends on the design, development and implementation of the application, the creation procedures are not highlighted like the enhancing access procedures. Therefore, the procedure involved in the creation of the resource is not as detailed as the enhancing access portions of the project.

However, the overview of the creation procedures is being outlined to assist readers to understand the flow of thought. But the fact of the matter is that the procedure for the creation of a virtual museum is an engagement of its own merit that requires expertise, time and resources. Such exercise encapsulates the detailed use of the 'ADDIE' model as briefly described in chapter three which encompasses analysis, design, develop, implementation and evaluation. A lot of activities go into each of the stages. Each of the stages has its own theoretical underpinnings.

4.7 Development - Selected Heritage for Demonstration

Guided by the conceptual framework, and with the employment of the first procedure (*analysis*) in the 'ADDIE' model, and for purposes of demonstration with the 'VIMUKNUST', some KNUST heritage were identified for collection. One artifact, historic building and interesting site were chosen for demonstration purposes respectively. With regards to the artifacts, the University Logo/Emblem was chosen. The rationale for selecting the University's logo/Emblem was that, the messages conveyed by the University Logo encapsulates the entire philosophy of the University. Therefore, an exposition of the logo provides insight as to the beliefs and core mandate of the University. The University Old Library (now Prempeh II Library) was picked as far as the historic buildings were concerned. The basis for the Library's selection was that, it is the heart beat of the University. The absence of the Library signifies the death of the University. This makes the Library so crucial and integral to the survival of the university. Regarding the Interesting Sites, the University Swimming Pool was selected. The motivation for this selection was to project the importance of recreation and leisure during teaching, learning and researching. After all, "All work and no play make Jack a dull boy……." Even though KNUST as a University has both tangible and intangible heritage the focus of the study under review is on some tangibles that can be seen, touched and appreciated readily for utilitarian purposes.

4.7.1 Artifacts

The Artifacts created consist of two basic categories of materials – organic and inorganic. Organic materials include those made from animal and plant products- fur, leather, wool, silk, bone, ivory, feathers, wood, paper, cotton and fibers. The inorganic artifacts are those made from nonliving materials such as metals, stones, ceramics and glass. They are mostly authored by students, lecturers and researchers. They encapsulate a variety of themes and concepts. Attempts have been made by the University to curate some for exhibition but to no avail. A chunk of these originates from the colleges of Art and Built Environment, Engineering, Health Sciences and Agriculture and Natural Resources. One major artifact is the University Logo whose components have been illustrated with the others as follows:

4.7.1.1 The KNUST Emblem/Logo

The Emblem of the Kwame Nkrumah University of Science and Technology is made up of the aesthetic arrangement of six distinct elements. These elements are relevant to the prime objectives of the University - Teaching, Research and Service to humanity. They are: A Pot of Fire, Calipers, a Golden Stool, an Eagle with outstretched wings, Green leaves, and a Slogan.

The Traditional Ghanaian Pot of fire, is placed at the top of the emblem with a pair of open calipers turned upside down and hooked to the sides of the stool on which is perched an eagle with outstretched wings. There are two green leaves, one under each wing of the eagle. There is a motif carved in the middle section of the stool called "Nyansapo" ("The Knot of Wisdom".) Beneath all these is a slogan "Nyansapo Wosane No Badwenma" ("The knot of wisdom is untied only by the wise".) The slogan is embossed on a banner folded artistically in three parts around the base of the stool.

The pot signifies the storehouse of knowledge. The flame represents the quest for knowledge which should be kept alive and burning always. The Calipers is tool which is used by a cross-section of scientists and technologists. It represents science and technology as the foundation or the cornerstone of the development and progress of the country. The Stool is the symbol of traditional authority, reinforcing the maxim: "Knowledge is Power". The stool consists of three parts - the seat, the middle portion with a motif and the base. The stool symbolizes the fact that the University is the highest level of the educational ladder. It also signifies the University's authority in science and technology in Ghana and beyond. The colour of the stool, gold, signifies the plethora of natural mineral resources of the nation. It also depicts the Golden Stool, the symbol of authority of the Ashanti nation, in whose capital the University is sited. The motif in the middle portion of the stool is called "Nyansapo", ("The Knot of Wisdom".) This underscores the University's status as the repository of knowledge and wisdom for untying intricate knots or problems.

The Eagle is the king of bird which soars gracefully higher and faster across the sky than all other birds. Eagles are also endowed with keen eyesight. This bird signifies the fact that the University has a wider and clearer view and understanding of the many problems confronting the country and the capacity to solve them effectively and efficiently. The eagle is decorated with a neck-band made of the colours of the national flag: red, yellow and green on which hangs a black star, indicating the national character of the University. Green Leaves stand for the land and its rich natural resources. The tree that produces these leaves is called "Adwunu". Leaves from the Adwunu tree are used for purification. The green leaves, therefore, also signify the purification of the minds of those who pass through this University. The Slogan "**Nyansapo wosane no badwenma"** *("The knot of Wisdom is untied only by the wise")* indicates the goal of the University which is to produce the highly skilled manpower required for the technological advancement of Ghana and Africa. *The Emblem*

Plate 4.4: KNUST Emblem

Source: Photographed by the Researcher 2018

4.7.1.2 The Statue of Dr. Kwame Nkrumah

The establishment of the University is an initiative of Dr. Kwame Nkrumah: the first President of the Republic Ghana. The University is named after him. The other relics surrounding the statute depict members in a jubilant mood celebrating the establishment of the University in a typical Ashanti Cultural Display. The drumming, dancing and the regalia worn are all symbolizing how happy the occasion is.

Plate 4.5: Statue of Dr. Kwame Nkrumah at the main entrance

Source: Photographed by the Researcher 2018

4.7.1.3 The Stool at the Main Entrance

The Stool is a symbol of authority thereby signifying that the University has authority in Science and Technology. Again, the Stool is the pride of the Ashanti Kingdom. The Asantehene who sits on the Golden Stool as the epitome of knowledge is the Chancellor of the University. In the Ashanti Tradition, knowledgeable people from the royal families among other criteria, are en-stooled as kings and queen-mothers. As one enters the University, the Stool reminds him that he has entered a place of knowledge and excellence.

Plate 4.6: The Stool at the KNUST (Main Campus) Entrance

Source: Photographed by the Researcher 2018

4.7.2 Historic Buildings

(*The source of information on historic buildings was gotten through a personal Communication with Professor Owusu Addo: An Architect and a Former Past Head of Department-Architecture, of KNUST, 1974-1988)*

In 1953, the Gold Coast Government employed a Consultancy firm -*James Cubits, Kenneth Scott and Partners* to survey and develop the architectural lay out of all Kumasi College of Technology (K.C.T) structures. Among the structures they constructed are the Engineering Workshops, Social Science Building, Pharmacy Block and some Staff bungalows at Okodee and Ring Roads. Notable among these was the Old Vice Chancellors' Residence. Unfortunately, the roofing and windows they fixed for the bungalows were not suitable to our environment. There were leakages whenever it rained and as a result their contract was terminated. The Consultancy Firm split and one of them; Kenneth Scott formed his own – *Kenneth Scott Associates.* This firm was later contracted to continue with the quantity surveying and architectural development of K.C.T. Williamson who became the new architect of the K.C.T did continue with the mandate. It was around this time that, the Independence, Queens and Republic Halls as well as the Asougya and Buroburo Roads were all constructed.

The Old Library Block, Agriculture Building, Architecture Studio Block and the Main Administration were all built around the same time. Until then the main administration was housed in Independence Hall. Below are selected historic buildings which are 50 years or above but are still being used for their original purposes. Some have undergone series of renovation since their construction in the late 50's and early 60's.

4.7.2.1 The Old Library Block

This Block was built in 1959. It began as a prefabricated structure around the then Institute of Mining and Mineral Engineering (IMME)-behind the present-day Jubilee Mart at Commercial Area. The design was an adaptation of the International Bauhaus style to suit the tropical conditions. The designs were also culturally sensitive; hence the *kente* motifs for the windows were preservation tools for the Asante Culture. It was moved to its present location in 1961 (Library Guide 2008) It is a three-story building with a technical, reference and administrative sections. It used to be called Kumasi

College of Technology Library but now it is called the Prempeh II Library. The Library was expanded with an adjoining new four-story spacious edifice which was officially opened in 2001. It has undergone several phases of renovation. Unfortunately, the expansion and renovation works did not factor the cultural ramifications of the older designs. A current renovation exercise is ongoing. The entire collections have been re-arranged, the seating architecture have been reengineered while reading and office spaces have also been given a phase lift. Signage has been enhanced, surveillance and security gadgets nicely installed and a host of others.

Plate 4.7: Old Library Block (January 1959)

Source: Photographed by the Researcher 2018

According to Mr. Osei Bonsu: a former Acting University Librarian (1999 -2000), the Library started with initial collections of 250 titles covering Engineering (general), Commerce (general) and general reference materials like dictionaries and encyclopedias and atlases. These were ordered from London and an augmented few transferred from Achimota College in Accra, Ghana where the 200 students who formed the nucleus of the starting student population were also transferred from. Chronicling from the past, the following managers have superintended over the Library *(As retrieved from a tile of photographs showing succession of past librarians from the University Librarians Office, 2018)*

Plate 4.8 G. M. Pitcher (1958 – 1978)

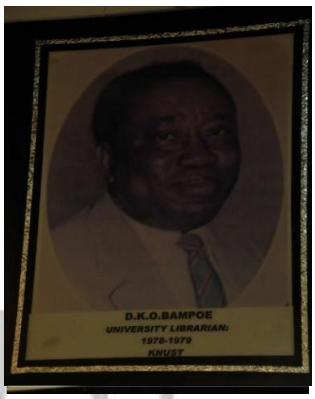


Plate 4.9: D. K. O. Bampoe (1978 -1979)

Plate 4. 10: S. P. H. Dove (Ag.) (1979 -1981)

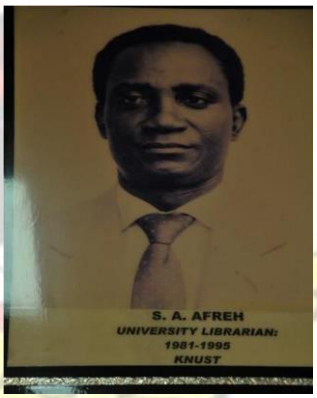


Plate 4.11: S. A. Afreh (1981 -1995)

Plate 4.12: G. E. Addo (1995 -1999)

Plate 4.13: M. Osei- Bonsu (Ag.) (1999 – 2000)

Plate 4.14: H. R. A. Hassan (2000 -2014) **Plate 4.15: K. Agyen -Gyasi (Ag.) (2014 -2015)**

Plate 4.16: S. K. Niikoi (2016 –)

4.7.2.2 School of Agriculture Block

The building was designed by Robbert Skeath during Williamsons' time and was built by A-LANG Contracting Company. The Project was supervised by Owusu Addo; now a Professor and a certified architect and a pioneer graduate of Kumasi College of Technology (K.C.T). The School of Agriculture was built by the British six (6) years after the Department of Agriculture was opened. It was established to train graduates to become professional agriculturists who can manage the Agricultural Ministry and to advice the University on relevant programmes- all with the view to develop capacity for the Agricultural Sector in Ghana.

Plate 4.17: School of Agriculture Block now Akuafo Building (October 1959)

Source: Photographed by the Researcher 2018

4.7.2.3 Architecture Studio Block

The first phase of the Architectural Studio was constructed under Charles Hobbis who was the then Head of Department of Architecture. But in 1963-64 the building was modified by John Loyd who succeeded Charles Hobbis

Plate 4.18: Architecture Studio Block (October 1963)

Source: Photographed by the Researcher 2018

4.7.2.4 Main Administration Block

This block was designed by an Architect called Graham Christopher and the contractor who built it was Etonene and Sons. It was among the buildings that were constructed during the time of Williamson as the Architect of KNUST. Kenneth Scott and Associates were the Consultants. Until then, the main administration was housed in the Independence Hall.

Plate 4.19: Main Administration Block (February 1960)

Source: Photographed by the Researcher 2018

4.7.2.5 Administration Block II

The Chief Architect for this monument was M. Marasovic and the Project Director was Ian Kirkbride. It served as an annex of the main administration until the main administration block could accommodate all the required administrative offices. It is still strong after 54 years of service

Plate 4.20: Administration Block II (June 1964.)

Source: Photographed by the Researcher 2018

4.7.2.6 Staff Club

This edifice was designed by M. Marasovic; a Yugoslav and was built by a contracting firm –Etonene and Sons. The project was supervised by Ciko Nicher. At first it was mosquito-screened but later changed to sliding windows. It used to be the busiest place

on campus in those times. It has since undergone several renovations and it is being still used for the same purpose but the aura surrounding it has subsided.

Plate 4.21: Staff Club (February 1965)

Source: Photographed by the Researcher 2018

4.7.2.7 The Great Hall

The Hall was designed by a Danish Architect'- Maxwell Gerlach. The original Catholic Church was also designed by him. The edifice contractors were A-LANG Construction Company. It was during the tenure of Dr. R. P Baffour as Principal (1960 -1961) and Vice Chancellor (1961 -1967) respectively. It was built with concrete blocks. The total seating capacity is 2000. The Hall has a gallery, washrooms, and conference rooms, control room, wings which also serve as conference rooms, 3 open spaces. The entire auditorium is air-conditioned. The Monument has been renovated severally. Notable among the renovation periods were the Vice Chancellorships of Prof. J.S.K. Ayim (1999 -2002) and Prof. W. O. Ellis (2010 -2016). It has a splendid compound decorated with flora and fauna.

Plate 4.22: The Great Hall (April – 1963)

Source: Photographed by the Researcher 2018

4.7.3 Interesting Sites

Kwame Nkrumah University of Science and Technology (KNUST) has parcels of interesting sites dotted on its main campus like the University Hospital, the Printing Press and a host of them. Only a few were considered in this write-up but the virtualization project after its acceptance would capture all of them. Those considered were as follows:

4.7.3.1 The Swimming Pool

The Swimming pool was created in 1964. The main objective was to entice expatriates' lecturers who found it difficult to leave the beaches of Accra to come to Kumasi to teach. There was no place to cool their bodies on campus. Meanwhile the University needed their services badly and therefore could not afford to lose them. The Pool was therefore created as a substitute of the Sea in Accra. There were no Diving Boards at first but when Prince Philip came to Ghana to officially open the Queen's Hall on campus, he noticed this shortfall of the swimming pool and quickly galvanize funds to erect Diving Boards to make the Pool complete and beautiful. It has undergone series of renovation since and the original purpose of creating it has also changed. Now it is a teaching learning aid for Sports and Exercise Science Department- a new programme which was created during the tenure of Professor Kwesi Ankwansa Andam as the Vice Chancellor of the University (2002 – 2006). It has a Restaurant and a Bar. The Pool caters for children, novice swimmers and veteran divers.

Several Managers have managed the site. Notable among them were Mr. White, Quarshie Sam and a host of others. Between 2004 and 2008, the Sports and Exercise Science Department took charge of the place but now it is being managed by an employed staff of the University in the person of Mr. Churchil Brobbey. The scenery is very beautiful and the avenue is exquisite to behold. The water in the wells are pure and treated and there are always trained personnel available to protect patrons of the place especially during special occasions where thousands of people throng to the place for recreation *(Source: Narrated by Mr. Churchill Brobbey the Manager as at writing 2018)*

Plate 4.23: Swimming Pool (1964)

Source: Photographed by the Researcher, 2017

4.7.3.2 Paa Joe (1899-1957) Stadium

The Stadium was built when Kumasi College of Technology (K. C. T.) became a fully-fledged university in 1961. The Stadium was named after a Sri Lankan called Joseph Arthur Hercules Ratnadurai. He was the former Head of Gold Coast and Ghana Sports Directorate. He was also former secretary to the Gold Coast and Ghana Amateur Sports Council. He was popularly called Paa Joe. Paa Joe was the first Senior Sports Master of Achimota College in 1926-1949. He initiated the construction of the facility and he was also the first University Sports Coach from 1952 – 1957. Paa Joe stressed the belief that a sound mind is found in a healthy body- a maxim rendered in Latin as *men sana in copo sano*. The Stadium was therefore needed badly for University Education. He was involved in an accident in one of his trips from Accra to Kumasi. The University therefore decided to honour him by naming the Stadium after him. The Stadium initially had the stance and the field. The Stadium was upgraded in 2008 when Ghana hosted the African Cup of Nations. This was during the tenure of Professor A. Adarkwa as the Vice Chancellor who assisted with the renovation of the facility. It was around this same time that the Tartan Tracks were built and a host of other sporting facilities. Currently it has 2 Soccer Fields, 1 Hockey Pitch, 2 Volley Ball and 2 Basket Ball courts. There is also 1 Netball and 1 Handball Courts *(This piece of information was gotten through a personal communication with Mr Joseph Adu: former KNUST Coach (2001 -2017).*

Plate 4.24: Paa Joe Stadium

Source: Photographed by the Researcher, 2017

4.7.3.3 River Wewe

This River takes its source from Ayigya; a nearby town. It cuts across the main Kumasi-Accra Road through campus to Ahensan where it joins the converging drainage from the adjoining towns. Apart from the Kumasi-Accra Bridge, two other bridges have been constructed on the River. These are the Hall Six and Faculty Bridges. The course and the vegetative cover of the River have added additional beauty to the University. It is the Pride of the University and generates cool breeze during the day. Fishes of different species can always be spotted whenever one gets closer to any of the bridges

Plate 4.25: River Wewe

Source: Photographed by the Researcher, 2017

4.7.3.4 Botanical Gardens

The Garden is situated at the heart of the University with a cool and serene environment. It has a diversity of flora and species belonging to different genera and families. One of the dominant tree species identified upon observation is Elaeis Guineensis. According to Anning (2008), the most dominant families are Fabaceae, Moraceae, Arecaceae and Euphorbiaceae. Other animal species could also be found in the Garden. The River Wewe flows through the Garden. The floristically richness of the garden makes it a potential for lasting conservation for educational, research and recreational benefits.

Plate 4.26: Botanical Gardens

Source: Photographed by the Researcher, 2017

4.8 Implementation

Implementation is the process of putting a decision or plan into effect. From the analysis of museum services in KNUST it was revealed that a strategic framework and statement of intent were crafted for the establishment of a physical museum. This framework was adapted to carry out the translation of what had been designed and developed (VIMU-KNUST) into reality. The only portions that were altered were physical collections that were converted to digital images; physical spaces that were converted to virtual spaces and finally the inclusion of research assistants who were knowledgeable in information and communication technologies. All collectibles were digitized, processed, preserved and disseminated virtually for access

4.8.1 Time Frame

The time span to implement a proposed virtual museum is not cast in iron. It may vary from place to place depending on the managerial and financial resources earmarked for the project. Whatever the case might be an estimated period of six months might be needed to translate an otherwise a theoretical but practical advocacy into a pragmatic activity. Guided by this, two months was used to recruit research assistants to help with the management of the project. Another two months was dedicated to fine-tuning the digital exhibitions of the uploaded relics while the last two months was used to outdoor the VIMU-KNUST. The intricacies associated with the resource were streamlined accordingly after evaluation

4.8.2 Management

The vision of the Virtual Museum must be spelt out clearly by management as that which aspires to become a leading state- of the art's virtual museum of Art, Science and Technology in Ghana. The mission of the VM must also be known that it exists to fulfil a core responsibility to educate and create awareness about the significance of and the need to conserve and preserve the natural and cultural heritage of KNUST and its immediate environment- Ashanti Region and the nation Ghana as a whole. It must be made clear that, the purpose of creating the virtual museum is to device an open educational resource for teaching, learning and research. It is also an alternative media to showcase the heritage of KNUST. The main objectives for creating the Virtual Museum is summarily for preservation, conservation and provision of excellent museological services. The broad activities of the virtual museum are to collect, preserve and display the heritage of KNUST. As indicated already, the collections cover past, present and future creation and inventions of KNUST and its immediate environment. Implicitly, the exhibitions also inform, entertain and invariably preserve the heritage of KNUST. The core values of the Virtual Museum are the same as that of the KNUST's which is leadership in innovation and technology, culture of excellence, diversity and equal opportunity for all and integrity and stewardship of resources. The Virtual Museum dubbed *KNUST's Heritage* ought to be regarded as a multidisciplinary and intercollegiate academic unit seen as the third component of
KNUST' intellectual repository-(Library, future Archives and Museum).

For a start, it could be centrally managed independent of any college, faculty or department. It must have a two-tier management structure. Thus, a KNUST Museum Board and KNUST Museum Management Committee. The Board will be responsible for external linkage, policy formulation and providing strategic direction. The composition of the Board Members would comprise the Chairman to be appointed by the Vice Chancellor, the director of the museum, two (2) representatives from academic Board, and one (1) representative each from National Commission on Culture and National Museum and Monuments Board. Two representatives from the community, the Collections Manager and a Secretary from General administration. The Management Committee on the other hand would be in charge of the general administration, operation of the museum programmes, acquisitions, fund raising, budgeting, staff and programme development. The Committee would comprise the Director who will coordinate the entire resource, one representative each from the six colleges, a curator as operations manager, collections manager, a researcher, a system analyst, a software designer, a network operator, a computer programmer and a photographer. A number of the experts outlined here would be needed but for a start, a few could be employed. Aside all these, there is the need to earmark an agency of the university to host the project and the obvious places are either the Library, the UITS or the College of Art and Built Environment. As indicated earlier, in the first few years of implementation, the Central Administration of KNUST would take oversight responsibility with the view to establish the appropriate directorate to manage the project subsequently.

4.8.3 Funding

A special fund set aside is needed to operationalize this advocacy research. The implementation depends largely on KNUST's financial strength and its commitment to develop the project. However, the fundamental cost of such projects must cover management, infrastructural development, collections and exhibition facilities. The University is already endowed with management personnel and the infrastructural facilities are already laid down by the University Information and Technological Services (UITS). Therefore, a rough initial investment of Three Hundred Thousand Ghana Cedis (GH₵ 300,000.00); an amount that could pay the salaries of ten (10) staff members of the Virtual Museum for at least three (3) months – (assuming that each

receives an average of six thousand Ghana Cedis a month) could start the project. Contributions from the following could all be sources of funding for the commencement and sustenance of the project:

- The Aluminous of the KNUST
- All commercial entities within the KNUST
- Grants for research and facility development by government
- A percentage of KNUST own Internally Generated Funds
- Periodic fund raising by the Virtual Museum Management Committee
- Proceeds from the users who would visit the manual exhibits which would be created subsequently.

4.8.4 Monitoring and Evaluation (M&E)

Monitoring and Evaluation is a process that helps improve performance and achieve results. Monitoring is the regular observation and recording of activities taking place in a project or programme. It is a process of routinely gathering information on all aspects of the project. To monitor is to check on how project activities are progressing. It is observation; ─ systematic and purposeful observation. Its goal is to improve current and future management of outputs, outcomes and impact. Their expertise and independence are of major importance for the process to be successful. At the programme level, the purpose of monitoring and evaluation is to track implementation and outputs systematically, and measure the effectiveness of programmes. This activity helped to determine exactly when an exhibit needed to be displayed and when changes also needed to be effected. More so, the M&E provided the Research Team the only consolidated source of information showcasing project progress. By monitoring progress against defined goals, the researcher was able to assess what was working and what was not, and from there could determine what portions of VIMU-KNUST needed to be polished.

4.8.5 Encountered Challenges

Like all other institutions, KNUST cannot claim absolute insulation from internal and external factors that could interrupt the smooth execution of the advocated virtual museum. These could manifest themselves in technical, managerial and financial challenges. In course of the demonstration, the researcher encountered similar

difficulties. Technically, the collections needed to be representative of the colleges which, was not the case. Assembling a balanced collection of Art, Science and Technology was a herculean task for the team. Again, issues on broadband and encryption were hard nuts to crack. Besides, managerial issues such as collaboration, continuity, constant supply of electricity and regular maintenance of equipment were major mountains during the demonstration periods. In the midst of all these was another crucial element; which was regular source of funding.

4.9 Evaluation of VIMU-KNUST to Enhance Access to KNUST's Heritage

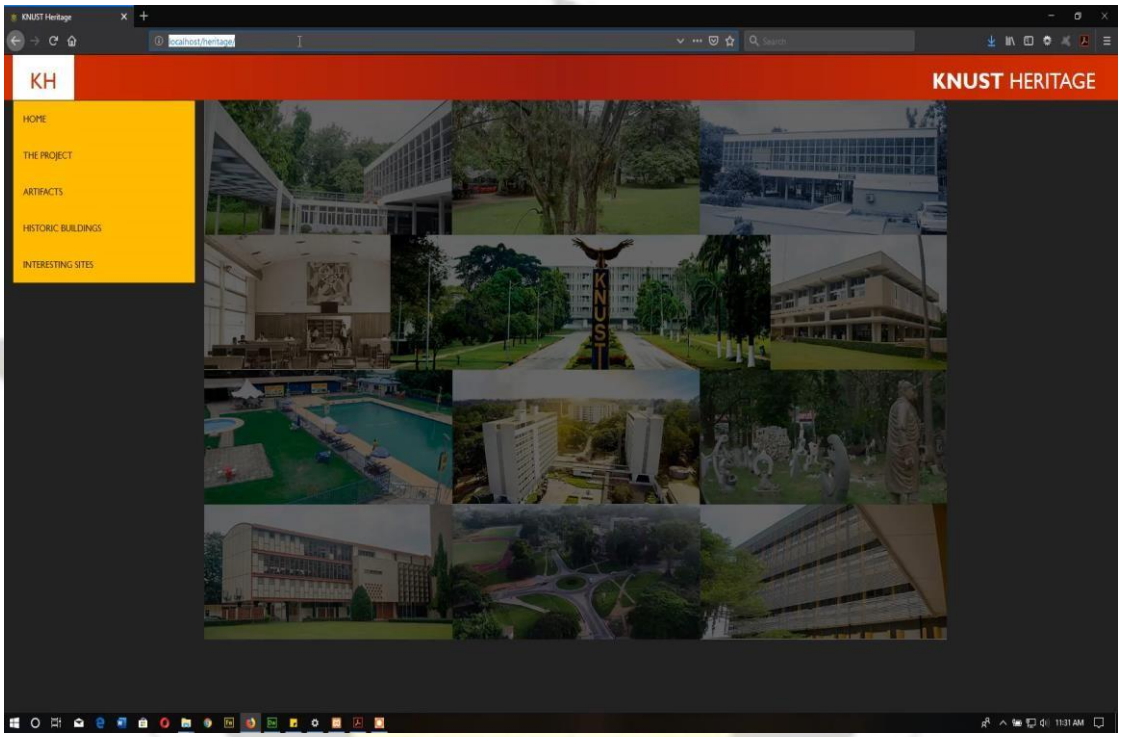


Plate: 4.27 VIMU-KNUST (home page interface)

Photographed by the Researcher, 2019

The home page of VIMO-KNUST interface shows the visitor the type of content to expect and the background information to the project. The content includes general tours of the University and specific tours of the Colleges. These appear like documentaries but the visitor can manipulate their movement. For demonstration purposes, an artifact, a historic building and an interesting site have been packaged for display. Each can be appreciated textually, visually or audio visually. The visitor controls and manipulates the facility as and how they like through the interactive devices of the resource. VIMU-KNUST has been made to be compatible with variety

of computers. As such it can be accessed on mobile phones, lap-tops, desk-tops and other personal digital devices. Friendly colours are used, quality images rendered, audible sound for narration and simple icons for navigation.

As suggested by Charitos and Bridges (1997), on the criteria for evaluation the designed DEMO (VIMU-KNUST) was presented for evaluation by the host institution, based on the following features:

a. Imageability
b. Interactivity
c. Navigability
d. Narration
e. Content

Questionnaires were designed and were administered to a purposively selected 40 respondents, after watching the DEMO. These were selected from the provost's offices of the six colleges, senior members in the Library, some heads of department at UITS and IDL and some staff of International Programmes Office of KNUST. Per their functions it was believed that they could provide relevant evaluation to the advocated project. Their evaluated responses were as follows.

Table 4.12: DEMO Assessment Responses from 40 Purposively Selected Respondents

A.	IMAGEABILITY	VERY GOOD	GOOD	POOR	VERY POOR	INDECISIVE	Mean	Std. Dev
	Picture Resolution	10	30	-	-		20	14.14214
	Contrast	9	31	-	-		20	15.55635
	Responses	15	25	-	-		20	7.071068
	Effects	2	30	8	-		13.3333	14.74223
B	**INTERACTIVITY**							
	Speed	10	25	5	-		13.3333	10.40833
	Colour Choice	15	25	-	-		20	7.071068
	Dialogue	10	25	5	-		13.3333	10.40833
	… Visibility	20	-	-	-		20	
C	**NAVIGABILITY**							
	Hyper Link	5	20	10	5		11.6667	7.071068
	Site Mapping	5	20	10	5		11.6667	7.071068
	Ease of …	10	25	5	-		13.3333	10.40833
	Compatibility	5	30	5	-		13.3333	14.43376
D	**NARRATION**							
	Background Information	30	10	-	-		20	14.14214
	Objective Significance Revealed	35	5	-	-		20	21.2132
	Coherence	35	5	-	-		20	21.2132
	Accuracy	35	5	-	-		20	21.2132
E	**CONTENT**							
	Artefacts	30	5	5			13.3333	14.43376

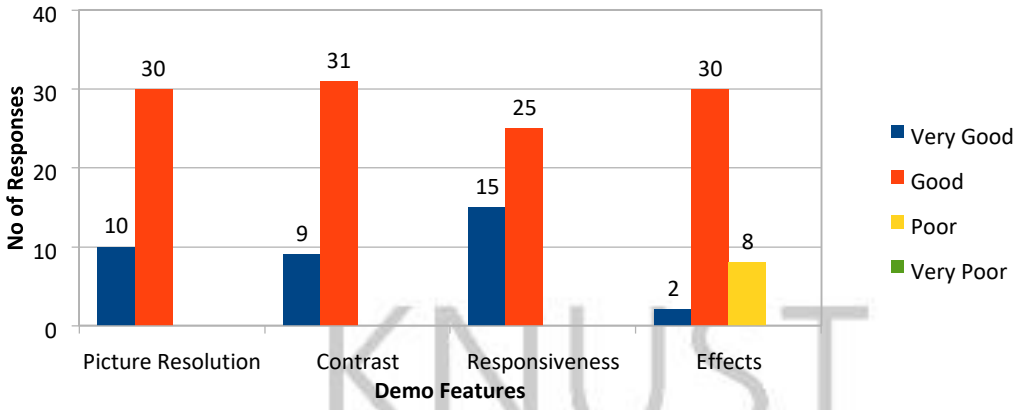


Figure 4.11: Imageability

Source: Generated from Table 4.10, 2018

4.9.1 Imageability

As far as the quality of the images were concerned, half of the total respondents indicated that it was good from resolution, contrast, and responsiveness to effects. Generally, good digital images have great composition and they capture the emotions of the viewers. Such images tell stories, leave something to the imagination of the viewer whilst at the same time capturing iconic moments. Just as the images are unique, they use unique lighting and colour with contrasting concepts as demonstrated below:

Plate 4.28: Low quality image

Source: Photographed by the Researcher, 2018

Plate 4.29: High quality image

Source: Photographed by the Researcher, 2018

4.9.1.1 Picture Resolution

Resolution refers to the number of pixels in an image. It is sometimes identified by the width and height of the image as well as the total number of pixels in the image. For example, an image that is 2048 pixels wide and 1536 pixels high (2048 x 1536) contains (multiply) 3,145,728 pixels (or 3.1 Megapixels). One could call it a 2048 x 1536 or a 3.1 Megapixel image. As the megapixels in a pickup device in a camera increase so does the possible maximum size image it can produce. This means that a 5-megapixel camera is capable of capturing a larger image than a 3-megapixel camera. Computer screens are set at a particular resolution. The larger the screen, the larger the resolution. A 17" monitor, is likely to be set at 800 x 600 pixels while a 19" screen is likely to be set at 1024 x 768. The settings can be changed but these are optimum for those screen sizes. A monitor set to 800 x 600 in displaying an image that is 640 x 480, will only fill up a part of the screen. But in opening up an image that is 2048 x 1536 (3.1 megapixels) will be larger than what the screen can display. It just won't fit. Since the computer monitor has a finite number of pixels per inch available (like 72), the quality of the images to be displayed would have to be dropped down to 72 to save file space. If one is going to put an image on a webpage or email it to a friend then he will want to first make it a useful size. Not too big, not too small. Maybe 200-300 pixels high would be a nice size. One can also reduce the size of the file (not necessarily the size of the image) so it loads faster. This is done by reducing the file size by compressing the image.

Plate 4.30: Compressed Image (201 KB)

Source: Photographed by the Researcher 2018

Plate 4.31: Uncompressed Image (2.55 MB)

Source: Photographed by the Researcher, 2018

4.9.1.2 Image Compression

In addition to image size, the quality of the image can also be manipulated through "compression." An uncompressed image is saved in a file format that doesn't compress the pixels in the image at all. Formats such as BMP or TIF files do not compress the image. JPG compression analyzes images in blocks of 8X8 pixels in size and selectively reduces the detail within each block. At higher compression rations, the block pattern becomes more visible and there may be noticeable loss of detail, especially when you attempt to make prints larger than recommended. The subject and pattern in the image are also a factor. For example, a picture of the blue sky can be compressed quite a bit without any noticeable effects but a picture of a colourful bird would "pixelate" quite quickly. Take another look at the two images at the top. The first is somewhat compressed, about 200 pixels high (size) and the file is only 14Kb. The image on the right is the same size but compressed quite a bit more reducing the file size to 4Kb. By using JPG compression, you can keep the physical size of the image the same and reduce the amount of disk space required to store it but you will be sacrificing the quality of the image.

Plate 4.32 Contrasted Image

Plate 4.33: Non-contrasted Image

Source: Photographed by the Researcher, 2018

4.9.1.3 Contrast

Simply put, contrast is the difference between two colors. On a web page, the amount of contrast required varies with different parts of the page. A high contrast between text and its background colour is usually desired. But too high contrast between design elements might give an unsettled and messy impression. Contrast is important because the meaningful essence of anything is defined by its value, properties, or quality relative to something else. The fact is that, nothing has much meaning by itself, which is one reason why design is important.

4.9.1.4 Responsiveness

The image must reflect the occasion during which it was taken. Every image possesses an inherent story. The image must speak to the viewer without any external assistance. The entire digital resource should be able to accommodate texts, sound and video files.

The findings revealed that the application of internet technologies to support the creation of a virtual museum at KNUST will consolidate and also be able to disperse the available information systems to enhance the issuance of control of the entire processes to audience to a larger extent which is represented by a mean of 20 and a standard deviation of 14.12. The Virtual Museum can use the application of ICT and online business culture to promote its activities and to also examine and collect data, which will assist in the creation of tactical visions and to discover an effective and efficient method to redesign the process which may permit cooperation and

collaboration to a larger degree as it is shown by a mean of 20 and a standard deviation of 15.6 by contrast. However, the effects and responses registered a mean of 20 with a standard deviation of 14.7. This is a representational outcome of the imageability.

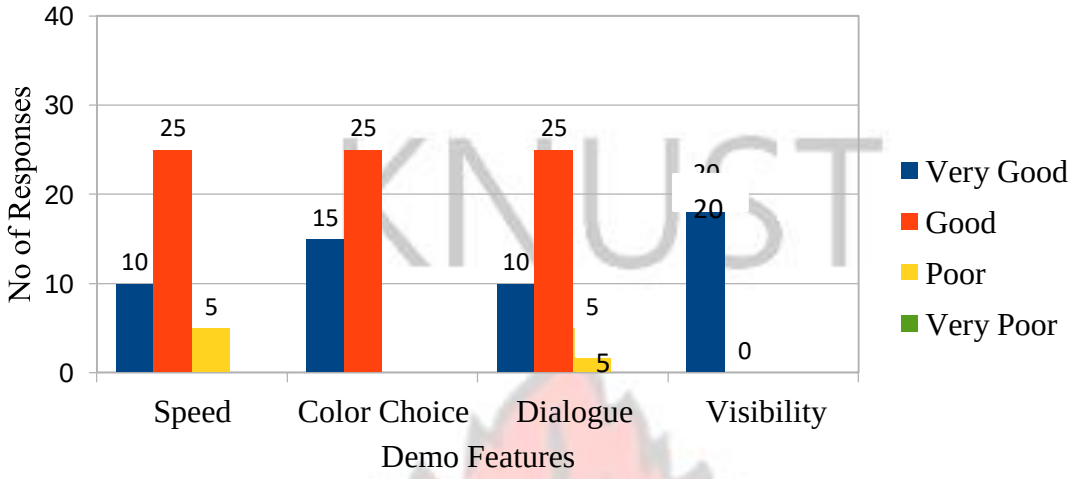


Figure 4.12: Interactivity

Source: Generated from Table 4.10, 2018

4.9.2 Interactivity

As revealed, a major intent of this advocacy is to enhance access to KNUST's Heritage. The level of interactivity determines the level of accessibility. Again, audience ability and flexibility in engaging the entire resource is a gauge for how much they learn and understand the objects being appreciated. Therefore, the speed of movement, visibility of icons and dialoguing features are all necessary motivation for access. Research has shown that, one of the major sources of attraction to sites and pages is user-friendliness of the interface which resulted from how interactive the system is (Styliani S., et al 2009). From the graph respondents evaluated almost all the features as good. This was a pointer to the fact that the DEMO, has been designed on the right direction. Twenty-five (25) respondents each asserted that the speed, colour choice and dialogue was good with 20 out of 40 saying visibility was good. However, 10 respondents admitted the speed and dialogue features were poor. It must be noted here that the effectiveness and efficiency of internet services on campus could be erratic sometimes and probably those who watched the DEMO, around those periods' experienced speed and dialogue challenges. These notwithstanding their comments were taken note of and were factored in the subsequent revision of the DEMO.

Technology is rapidly revolutionizing the modern business scenario and every organization - small, medium-sized, or large – needs an attractive, informative and engaging website that can offer it maximum visibility. Needless to say, capturing and retaining the attention of users is an absolute challenge. The simple truth is that users get easily fed up if they are bombarded with an overdose of information and a confusing mish mash of images. In this context, an interactive website is the best way to provide a meaningful and engaging user experience (Nayanathara 2016). An interactive website is essentially an Internet page that uses different kinds of software to create a rich, interactive experience for the user i.e. it facilitates the user to be actively engaged with the site. Among other interactive features, at least the speed, color choice, dialogue and icon visibility should be something good to write home about.

4.9.2.1 Choice of Colour

The first element that is likely to turn visitors off is the colour scheme of the site and pages. Therefore, major emphasis needs to be put on the colour blend. In designing the DEMO, the colour wheel was juxtaposed with the KNUST's brand in order to ensure coordination and uniformity. Colour is a fundamental aspect of how the world is perceived. In fact, it is so deeply ingrained in human life that, it is often taken for granted. From the vivid oranges and reds of a sunset, to the deep and mystical blue of an ocean, colour is everywhere. The right hue has the power to mould perceptions of a situation, and even change the circumstances of the time. That is why website color schemes are one of the most powerful tools in a designer's arsenal (Mase, K., Kadobayashi, R. and Nakatsu, R. 1996). Choosing the best website color schemes can make or break a design, and some of the most iconic imagery in the world today might not come from the expected background. For instance, Facebook is blue because it's the richest colour for Mark Zuckerberg, the red-green color-blind entrepreneur. Yet blue also promotes a sense of friendship and security from a psychological level, making it the ideal choice for a social platform. According to experts like Buffer, more than 90% of consumer assessment of a product or service is based on colour. It makes sense then, that designers would focus carefully on the colors used in each design. After all, a website is the first chance to make an impression on customers. If the colour pallet is

all wrong, then customers are likely to abandon the website in search of something more appealing.

Colour theory is a set of principles that are used to create harmonious and seamless combinations of color that can be applied to everything from graphics, to background images, logos, and text. Though the basics of colour theory are essential to most designers, they also need to consider the emotional and psychological impact of each colour too. Understanding how each different colour prompts disparate actions allows designers to make choices that support the fundamental aims of a specific company. Though it seems simplistic, color has a significant impact on our emotions and attitudes. It has been realized upon examination that, colour, communicates with the hypothalamus of the human brain which connects to the pituitary gland, endocrine system, and thyroid glands. This journey leads to the release of hormones that change the way humans think, feel, and act. In creating an effective design, web experts examine the concept of "colour psychology", or how color changes human behaviour. One part of the broader field of "behavioural psychology", colour psychology is all about testing the theories behind why certain hues make humans think and feel in different ways. Though the research into color psychology is ongoing, some facts are indisputable. Colour Theory addresses not only the practical nature of colour, such as how one hue can make part of a website stand out, but also the psychological impact of different tones and images. When it comes to designing a website, color is just as important as usability and navigation. After all, a well-designed website will quickly be disregarded if it's covered with unattractive colours. The fundamental rules of color theory are displayed through "colour wheels", or colour charts as illustrated below that help designers to see how different colours interact.

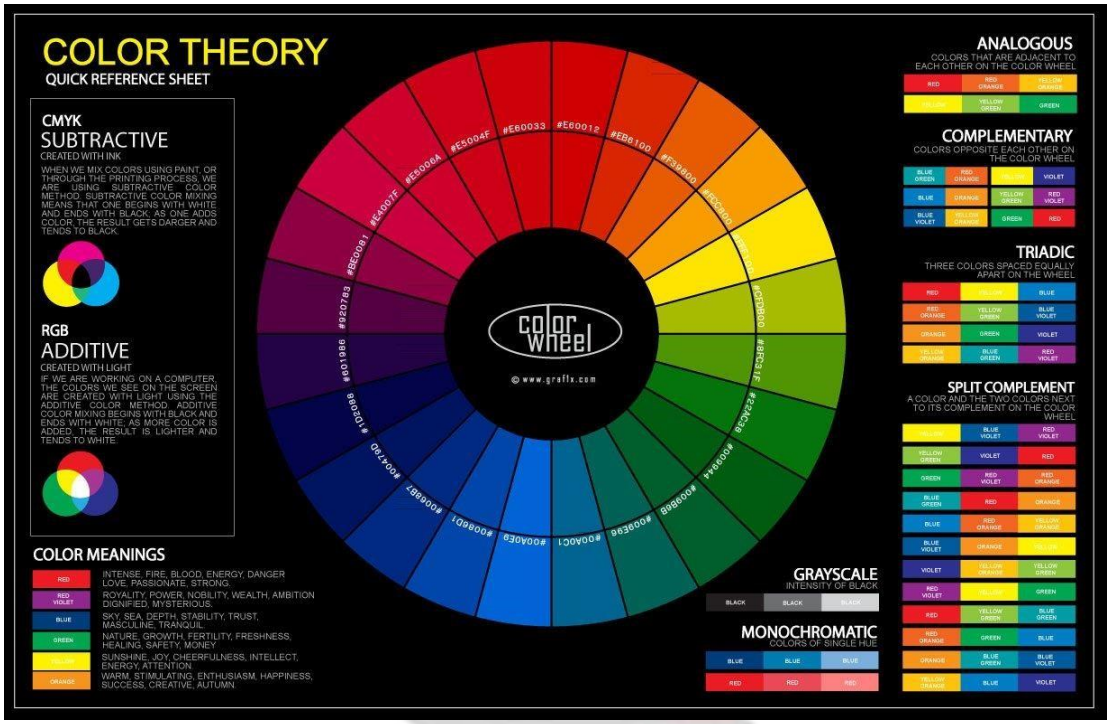


Figure 4.13: Colour Wheel Poster.

Source: GrafIx.com, 2019

By using the colour wheel, designers can create a "colour scheme", which is a collection of colors used in design for a range of media purposes. For instance, the most common colour schemes fit within a set group of specific categories, including:

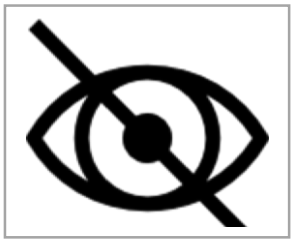
4.9.2.2 Dialogue

A dialogue box is a box that pops up to enable communication between the computer and the user. Dialogue boxes may ask the user questions or give him information. Once the input has been made, the dialogue box will generally disappear. Some types will be 'alerts' which give information with a request for an acknowledgement that the message has been read for example an 'OK' button. Some alert boxes will require an action to decide if it should proceed - with an OK button or a Cancel button. It may have a black exclamation mark in a yellow triangle as an alert icon. Other boxes may ask for an action relating to the application the user is using. For example, closing down a Word document may bring up a dialogue box asking for 'save' or 'don't save' or to cancel the request. Generally, if a dialogue box does appear on the screen, an action must be taken relating to it before you can access other applications on the computer. Sometimes

dialogue boxes can get hidden behind other windows, which can be frustrating. Minimizing these windows should give access to any hidden boxes.

4.9.2.3 Icon visibility

Icons are directional symbols placed on the screen to aide interaction. Icons are most effective when they improve visual interest and grab the user's attention. They help guide users while they're navigating a page. Below are a few examples



Hide

Drop up arrow

Cursor

Help

Previous

Since, the institution recognizes users in the plan of information and communication technologies (ICT) to maximize its output in the future and to a great extent which is portrayed by a mean of 13.3 and a standard deviation of 10.4. The KNUST may create their user interface with some kind of user friendliness and ease of accessibility online, thereby providing a direct linkage to make it easy for users at a reduced cost and time. The user friendliness of the website and the connectivity of the internet system may assist the institutions to connect directly to virtual audiences.

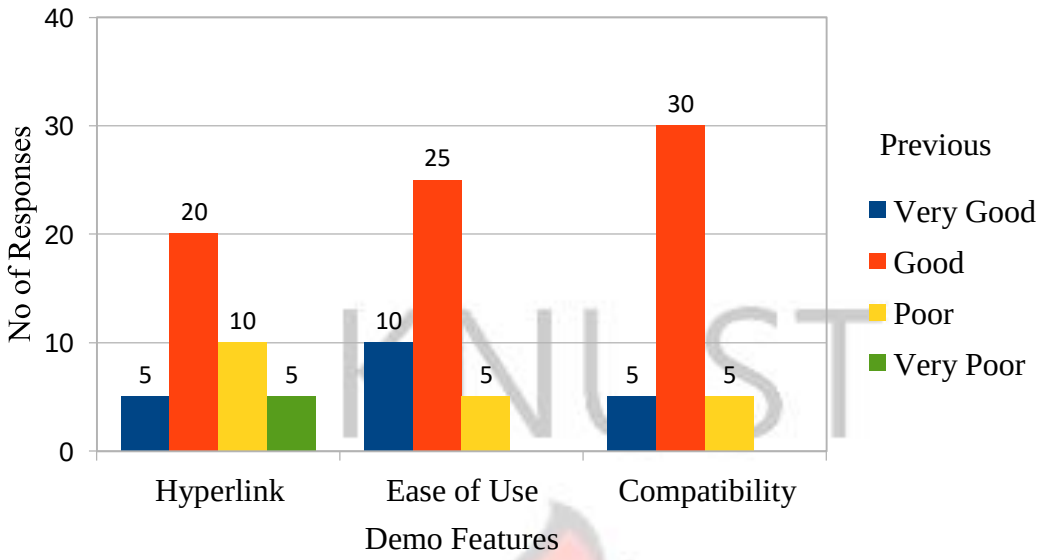


Figure 4.14: Navigability

Source: Generated from Table 4.10, 2018

4.9.3 Navigability

Navigation is about the means of exploring the content of web pages in a website or database. Thus, the tools that enables visitors to move through the different pages and portions of the system which in this case a virtual museum dealing with organized collections of digital images in virtual galleries. The movement through the pages should be easy efficient and smooth. In the DEMO, heritage categories had been divided clearly, all navigation elements had clickable links and accurate titles. The Site Mapping Feature as at the time of administering the questionnaire had not been built into the DEMO and was therefore not considered in the analysis of responses. As many as 25 and 30 respondents indicated that the ease of use and compatibility was good respectively while 5 respondents opined that the hyperlink was very poor. However, 20 saw it as good and 5 were very much enthused about the hyperlinks within the resource. Even though the general impression from the responses were good, the variant responses are a pointer to the fact that the other features need to be improved upon.

As a result of the outcome, the more a virtual museum relies highly on the information technology the more it turns out to be the focal center of attraction and redesign as it is indicated by a mean of 11.7 and a standard deviation of 7.1, through the hyperlinks created on the interface. The site mapping on the other hand registered the same mean

and standard deviation. With reference to the ease of navigation which measures a mean and a standard deviation of 13.3 and 10.4 respectively. The comparability also measured a mean of 13.3 with a standard deviation of 14.4. Additionally, the navigation element with easy and fast movement, with clear titles enhances the smoothness of the system technologies.

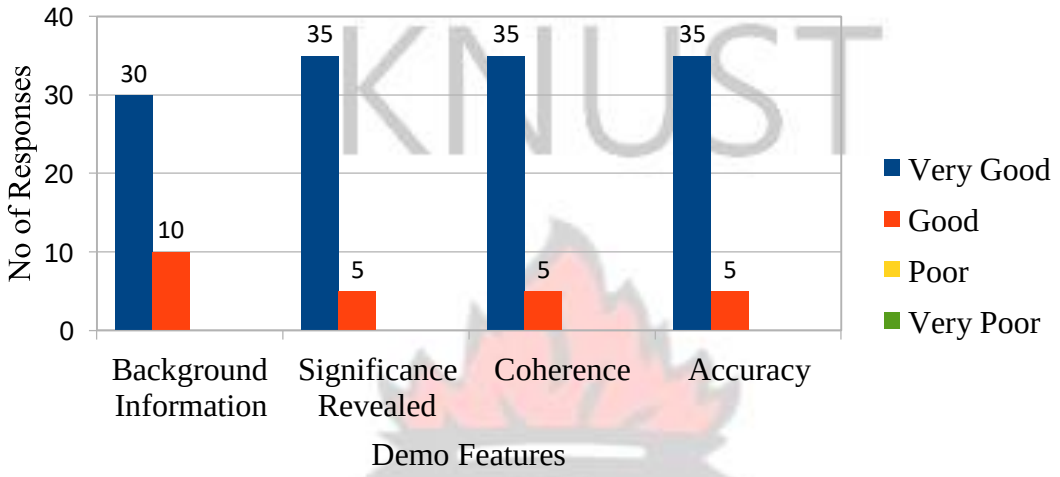


Figure 4.15: Narration

Source: Generated from Table 4.10, 2018

4.9.4 Narration

The narration was done in such a way that the visitor could constructively know and understand the object if even it was not showcased in the virtual gallery. The narration that accompanied each of the exhibits revealed the objective, philosophy and history of KNUST's existence. This means that for every object there is an inherent story to tell as why, when, where and how it was created. As evidenced from the Bar graph in **Figure 4.15**, over 90% of the total respondents rated the narration as very good. The background information; the revelation of the significance of the exhibits; the coherence of the descriptions and the accuracy of information were appreciated as excellent. Out of forty (40) respondents, thirty (30) rated the background information as very good while 35 each evaluated the objective, coherence and accuracy as very good also. Regarding those who evaluated the narration as good, 10 vouched for background information while 5 each checked for the rest. The obvious deduction was that the narration was perfectly done. If one of the intentions of the creation of the virtual museum is to teach, then interpreting the exhibits must do exactly that. By so doing the visitor could satisfy himself/herself that he/she has really learnt from the narration. For

each exhibit, possible questions were identified and their answers were incorporated into the narration. This synchronizes well with Bonnett (2004) when he asserted that:

"……. Their design must be carried out according to their raison d'être and the information provided must be organized in order to construct a narrative. A virtual museum has to define its target community/ies, its aims, its content and how this will be structured and delivered. Throughout all the creation phases of the virtual museum, evaluation studies that involve real users must be undertaken, in order to identify the parts of the program that need further improvement"

In summary, the background information measured a mean of 20 and a standard deviation of 14.1. The objective and significance also measured a mean of 20 and a standard deviation of 21.2 which is similar to the mean and the standard deviation of coherence and accuracy, which signifies a good background for narration.

4.9.5 Content

As seen from the DEMO, evaluation responses 30 out of 40 respondents evaluated the items selected as very good while 5 each opined that it was good and poor respectively. The term 'artifact' used for the *content* represents a generic term for all the objects exhibited in the DEMO VM. For demonstration purposes, the entire heritage of KNUST was categorized into three: (a) Artifacts (b) Historic Buildings and (c) Interesting Sites. For each of these categories, one item was selected for demonstration. Within the artifact (movable) category, the KNUST Logo (emblem) was chosen. The interpretation of the parts of the Logo (emblem) reveals the philosophic ideals that the institution hinges on. The University Library on the other hand was chosen from the historic building category for its strategic position in the life of the University while the Swimming Pool was selected to drum home the idea of – 'all work and no play make Jack a dull boy' concept. The detailed Virtual Museum when welcomed by KNUST, would contain as well intangible properties because they are all part of the institutional heritage. Such heritage includes memories of KNUST inaugural songs, recipes, dances, maiden university rules and other beliefs. Thus, the content of the artefacts which measures a mean of 13.3 and a standard deviation of 4.4 show the level of significance and the philosophic ideals the 'VIMOKNUST' hinges on.

4.9.6 Any Other Comment

A critical look at the various comments given portray the fears that the respondents were entertaining. This deduction was made from sampled transcriptions as shown below:

Resp. 1:

> *"Though a good resource but it is an additional financial burden to the University. Already, the University is trying to Cushion itself with internally generated funds. If they are able to generate funds from the facility that will be of much help towards the sustainability of the facility."*

Resp. 2:

> *"Students of these days are so crafty and technologically savvy; they have weird ways of entering into such systems and causing havoc. How secured will the facility be such that the users cannot tamper with the configurations"?*

Resp. 3:

> *"The "Dum-so" era is still not gone. It is very irritating when you are in the middle of browsing and the light goes off. If you are lucky to have an uninterrupted power supply, then you can save or keep what you want somewhere before the system finally shuts down."*

Resp. 4:

> *"I know that images occupy bigger spaces and their movement are not fast like textual information so the University may need bigger bandwidths or else the system will be slowed down and unattractive"*

Resp. 5:

> *"Let us pray that subsequent administrators will keep an eye on the project so it does not crumble like the first one"*

Resp. 6:

"You are saying it will be KNUST's heritage but at the end of the day it will be high-jacked by the College of Art and Built Environment. Meanwhile, all the colleges have something to showcase"

Resp. 7:

"Until we have a constant supply of power, these online resources will not be utilized to the fullest. Every minute the power is interrupted, the on –and offs can even damage the entire resource. How are you handling that challenge?"

Resp.8:

"How does the University get money from it, if it is made available to all and sundry through the internet? I am not clear about that portion"

Resp.9:

"I will be happy to see my college represented fully. There are some documentaries authored by students in my college which can be added to the collections. Please contact the provost office of Engineering. You might get some content from there"

Resp.10:

"Generally, Africans place little premium on the appreciation of artifacts. Unlike the Westerners and therefore it takes interest of the University to sustain it and I am not sure the University has that interest. Please I do not mean to discourage you but it all bothers on the interest of the Vice Chancellors who will come in successions to sustain it"

As revealed from their comments, some expressed the fear that just as the KNUST website was once hacked into so will the virtual museum. They were not sure of how the resource could be protected from tampering. One Head of Department (R*eference from Resp. 1 above name withheld for ethical reasons)* retorted that:

"Even though the idea is good it will be an additional financial burden for the University".

Again, they were skeptic about the success of the resource because electricity supply on campus was erratic coupled with smaller bandwidths that the university operates

with. More so, they expressed uncertainty as to whether the project could be sustained with subsequent administrators of the University, because lack of continuity according to them was one of the probable factors that led to the collapse of the physical museum. Furthermore, they appealed to the researcher that he should make sure that the collections of the virtual museum are representative of the six colleges and not skewed towards the college of Art and Built Environment. There was also a comment on the general Ghanaian poor culture of maintenance as a major issue to be guided against.

CHAPTER FIVE

SUMMARY, CONCLUSIONS AND RECOMMENDATIONS

5.1 Summary

The use of telecommunication technologies offers interesting perspectives for museums and the opportunity to add a new, digital dimension to the traditional museum, thereby creating a "virtual museum". The foundations for the "virtual museum" are already laid. Bearman (1995b, pp. 15f) estimates that by the end of this decade over 20 million original objects will have been digitized. In this way, museums and the digital information they offer will become loadstones of content for the growing multimedia industry and for museum initiatives for outreach to the public (Bearman 1995a, p. 12). As some statistics and research suggest, the public looks for and appreciates museum information on the Internet but has high standards that the museums have to meet. The benefits of virtual museums are noteworthy for museum curators and various groups of end-users, like students, specialists and tourists. Virtual museums have the potential to preserve and disseminate the cultural information in an effective and low-cost way through innovative methods and tools. They do not aim at replacing the physical museums, but they act complementary. Virtual museums that are an engaging medium with great appeal to various visitors' groups can promote the 'real sites' by providing information about museum exhibitions and offer an enhanced display of museums' artifacts through emerging technologies. (Bowen and FilippiniFantoni, 2004). The next generation of on-line virtual museums using 3D technology is now possible and affordable. The Internet is a great opportunity which the museums should use to broaden its audience. However, the bandwidth to provide the requisite speed should not be toyed with.

The educational potential of Virtual Museums (VMs) has also been exposed, by putting forward the idea that when using VMs in classrooms, coherently with the overall mission of 21st century education, a wider spectrum of learning objectives can be addressed in addition to those that are considered "standard" in the field of cultural heritage education. Indeed, this doesn't happen 'automatically', which means that it is not the use of technology that per se guarantees the development of certain skills, but whenever teachers design the learning activities properly and adopt suitable educational methods; VMs can represent an important asset to the development of some of these 21st century skills. Besides, VM developers should carefully design the educational affordances of their tools, by embedding functionalities (such as learning analytics, data

mining, turn over options) able to foster the adoption of advanced educational methodologies and techniques (e.g.: personalized, active and discovery learning, collaborative learning, etc.). These affordances should be considered as integral part of VMs, and should be taken into account from the very beginning of the design process, so to transform the learner's "virtual visit" into an effective "learning experience" (Ott and Pozzi 2011). Intermittent power cuts might render this laudable objective valueless.

Furthermore, the study has presented a user-oriented platform for designing and executing virtual exhibitions. Implicit generation and adjustment of user profiles allows applications that have been implemented on this platform to dynamically adapt content presentation to user interests and preferences, based on user stereotypes and prior interaction of users with exhibits. Additionally, it is possible to detect similarities among user models, leading to the formulation of user interest communities. A virtual museum demonstration clip has been experimented with in order to gain insight about the effectiveness of this approach. Viewer comments on the DEMO after watching produced favorable feedback towards the application of this framework in virtual museums and virtual content presentation systems in general.

Finally, an ongoing extension of this work is to enrich the platform by allowing users to customize their personal space, thus providing stronger feedback on the quality of their user model (Kim, Kesavadas and Paley 2006) More so, the various types of virtual museums in the light of a range of classifications have been discussed. With the use of imaging technology, Web3D, VR, AR, MR, haptics and hand-held devices as PDAs, museums can exploit all possibilities of the new media, analyze and answer in various ways to visitors' needs, enable an intuitive interaction with the displayed content and provide an entertaining and educational experience. The benefits of virtual museums are noteworthy as far as museum curators are concerned and in terms of documentation, conservation, research and exhibition. The virtual museums have the potential to both preserve and disseminate the cultural information in an effectively and at a low-cost through innovative methods and tools. They are an engaging medium with great appeal to a variety of groups of visitors and can promote the 'real sites' by providing information about museum exhibitions and offer an enhanced display of museum artifacts through emerging technologies (White et al 2004). Various groups of end-users

such as tourists, students and specialists can take advantage of them and satisfy their learning and entertainment needs. The visit of virtual museums can be an enjoyable and productive experience that draws the user into involvement and participation and help the promotion of real museums (Jackson et al 1998).

The virtual museums enrich the museum experience by allowing an intuitive interaction with the virtual museum artifacts. A comparison between real and virtual museums indicates that there still are important issues for virtual museums to solve. Good collaboration must be ensured between cultural heritage specialists (museum curators, historians, archaeologists, etc.) and information science specialists to achieve optimal results and in order to avoid dependence on market-produced software and to promote open-source software that may be produced with the aid of cultural heritage specialists. According to Liarokapis and White (2005) virtual museums cannot and do not intend to replace the walled museums. They can be characterized as 'digital reflections' of physical museums that do not exist per se, but act complementarily to become an extension of physical museum's exhibition halls and the ubiquitous vehicle of the ideas, concepts and 'messages' of the real museum. Their primary aim is (or should be) to investigate and propose models for the exploration of the real purpose and conceptual orientation of a museum. Virtual museums can respond in various ways to visitors' needs. With the use of VR, AR and Internet technologies, they can provide an entertaining and educational experience.

The study has discussed the benefits of the new technology and concept approach for both the participant and the museum. 3D created reality is the next logical step in museum presentation beyond web-based Internet technology. 3D created realities are seen to be in a similar position as the World Wide Web was in the early 90's. Like the web in the early 90's, computers power and internet access will only continue to increase and thus provide even more impetus to the use of immersive realistic environments for museum presentation (Jones 2002).

In addition, the study has shed new light on the design of virtual museums by looking at some of their anticipations in the fields of exhibition design and interactive media art. The study does not claim that these are the only factors that explain the nature and

the emergence of the virtual museum as an institution. Even in the field of experimental art there are other phenomena that still deserve to be investigated. An interesting starting point for this continued analysis is Craig J. Saper's recent study titled "Networked Art". In the study, Saper explores the background of current electronic networking art practices by analyzing such overlooked phenomena as mail art networks and visual poetry as a communication system (Huhtamo 2002).

5.2 Conclusions

Information gathered after the analysis of museum services in KNUST suggest that, the brick-and-mortar museum was not the taste of students and staff. Rather, their preference was a virtual museum where patrons could sit anywhere and access it via the internet. Even though the physical brick-and-mortar museum was not the taste of the University Community, the collapse of it was attributed to lack of publicity by the interim museum management committee. The obvious inference from the outcome of the analysis of museum services is that the low patronage of museum services was due partly to the operations of planning committee members and the miscalculation of the university's interest in a manual museum. Thus, there are still KNUST community members who are not aware that, the university has ever established a physical museum which has folded up. The edifice earmarked for the museum is now center for business incubation.

The development and implementation of VIMU-KNUST was carried out as intended but some elements of the design features received queries by the beneficiaries. Thus, the University community applauded the VIMU-KNUST created as a prototype but wished that portions of its architecture like the interactivity and navigability features were improved upon. The insight gained from this stance is that not all the features of VIMU-KNUST met the desires of the University community. For example, the navigability and interactivity features of the resource was not up to task.

Again the pervasive idea drawn from the additional comments like (*the erratic nature of electricity supply, smaller bandwidths, and discontinuity of projects by successive administration, skewed collections and the ability to maintain the resource after creation*) also pointed to the fact that the University was a bit skeptical about the

security, content and sustenance of the project. However, the images, content and narration features of VIMU-KNUST was well applauded by the University.

From the reasons provided on the relevance of VIMU-KNUST, the researcher can conclude without any shade of doubt that the resource would provide educational, cultural and monetary benefits to the University. The creation of a virtual museum as a project can never be finished because the resource needs to be updated every now and then

5.3 Recommendations

Now that it is evident that the University is interested in a virtual museum all conscious efforts must be made by the University Management Committee to create such a resource as an alternative media to enhance access to KNUST's heritage. The following recommendations must also be taken into consideration in the University's bid to create the advocated virtual museum. The others are general professional advice given to curators as they decide to create virtual museums for educational, research and recreational purposes as noted from the review of related literature.

Technical

5.3.1 Careful Selection of Content

The virtual audience that visit virtual museums come from different backgrounds with different educational needs. Curators/Managers of Virtual museums are expected to factor these multifaceted needs of virtual audience into the selection of their collections. It is difficult to meet the desires of all virtual visitors but for a targeted group, this could be done to a large extent. A virtual museum of Art, Science and Technology like the one under review should be able to satisfy the artistic, scientific and technological thirst of its visitors. Each College in the University must feel represented as far as collections are concerned. In this vein, the Museum Board ought to be a professional one with a few stakeholders. There could also be Trustees. Once these groups are satisfied after visiting, they become regular patrons of the site and their feedback becomes a crucial contribution towards the improvement of the Virtual Museum. It is against this backdrop that the selection of the content of the Virtual Museum should be carefully done.

5.3.1.1 Bigger Broadband for Network Speed

The degree of broadband that a system possesses have direct impact of its speed of operation. Most systems that snails with the least traffic tend to be those that have smaller bandwidths. Comparatively, visuals need bigger spaces to occupy and more time to move than textual information, this could be enhanced with the use of bigger bandwidths. Therefore, the Virtual Museum must have a dedicated bandwidth to operate on instead of sharing same with other applications. The speed of network attracts audience to stay on sites but the 'snailing' networks repels audience from the sites. There should therefore be special budgetary allocations for the purchasing of bigger bandwidths for Virtual museum operations. Many visitors visiting a virtual museum site at the same time could be very frustrating if the resource does not have a bigger bandwidth to contain such traffic. After all it is the intention of Virtual Museum to offer easy and quick access to information and this could be defeated if the network speed is questionable.

5.3.1.2 Protection of Resource from Attacks

Once the Virtual Museum is connected to the internet for global access, it becomes a potential target to an array of cyber threats, such as hackers, key loggers and Trojans that attack through unpatched security holes. There is therefore the need to build barriers in the resource to shield it from the enumerated attacks. Integration of firewalls into the system is commendable because such devises can intercept malicious attacks from entering the resource through the internet. These firewalls can be installed in hardware or software form or a combination of both. A little alteration of an image or arrangement or narration in any page of the virtual museum renders the entire page valueless. A Professional - knowledgeable in network security is needed to oversee these defects.

Managerial

5.3.2 Good Collaboration for Optimal Results

Offering Virtual Museum Services require the synergy of varied professional staff. The partnership of these experts is needed right from the collection of exhibits to the displaying of the exhibits. Thus, the assembling of collections requires expertise from researchers, librarians, archivists, archaeologists, historians, artists, ethnographers, scientists, photographers just to mention a few. In much the same way, the preservation, storage (mostly digital images) and retrieval also require professional hands like computer programmers, network operators, web designers, system analysts just to mention a few. The roles played by each complements the other towards the effective and efficient delivery of virtual museum services. Each professional need the assistance of the other in order for the system to run. The partnerships should be one of understanding and friendly for optimal results.

5.3.2.1 Continuity of Unfinished Projects

As could be drawn from the factors that led to the low patronage of museum services in KNUST, there is therefore the need for successive University Administration to continue the unfinished projects of the previous administration. Indeed, each administration comes to power with its own vision and objectives and would want to achieve them during their term of office. However, if there are already projects running, it is just economically prudent to see to the fruition of such projects in order not to waste such investments. The challenge might be inadequate resources or prioritizing newer projects against older ones. This management principle could be carried into the management of the advocated Virtual Museum when the leadership changes hands. This notwithstanding the cost benefit analysis of previous projects should be critically analyzed before considering their continuity.

5.3.2.2 Constant Supply of Electricity

The impact of bad power supply on electrical systems/appliances can be significant. They can cause disruption of power to equipment resulting in operational delays, equipment instability and failure. Power cuts result in downtime. If visitors are unable to visit the site, the project is indirectly losing audience. Such situations could also result in audience losing confidence in the service. This demonstrates the importance

of good power supply. Poor power quality also results in higher energy costs due to the inefficient use of power. Sensitive electronic equipment like computers are prone to problems when exposed to unreliable power supplies. Bad power supply can cause components to operate outside of normal values, this causes overheating and operation issues such as data error or loss, equipment malfunction and component failure. Transformers, generators and other switchgear/cabling – Electrical switchgear operating in over or under voltage conditions are prone to overheating and unstable operation. Fuses and Circuit breakers – The most common outcome of poor power quality on fuses and circuit breakers is nuisance tripping. Nuisance tripping can have a significant impact on equipment performance as it causes unplanned shutdown of equipment, data error or loss and damage to equipment.

5.3.2.3 Regular Maintenance of Equipment

Regular maintenance of equipment is an important and necessary activity. The term *'maintenance'* covers many activities, including inspection, testing, measurement, replacement and adjustment, and is carried out in all sectors and workplaces. Employers have a legal obligation to ensure correct maintenance of machinery in the workplace. This helps to reduce any risks as a result of unexpected failures and helps to keep the work-force safe. On top of this, there are several good reasons to keep the machines serviced on a regular basis. The cost of regular maintenance is very low when it is compared to the cost of a major breakdown at which time there is no production. The main purpose of regular maintenance is to ensure that all equipment required for production are operating at 100% efficiency at all times. It improves security, efficiency, productivity and helps make business processes run smoothly but Information Technology (IT) systems require regular maintenance to ensure the systems themselves continue to work efficiently. Most of the repetitive maintenance activities carried out on IT systems are done manually but can be easily automated.

General

5.3.3 Adaptation to Fast Technological Changes

Technology is always in a state of change since new developments are continually emerging. Technological products change, and the way they are used changes. To stay in business, one needs to be aware of technological advancements relevant to his

operations. The resource should have the capacity to function in different environments with new user queries as well. Inability to move abreast with time may render an otherwise good resource a valueless one. It is therefore incumbent upon the curators and the entire team of administrators to integrate newer technologies as and when they emerge into the virtual museum project in order to remain competitive. As the system adapts to technological changes so must the collections be updated as frequently as possible.

5.3.3.1 The Need for Feedback

Feedback is about audience's response; it enables administrators to evaluate the effectiveness of their operations. It is valuable information that could be used to make important decisions. Top performing companies are top performing companies because they consistently search for ways to make their best even better. Effective feedback has benefits for the giver, the receiver, and the wider organization.

It is vital to the virtual museum's ongoing development. It clarifies expectations, helps virtual visitors learn from their mistakes and builds confidence. Constructive feedback is one of the best things' curators can provide to their audience. Feedback promotes personal and professional growth. Feedback is about listening actively, taking the time to analyze, and then thinking of the best possible solution to perform better. It provides positive criticism and allows to see what everyone can change to improve their focus and results. Feedback is an essential part of effective learning. It helps virtual audience to understand the artifact being studied and gives them clear guidance on how to improve their appreciation. Providing a feedback facility in the VM app is therefore very crucial.

The uncovered part of this study: *intangible heritage* could be a subject for future investigations.

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APPENDICES

APPENDIX (A.1) (Questionnaire and Interview Guides) How would you assess the DEMO based on the outlined features? Please tick as appropriate

A. IMAGEABILITY	**Very Good**	**Good**	**Undecisive**	**Poor**	**Very Poor**
Picture Resolution					
Contrast					
Responsiveness					
Effects					
B. INTERACTIVITY					
Speed					
Colour Choice					
Dialogue					
Icons Visibility					
C. NAVIGABILITY					
Hyper link					
Site Mapping					
Ease of Use					
Compatibility					
D. NARRATION					
Background Information					
Object Significance revealed					
Coherence					
Accuracy					
E. Content					

RECOMMENDATION

Would you recommend its creation for KNUST after refinement?

YESs YES NoN NO

Please give reason (s) for your choice of (Yes/No) Any other comment?

QUESTIONNAIRE (Pre-Screening) APPENDIX (A .2)

ENHANCING ACCESS TO KNUST HERITAGE: VIRTUAL MUSEUM AS THE KEY

Dear Respondent,

This survey seeks to find out the preference rate of the students and staff, if KNUST should create a virtual museum to enhance access to hear heritage. Please your responses will be accorded with the utmost confidentiality that they scholarly deserve.

Gracias

Rev. Kwabena Ofori Asiamah

(PhD, African Art and Culture)

STUDENTS

1. GENDER

□ Male □ Female

2. AGE RANGE

□ 15-19 □ 20-24 □ 25-29 □ 30-34 □ 34+

3. LEVEL

□ Undergraduate □ Masters □ Doctoral

4. COLLEGE

□ CoS □ CoE □ CANR □ CABE □ CHS □ CHSS

5. KNOWLEDGE OF VIRTUAL MUSEUM

Kindly tick the appropriate box

Poor	Fairly Good	Good	Very Good

6. WOULD YOU LIKE KNUST TO HAVE A RESOURCE? □ Yes □ No

7. PLEASE, GIVE REASONS FOR YOUR CHOICE

QUESTIONNAIRE (Pre-Screening) APPENDIX (A.3)

ENHANCING ACCESS TO KNUST HERITAGE: VIRTUAL MUSEUM AS THE KEY

Dear Respondent,

This survey seeks to find out the preference rate of the students and staff, if KNUST should create a virtual museum to enhance access to hear heritage. Please your responses will be accorded with the utmost confidentiality that they scholarly deserve. Gracias

Rev. Kwabena Ofori Asiamah

(PhD, African Art and Culture)

STAFF

1. GENDER: □ Male □ Female

2. AGE RANGE: □ 21-30 □ 31-40 □ 41-50 □ 51-60 61+

3. CATEGORY: □ Senior Member □ Senior Staff □ Junior Staff

4. JOB STATUS: □ Teaching □ Non-Teaching

KNOWLEDGE OF VIRTUAL MUSEUM

Kindly tick the appropriate box

Poor	Fairly Good	Good	Very good

WOULD YOU LIKE KNUST TO HAVE SUCH A RESOURCE? □ Yes □ No

PLEASE, GIVE REASONS FOR YOUR CHOICE

INTERVIEW GUIDE APPENDIX (A.4)

THESIS TITLE: ENHANCING ACCESS TO KNUST'S HERITAGE: VIRTUAL MUSEUM AS THE KEY

- CATEGORY OF RESPONDENT- (Administrator, lecturer, Postgraduate, Other Staff)

- AWARENESS OF KNUST'S MUSEUM

- CAUSES OF LOW PATRONAGE

- RELEVANCE OF THE MUSEUM

APPENDIX (B.1) (Supporting Documents) ENHANCING ACCESS TO KNUST HERITAGE: VIRTUAL MUSEUM AS THE KEY

(A PhD thesis by Rev. Kwabena Ofori Asiamah at the Department of Educational Innovation in Science and Technology, Faculty of General Art Studies, College of Art and Built Environment)

STRATEGIC SELECTION AS A RESPONDENT

As part of collecting data for the Thesis, may I humbly inform you with all due respect that, I have kindly selected you strategically as a special respondent to a DEMO Review Questionnaire which would be filled on Wednesday, 18th July 2018 at the Research Commons-Prempeh II Library between 10.am and 10.30 am

A Fifteen-minute DEMO of the intended Virtual Museum would be screened; after which you would respectfully assess the viability of the proposed project by responding to the attached questionnaire.

I am only trusting that, my humble request as a researcher shall find favour with you.

God bless you for your understanding and continuous assistance

Rev. Kwabena Ofori Asiamah

College Librarian

CANR – KNUST

(0246 175846)

DEPARTMENT OF GENERAL ART STUDIES
FACULTY OF ART, COLLEGE OF ART & BUILT ENVIRONMENT
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Headgeneralart.cass@knust.edu.gh

Ref: GASS/S/3 Date: 7th March, 2017

The Provost

College of Agriculture and Natural Resources

KNUST

Dear Sir,

LETTER OF INTRODUCTION: KWABENA OFORI ASIAMAH – 20490509 AND KWASI AMOAKOHENE – 20462335

The bearers of this letter are PhD Students of the Department of General Art Studies reading African Art and Culture.

As part of the preparations to resuscitate the folded-up Museum and to advocate for the creation of a Virtual Museum for KNUST, it has become necessary to identify various inventions, relics and other objects of interest within the Colleges for curatorial attention. This is the Project these students are working on.

The Department would be very appreciative if you could accord the researchers the necessary assistance when they approach your College for directions. Yours faithfully,

Dr. Patrick Osei-Poku

(Head of Department)

Krejcie & Morgan Sample Size Determination Table APPENDIX (B.3)

N	S	N	S	N	S

10	10	220	140	1200	291
15	14	230	144	1300	297
20	19	240	148	1400	302
25	24	250	152	1500	306
30	28	260	155	1600	310
35	32	270	159	1700	313
40	36	280	102	1800	317
45	40	290	105	1900	320
50	44	300	109	2000	322
55	48	320	175	2200	327
60	52	340	181	2400	331
65	56	360	186	2600	335
70	59	380	191	2800	338
75	63	400	198	3000	341
80	66	420	201	2500	346
85	70	440	205	4000	351
90	73	460	210	4500	354
95	76	480	214	5000	357
100	80	500	217	6000	361
110	86	550	226	7000	364
120	92	600	234	8000	367
130	97	650	242	9000	368
140	103	700	248	10000	370
150	108	750	254	15000	375
160	113	800	260	20000	377
170	118	850	265	30000	379
180	123	900	269	40000	380
190	127	950	274	50000	381
200	132	1000	278	75000	382
210	136	1100	285	100000	384

(Source: The NEA Research Bulletin, Vol. 38 (December, 1960), p. 99) Note.

—N - Population size.

S – Sample size