UNIVERSITY OF CAPE COAST

INTERNET OF THINGS AND LIBRARY SERVICE DELIVERY IN

SELECTED PUBLIC AND PRIVATE UNIVERSITIES IN GHANA

BY

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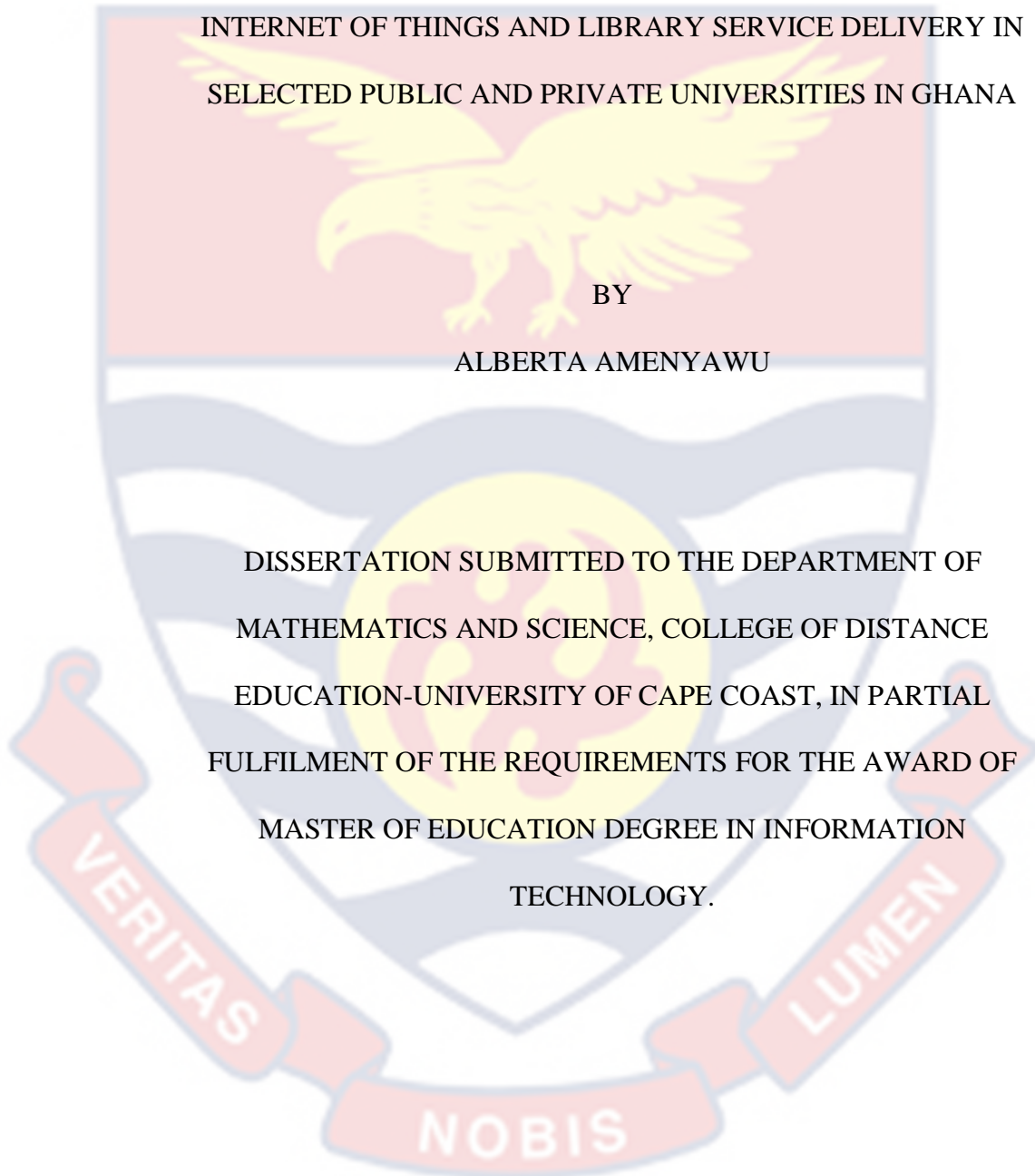
AUGUST 2023

DECLARATION

Candidate's Declaration

I hereby declare that this dissertation is the result of my original work and that no part of it has been presented for another degree at this university or elsewhere.

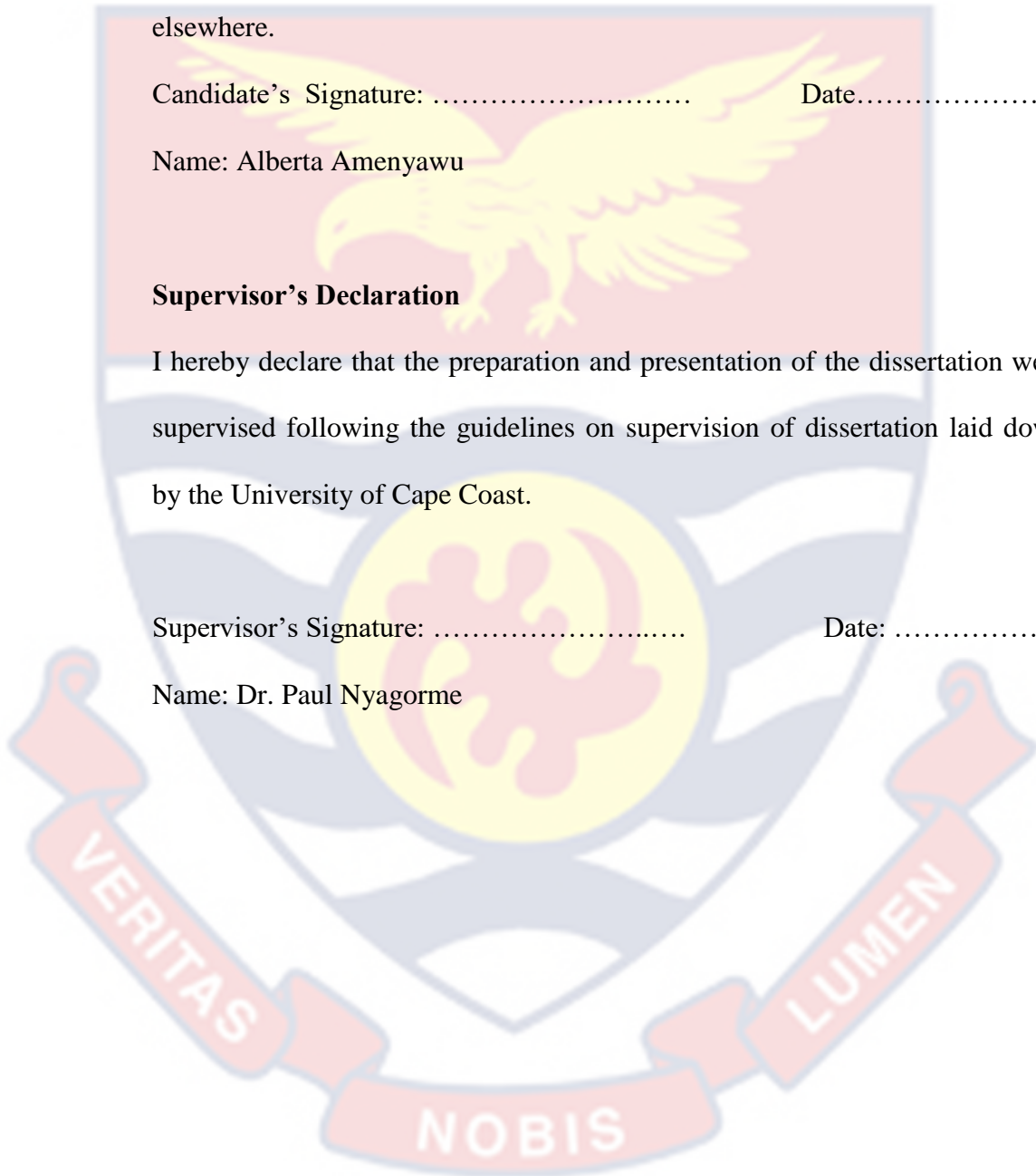Candidate's Signature: ……………………   Date…………………

Name: Alberta Amenyawu

Supervisor's Declaration

I hereby declare that the preparation and presentation of the dissertation were supervised following the guidelines on supervision of dissertation laid down by the University of Cape Coast.

Supervisor's Signature: ………………..…..   Date: ………………

Name: Dr. Paul Nyagorme

ABSTRACT

The study assessed the usage of the Internet of Things (IoT) in library service delivery at both public and private university libraries in Ghana. The study adopted a descriptive research design. The target population was students of the University of Cape Coast, University of Ghana, Kwame Nkrumah University of Science and Technology, Valley View University, and University of Health and Allied Science. Two hundred students who patronize their university libraries were sampled through convenience sampling method. Data gathered from the questionnaire administered to the two hundred students, were analyzed with mean and standard deviation. The study revealed that IoT is incorporated in library service delivery at the universities where the study was carried out. Also, university students are highly satisfied with library-service delivery that incorporate the Internet of Things (IoT) in service delivery. Again, the study found that there are challenges in the smooth running of IoT in library service delivery at the university libraries in Ghana. Furthermore, the study showed that E-journal is commonly available at the university libraries in Ghana. The results of the finding revealed that the internet of things contributes to an effective learning climate that achieves higher levels of satisfaction. Students are satisfied with online information in the modern library. Based on the findings from the study, it was recommended that the University library management should place more priority on access to electronic resources such as journals E – Thesis E – research, E-Bibliography, and E-book, which show more rating by the respondents.

KEYWORDS

IoT

IP

Library Service

Sensor

Smart Library

University Library

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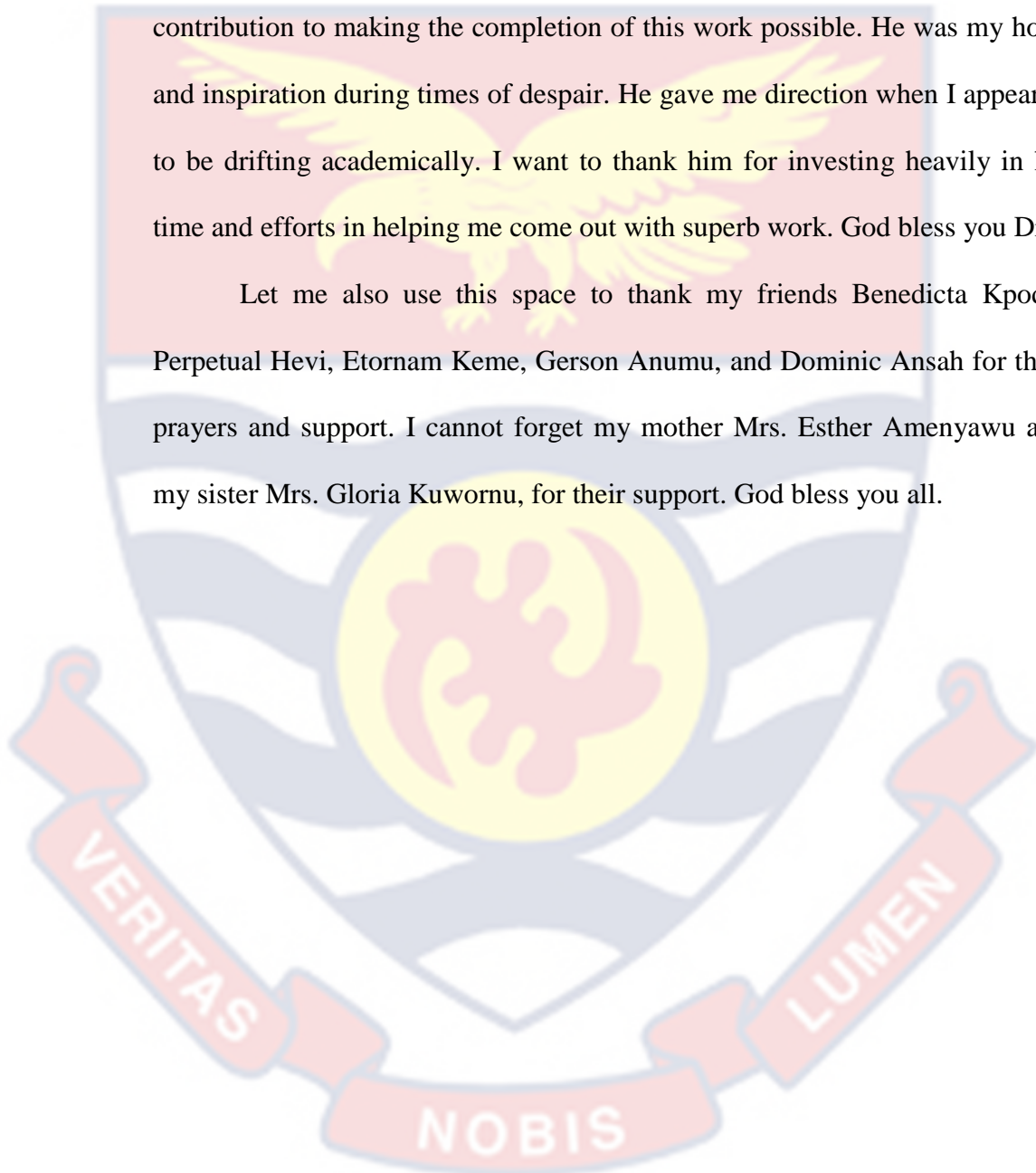
DEDICATION

To my husband, Mr. Richard Kumashie, and my children, Divine Kumashie,

Esther Kumashie, Desmond Kumashie, and John Kumashie.

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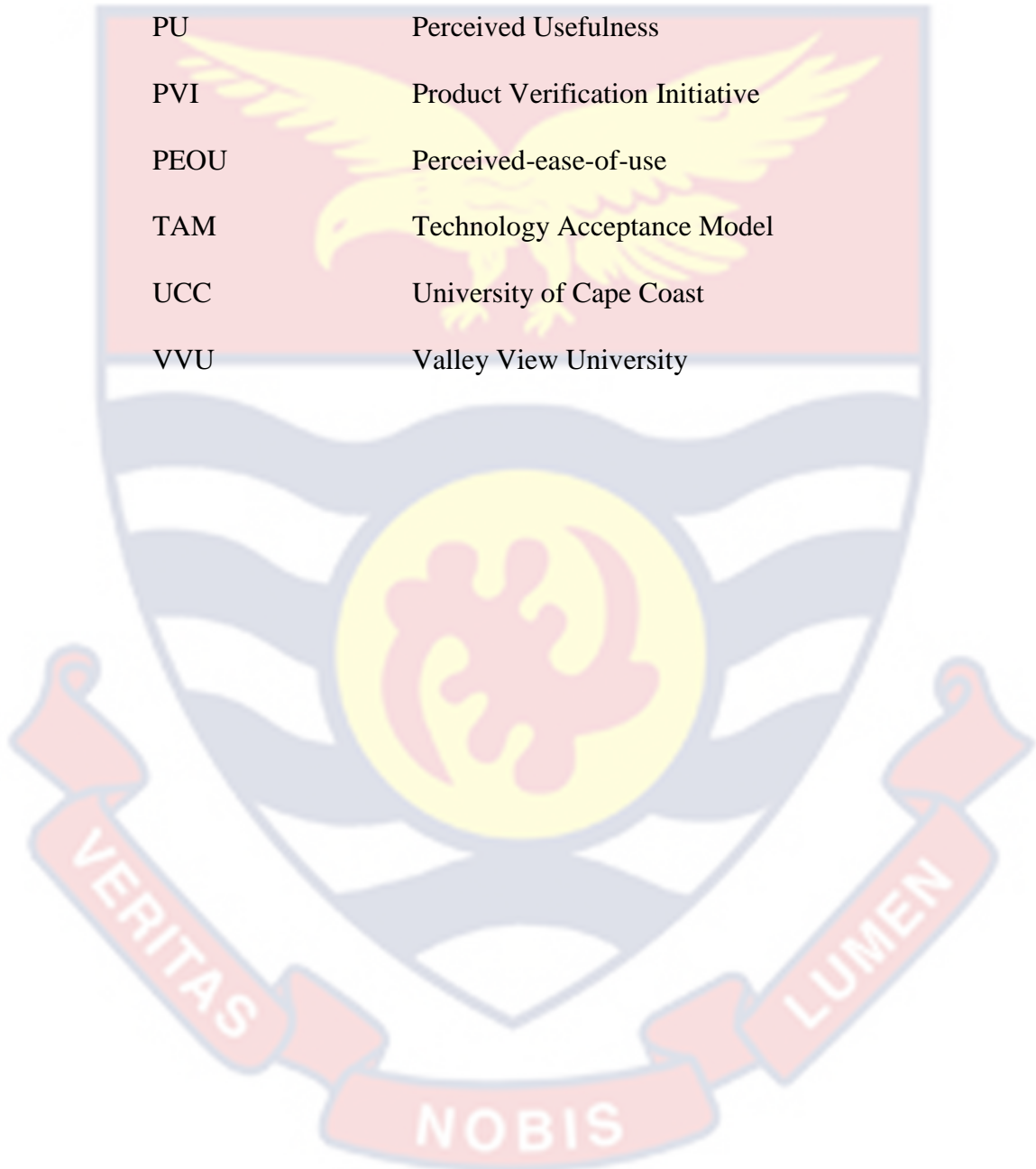|	
FRID	Radio Frequency Identification
IoT	Internet of Things
IP	Internet Protocol
PU	Perceived Usefulness
PVI	Product Verification Initiative
PEOU	Perceived-ease-of-use
TAM	Technology Acceptance Model
UCC	University of Cape Coast
VVU	Valley View University

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CHAPTER ONE

INTRODUCTION

Background to the Study

Generally, Information and Communication Technology has come to reshape the way we do things in all spheres of our lives. For instance, the use of home appliances is made easier, where appliances can be used remotely. A study was conducted on how the Internet of Things (IoT) has made the use of home appliances so easy (Patru, 2016). The study concluded that there has been a huge growth in the world of intelligent devices for home automation. Such gadgets are designed in order to ease the interaction between people and daily home duties. Although individually they are simple to work with, each appliance has its own configuration interface which adds overhead to the general user experience. The study also presented a solution for connecting more devices into a signal entity which can be easily accessed at any time. The implementation integrates the functionalities of different home automation devices into a single application.

The Internet of Things is the extension of internet connectivity into physical devices and everyday objects. Embedded within electronics, internet connectivity, and other forms of hardware, IoT turns the objects into smart ones which are connected through internet protocol (IP). (Vasseur & Adam, 2015) dwelt much on IoT and its connectivity.

Egypt has shown that IoT solutions can be used to solve societal problems through innovation. A Cairo-based technology firm called Integreight announced that it has developed an IoT chip that can be integrated with modern appliances like refrigerators, cameras, TVs, and washing

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machines. This IoT-based application named 1shield gives users the capability to use their appliances remotely by simply connecting the chip to their smartphone (Octavio, José, Salcedo & Parra, 2020).

The 1sheeld technology uses an Arduino board, and the 1sheeld application can then be accessed from a smartphone by using Bluetooth. Using the 1shield library, codes can be written into the Arduino software application before uploading to the board. This allows the control of many different sensors that are available on the board. Other IoT-based applications can be used on farms, our source of food (Mahdad, Maral, Hasanov, Mustafa, Isakhanyan, Gohar, & Dolfsma, 2022).

Farmers are using remote sensors to monitor moisture levels and soil conditions in the fields to avoid crop failure (Rodríguez-Fernández, Nemesio, Bitar, Ahmad Al, Colliander, Andreas Zhao, & Tianjie, 2019). Similar sensors are providing remote control of micro-irrigation pumps in India and water pumps in Rwanda, improving the functionality and reducing repair intervals (Samuel, Manoj, & Suresh, 2021).

Technology is again helpful in the area of Waste Management. Kenya used IoT-based applications to deal with waste management issues. Nairobi County in Kenya has been grappling with waste management issues for a long time. To tackle this problem, Nairobi officials approached IBM (International Business Machine) which is a multinational technology company, to develop an IoT- based application for waste management. The idea is to develop a solution that can be installed in the waste collection fleet to monitor them in real-time (Dhanalakshmi & Hemalatha, 2021).

The IoT-based solution called for the fleet of waste collection trucks to be installed with smart sensors that would tell when the vehicles are in the garage or on the road. The IoT-based sensors can also check dumpsites to see if they are full and need to be drained, check how long the waste collection truck has taken in traffic, and the time they take to collect garbage. The IoT application is also expected to automatically monitor the driver's behavior, detect speed bumps and potholes, and check fuel usage by the driver.

The IoT-based initiative has enabled Nairobi County to track the garbage fleet and ensure that the trucks are doing their job at the allotted time. The smart sensors allowed Nairobi County to see great improvements during the trial period as collected waste volumes tremendously increased (Muthoni, 2018). Productivity will increase if workers know that their activities are being monitored remotely by sensors in machines. So, it can be deduced that supervision plays a significant role in high productivity, and in this case, it is done through IoT.

Another area of our lives that has seen improvement through technology is health. (Dhanalakshmi & Hemalatha, 2021) explained how IoT is used in the health sector. For example, Nigeria used technology (IOT-based) to curb drug counterfeiting through the Product Verification Initiative (PVI). Faced with a perennial drug counterfeiting problem, Nigeria's National Agency for Food and Drug Administration and Control (NAFDAC) 2010 resorted to the IoT-based (PVI) to curb drug counterfeiting by using Radio Frequency Identification (RFID). The IoT-based technology was carried out in collaboration with Verification Technology Limited (VTL). The IoT solution used tags equipped with RFID to secure the integrity of the drugs throughout

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the supply chain, starting from the manufacturers to the distributors, wholesalers, retailers, and consumers.

The RFID tags are expected to track down the drug's path as it moves across the supply chain. To verify the drug's authenticity, special RFID scanners were placed at the port of entry. It is also expected that RFID scanners will be purchased by all hospitals, pharmacists, and manufacturers to have a collective effort in dealing with the problem of drug counterfeiting in general.

Educational enterprises are not left out of beneficiaries of technology. One of the areas under education where technology is employed is teaching and learning. Ghavifekr and Rosdy (2015) did extensive work on the usage of technological tools such as video conferencing, Google classroom, Google meet, Moodle, employed in teaching and learning. This has made teaching and learning deliverable and accessible regardless of the location of the instructors and learners.

When it comes to educational administration, technology is still relevant. Kapur (2019) stated that the use of technology in educational administration leads to a reduction in delays in inordinate file processing and movement. Administrative activities such as meetings, are done not necessarily in person but online. Video conferencing tools such as ZOOM and Google Meet are used for deliberations on issues affecting education at the regional, Metropolitan, Municipal, District, and school levels. Apart from this, the video conferencing tools are also used by administrators at various educational institutions, right from kindergarten to tertiary.

With admissions at the second-cycle institutions and tertiary institutions, technology is employed so parents and students do not have to travel distances to check on admission issues. This was not the case before the arrival of technology. Smart devices can collect and exchange data along with automatic decision-making. In light of this, every emerging light of the Internet of Things will change the narrative where, the libraries' future was considered a fiction, into a better library service delivery. With the arrival of IoT, library service delivery such as availability of E-resources, library resource access, and user satisfaction which were formally neglected will be brought to the limelight and attended to with all seriousness. In Ghana, even though The Internet of Things is in its early stages, experts view it as a game-changer. One author described the IoT as Silent Intelligence (Obodovski, 2013).

A library is a collection of materials, books or media that are easily accessible for use and not just for display purposes. It is responsible for housing updated information in order to meet the user's needs on a daily basis. A library provides physical (hard copies documents) or digital access (soft copies) materials, and may be a physical location or a virtual space, or both. A library's collection can include printed materials and other physical resources in many formats such as DVD, CD and Cassette as well as access to information, music or other content held on bibliographic databases (Kennedy, 2005).

A library, which may vary widely in size, may be organized for use and maintained by a public body such as a government; an institution such as a

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school or museum; a corporation; or a private individual. In addition to providing materials, libraries also provide the services of librarians who are trained and experts at finding, selecting, circulating and organizing information and at interpreting information needs, navigating and analyzing very large amounts of information with a variety of resources (Mulumba, Onan, Akullo & Nekesa, 2018).

Library buildings often provide quiet and conducive areas for studying, as well as common areas for group study and collaboration, and may provide public facilities for access to their electronic resources; for instance: computers and access to the Internet. The library's clientele and therefore the services offered vary depending on its type: users of a public library have different needs from those of a special library, for example, Libraries may also be community hubs, where programs are delivered and people engage in lifelong learning. Modern libraries extend their services beyond the physical walls of a building by providing material accessible by electronic means, including from home via the Internet. Hence managing information in an information world has become very easy simply because information can be provided or being accessed virtually by people who are in remote areas and other places away from the library.

The services the library offers are variously described as library services, information services, or the combination although different institutions and sources define such terminology differently (Rysavy, Michalak & Russell, 2019).

Statement of the Problem

The way information is gathered, stored, organized, accessed, retrieved, and consumed should be productive and more friendly. In Ghana, the demand for computers to access information rapidly puts libraries in a more critical position to meet the complex and ever-changing needs of the users and stakeholders most effectively and efficiently.

Universities are the highest learning institutions and intellectual hubs of every nation and university libraries are the driving force behind all the intellectual activities of universities. University libraries are the heart of every university. They are now moving from traditional book resources to more dynamic and flexible E-resources. (Saklani, 2021). University libraries are moving towards having access to more and more E-resources in their collection as they form major intellectual research output of the world.

Libraries serve as the backbone of every educational institution as well as in the lives of students. Thus, libraries play a key role in research, teaching, and learning (Devan, 2020). Some services are required of libraries. Such services may be in the form of lending, making resources available, providing information literacy, and above all, giving satisfaction to library users.

This can be time-consuming and tiresome. The time spent walking or transporting oneself to the library can be used in reading a paragraph or two of lecture-note or an electronic document related to a student's field of study.

The problem of library users being physically present at a university library to access services can be overcome if libraries are brought to the doorsteps of students and other users. A modern library is supposed to provide readily available services in various forms such as chat, e-mail, social media,

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mobile applications, and others (Campbell, 2020). In this context, there is a need of turning the traditional university libraries in Ghana, into smart libraries. Smart libraries are born out of the Internet of Things (IoT).

Technology is dynamic and keeps evolving. As a result, new technologies emerge now and then affecting every institution in the world, (Thakare, Patil, & Siddiqui, 2016). One of such technologies is the Internet of Things.

When IoT is incorporated into Ghanaian University libraries, users especially students can access library resources everywhere, access E-Resources, and derive maximum satisfaction from using the libraries (Dawar, 2021).

The problem here is traditional libraries that were considered as the storehouse for books and available for kings and renowned personalities of the society, need to be changed to modern libraries, which should serve as information centers (Ozeer, 2019). The books need to be replaced by information, which sole purpose will be for dissemination and not for preservation. Tremendous advancement in technological developments is taking place in the field of technology and so is the user demand for library service delivery.

One of the things that advanced technology has given birth to is the Internet of Things (IoT). When Internet of Things is incorporated in library service delivery at the university libraries in Ghana, it can help meet the needs of the 21st century students (Alandjani, Pervez, & Rehman, 2018). The 21st century students use libraries to broaden their knowledge and eventually become successful in their academic work. If university students depend on traditional libraries, where they have to be present physically in a structure

called library in order to access information, they will waste precious time that could have been used on reading something from a smart library.

Previous researches discussed the usage of Internet of Things in home appliances, where gadgets such as fridges, television, doors, electrical bulbs and Google home voice-controller are made smart through home automation (Luechaphonthara, 2019). Researchers also worked on the use of IoT in farming, where soil moisture level can be determined remotely. Again, research work was done on the use of IoT in curbing drug counterfeiting. Furthermore, research work had been done on how Internet of Things is used in waste management.

In summary, a lot of research work has been done on usage of Internet of Things in other areas including those mentioned above but usage of IoT in library service delivery has not been brought to the limelight. So, it has become necessary to find out if there is usage of IoT in library service delivery in Ghana's universities.

Purpose of the Study

The purpose of carrying out this study was to explore the usage of the Internet of Things in library service delivery at public and private universities in Ghana.

Objectives of the Study

Specifically, the study seeks to:

1. Assess the usage of the Internet of Things (IoT) in library service delivery in public and private universities in Ghana.

2. Find out the availability of E-Resources at the libraries at the public and private universities in Ghana.

3. Find out students' satisfaction regarding the usage of IoT to deliver library services at public and private universities.

Research Questions

The following research questions guided this study:

1. How does IoT usage affect library service delivery in the public and private universities in Ghana?

2. What are the available e-resources for library service delivery in public and private universities in Ghana?

3. What is students' satisfaction regarding the usage of IoT to deliver library services at public and private universities?

Significance of the Study

The research findings would provide empirical evidence to the university library boards, university librarians, and university students in Ghana. The study will also inform Government and University Boards on the impact of the usage of the Internet of Things (IoT) on academic library service delivery to users. This will inform all stakeholders of the universities in Ghana as to how to formulate policies to guide the university libraries. Again, the study will add to the literature available on the subject and also serve as a guide for future researchers who may want to embark on a similar study.

Delimitation

The main purpose of this study is to assess the usage of the Internet of Things in University Library Service Delivery in public and private Universities in Ghana. The study was conducted at the University of Cape Coast, University of Ghana, University of Health and Allied Science and Valley View University.

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The study was limited to two-hundred (200) university students (male/female) who study various courses such as Accounting, Education, Business Management and Information Technology and use their university libraries. The study sought students' view through questionnaire, which questions were spread under three areas namely: the usage of internet of things and university library service delivery; the availability of E-Resources; and user satisfaction.

The librarians of the universities mentioned above were also interviewed through face-face structured interview.

The Technology Acceptance theory, Structure theory, and Diffusion of Innovation theory provided the theoretical bases for the study.

Limitations

Every study is likely to be faced with imposed restrictions and this study is not an exception. First and foremost, the study adopted the descriptive survey research design which has its limitations. For example, (Amedahe, 2002) maintains that in descriptive research, an accurate description of activities, objects, processes, and persons is objective. However, the design has its weakness as there is no way to statistically analyze results because there is no manipulation of variables as in experimental designs (Shuttleworth, 2008). Also, this study adopted the questionnaire and challenges emanated from this source. Some of the items were not answered. Concerning data collection, meeting respondents posed a challenge due to the busy work schedules of the researcher as well as the respondents. Again, some of the respondents were reluctant to divulge information to the researcher. But the researcher assured the respondents of their anonymity and confidentiality.

Organization of the Study

The study was organized into five chapters. Chapter one consists of an introduction to the study; the background to the study, the statement of the problem, the purpose of the study, and the objectives of the study. In addition, the research questions, significance of the study, delimitation of the study, limitations of the study, as well as the organization of the study, are presented in Chapter One of the study. Chapter Two deals with the review of related literature to the study from documents published and unpublished, including books, journals, newspapers, the internet, and other materials that will be relevant to the study. Chapter Three deals with the research methods used in the study. The content of this chapter includes the research design, study population, sampling procedure, data collection instruments, data collection procedure as well as the data processing and analysis plan. Chapter Four focuses on the results of the study and discussions. Chapter Five deals with the summary, conclusions drawn from the study, recommendations, and suggestions for further research studies.

CHAPTER TWO

LITERATURE REVIEW

Introduction

This chapter reviews literature under the following sub-headings: theoretical review; conceptual review; and conceptual framework and empirical review. Theoretically, the Technology Acceptance Model, the Structure Theory, and the Diffusion of Innovation Theory constituted the theoretical bases for the study. Conceptually, literature was reviewed on the Internet of Things as well as the concept of the academic library. Finally, the chapter concludes with an empirical review on the usage of the Internet of Things at the university libraries, the availability of E-Resources at the university libraries, the relationship between library resource access and IoT, and the relationship between library-user satisfaction and Internet of Things at the university libraries.

Theoretical Framework

A theory is a proposition about the existing relationship between things. According to (Brewer, 2000), a theory includes plans and associations about the existing human contacts and their effect on each other. (Bell, 2006), explains that a theory refers to the current state of knowledge and this can be best understood in its relation and influence on others.

The theoretical framework has a myriad of definitions. According to Miles and Huberman, (1998), a theoretical framework is a hypothetical description of a complex entity or process. They further explain that it is an explanatory device that explains the main things to be studied (the factors or variables). In formulating the theoretical background of this study, I focus on,

the Technology Acceptance Model (TAM), the Structure Theory (ST), the Theory of Reasoned Action (TRA), and the Diffusion of Innovation Theory (DOI).

The Technology Acceptance Model

The technology acceptance model (TAM) is an information systems theory that models how users come to accept and use a technology. The actual system use is the end-point where people use the technology. Behavioral intention is a factor that leads people to use the technology. The behavioral intention (BI) is influenced by the attitude (A) which is the general impression of the technology.

The model suggests that when users are presented with a new technology, a number of factors influence their decision about how and when they will use it, notably:

Perceived usefulness (PU) – This was defined by (Davis, 1989) as the degree to which a person believes that using a particular system would enhance their job performance". It means whether or not someone perceives that technology to be useful for what they want to do.

Perceived ease-of-use (PEOU) – Davis defined this as the degree to which a person believes that using a particular system would be free from effort (Davis 1989). If the technology is easy to use, then the barriers conquered. If it's not easy to use and the interface is complicated, no one has a positive attitude towards it.

External variables such as social influence is an important factor to determine the attitude. When these things (TAM) are in place, people will

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have the attitude and intention to use the technology. However, the perception may change depending on age and gender because everyone is different.

The TAM has been continuously studied and expanded—the two major upgrades being the TAM 2 (Venkatesh & Davis, 2000) and the unified theory of acceptance and use of technology or UTAUT, (Venkatesh et al., 2003). A TAM 3 has also been proposed in the context of e-commerce with an inclusion of the effects of trust and perceived risk on system use (Venkatesh & Bala, 2008).

The Structure Theory

The theory of structuration is a social theory of the creation and reproduction of social systems that is based on the analysis of both structure and agents, without giving primacy to either. Furthermore, in structuration theory, neither micro- nor macro-focused analysis alone is sufficient (Gibbs, 2017) . The theory was proposed by sociologist Anthony Giddens, most significantly in The Constitution of Society, which examines phenomenology, hermeneutics, and social practices at the inseparable intersection of structures and agents. Its proponents have adopted and expanded this balanced position. Though the theory has received much criticism, it remains a pillar of contemporary sociological theory.

The Theory of Reasoned Action

The Theory of Reasoned Action (TRA), developed by Fishbein and Ajzen, (1980), derived from previous research that started out as the theory of attitude, which led to the study of attitude and behavior. The theory was "born largely out of frustration with traditional attitude-behavior research, much of which found weak correlations.

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Diffusion of Innovation Theory

The process of adopting new innovations has been studied for over 30 years, and one of the most popular adoption models is described by Rogers in his book, Diffusion of Innovations (Sherry & Gibson, 2002). Much research from a broad variety of disciplines has used the model as a framework. Dooley (1999) and Stuart (2000), mentioned several of these disciplines as political science, public health, communications, history, economics, technology, and education, and defined Rogers' theory as a widely used theoretical framework in the area of technology diffusion and adoption. Rogers' diffusion of innovations theory is the most appropriate for investigating the adoption of technology in higher education and educational environments (Medlin, 2001; Parisot, 1995). In fact, much diffusion research involves technological innovations so Rogers (2003) usually used the word "technology" and "innovation" as synonyms.

For Rogers, "a technology is a design for instrumental action that reduces the uncertainty in the cause-effect relationships involved in achieving a desired outcome" (Rogers, 2003 p. 13). It is composed of two parts: hardware and software. While hardware is the tool that embodies the technology in the form of a material or physical object, software is the information base for the tool. Since software (as a technological innovation) has a low level of observability, its rate of adoption is quite slow. Adoption is a decision of full use of an innovation as the best course of action available and rejection is a decision not to adopt an innovation. Rogers defines diffusion as the process in which an innovation is communicated thorough certain channels over time among the members of a social system. As expressed in the

above definition, innovation, communication channels, time, and social system are the four key components of the diffusion of innovations.

Rogers offered the following description of an innovation: An innovation is an idea, practice, or project that is perceived as new by an individual or other unit of adoption. An innovation may have been invented a long time ago, but if individuals perceive it as new, then it may still be an innovation for them. The newness characteristic of an adoption is more related to the three steps (knowledge, persuasion, and decision) of the innovation-decision process

In addition, there is a lack of diffusion research on technology clusters. A technology cluster consists of one or more distinguishable elements of technology that are perceived as being closely interrelated. Uncertainty is an important obstacle to the adoption of innovations. An innovation's consequences may create uncertainty, which may result in the changes that occur in an individual or a social system as a result of the adoption or rejection of an innovation.

To reduce the uncertainty of adopting the innovation, individuals should be informed about its advantages and disadvantages to make them aware of all its consequences. Moreover, Rogers (2003) claimed that consequences can be classified as desirable versus undesirable (functional or dysfunctional), direct versus indirect (immediate result or result of the immediate result), and anticipated versus unanticipated (recognized and intended or not).

The second element of the diffusion of innovations process is communication channels. Communication is a process in which participants

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create and share information with one another in order to reach a mutual understanding. This communication occurs through channels between sources. Rogers states that a source is an individual or an institution that originates a message. A channel is the means by which a message gets from the source to the receiver. Also, diffusion is a specific kind of communication and includes these communication elements: an innovation, two individuals or other units of adoption, and a communication channel. Mass media and interpersonal communication are two communication channels. While mass media channels include a mass medium such as TV, radio, or newspaper, interpersonal channels consist of a two-way communication between two or more individuals.

On the other hand, diffusion is a very social process that involves interpersonal communication relationships. Thus, interpersonal channels are more powerful to create or change strong attitudes held by an individual. In interpersonal channels, the communication may have a characteristic of homophily. Two or more individuals who interact are similar in certain attributes, such as beliefs, education, socioeconomic status, and the like, but the diffusion of innovations requires at least some degree of heterophily, which is the degree to which two or more individuals who interact are different in certain attributes. In fact, one of the most distinctive problems in the diffusion of innovations is that the participants are usually quite heterophilous.

Communication channels also can be categorized as localite channels and cosmopolite channels that communicate between an individual of the social system and outside sources. While interpersonal channels can be local

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or cosmopolite, almost all mass media channels are cosmopolite. Because of these communication channels' characteristics, mass media channels and cosmopolite channels are more significant at the knowledge stage and localite channels and interpersonal channels are more important at the persuasion stage of the innovation-decision process.

Time should not be ignored in behavioral research. Time according to (Rogers, 2003), the time aspect is ignored in most behavioral research. He argues that including the time dimension in diffusion research illustrates one of its strengths. The innovation-diffusion process, adopter categorization, and rate of adoptions all include a time dimension. The last element in the diffusion process is the Social System.

The social system is the last element in the diffusion process. Social system is defined as a set of interrelated units engaged in joint problem solving to accomplish a common goal. Since diffusion of innovations takes place in the social system, it is influenced by the social structure of the social system. Structure is the patterned arrangements of the units in a system and the nature of the social system affects individuals' innovativeness, which is the main criterion for categorizing adopters.

The innovation-decision process was described by (Rogers, 2003) as "an information-seeking and information-processing activity, where an individual is motivated to reduce uncertainty about the advantages and disadvantages of an innovation" The innovation-decision process involves five steps: (1) knowledge, (2) persuasion, (3) decision, (4) implementation, and (5) confirmation. These stages typically follow each other in a time-ordered manner.

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The aforementioned theories are important for the study because the Technology Acceptance theory was relevant to the study. After all, helped to investigate the attributes that influence technology acceptance such as the use of IoT at the university libraries, the Structure theory was helpful to the study in the sense that it spells out how human beings interact with technology. Also, the Theory of Reasoned Action talks about how humans behave based on the benefits they derive from technology. Again, the Diffusion of Innovation theory guided how the innovation of technology solutions, in this case, IoT are diffused in all sections of the university libraries.

Conceptual Framework

A Conceptual Framework is the use of a diagram that displays how variables relate to each other. A conceptual framework utilizes a diagram to explain the relationships among variables of the research problem. Latham (as cited in Adom, Hussein & Joe, 2018) explained that the whole methodology of the research under study must agree with the variables and their relationships and context.

The diagram below shows the relationship between the dependent variable: library service, and the independent variable: IoT.The diagram indicates that a library in which IoT is incorporated makes use of artificial intelligence and so there are opportunities of internet forums, discussion groups, voice-based search and digital lending. If these things are available in a library, then the library is smart. A smart library is able to offer E-resources, easy access to library resources and maximum satisfaction for library users. In other words, if a university library is able to provide E-resources, 24hour access to resources, where location or distance is not a barrier and users derive

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maximum satisfaction from the library's service delivery, then there is usage of IoT in that library.

| INTERNET OF THINGS (IoT) | ←→ | UNIVERSITY LIBRARY SERVICE DELIVERY |

SMART LIBRARY

Artificial intelligence

Forum

Discussion group

Voice-based search

Digital lending

YES

USASGE OF IOT

AVAILABILITY OF E-RESOURCES

RESOURCE ACCESS

USER-SATISFACTION

Independent Variable   Dependent Variable
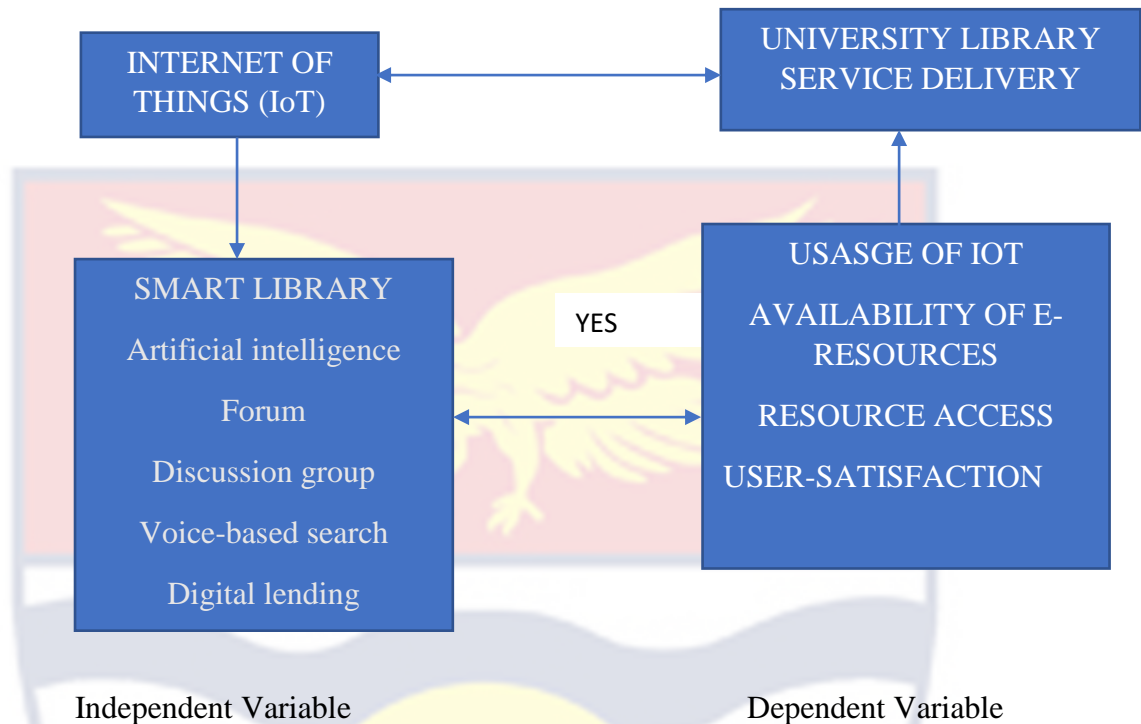
Figure 1: Conceptual Framework

The Concept of Internet of Things

The Internet of Things is considered the third wave of information technology right after the Internet and mobile communication network, which is characterized by more comprehensive interoperability and intelligence. Initially, there was only information online that is data contained on the internet, then people were connected utilizing e-mail, social networking but now the time has come for objects to be connected and that's what the internet of things is all about (Szoniecky, Samuel, Toumia & Amri, 2019).

The IoT describes physical objects (groups of such objects) that are embedded with sensors, processing ability, software, and other technologies, and that connect and exchange data with other devices and systems over the internet or other communications networks. The "Thing" in the Internet of

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things refers to the product's information (Huang, 2010). Hence every object be it a television or a plant, can be connected to the internet. The object's information is shared across the globe using the internet and hence the objects can be accessed from a remote place (Daqiang, Laurence, & Hongyu, 2011). The semantic meaning of these words forms ontology and hence internet of things form a part of the semantic web.

The information uploaded has certain attributes that make it different from other applications. Moreover, the objects generate a lot of dynamic sensor readings which in turn lead to frequent changes of information and require more space. In contrast, Web pages are static (Daqing, Laurence & Hongyu, 2011), consume lesser space, and are updated weekly or monthly. Since the internet of things is based on the idea of "smart objects" or things, it is important to set a clear definition of "smart objects."

Smart objects can share resources. According to (Miorandi et al., 2012), smart objects are presented as physical things that are identified by certain physical features that rely on an identifier. They have a low capacity to be recognized and can accept and reply to incoming signals that are identified by a name and address. Smart objects acquire basic computing abilities while detecting physical phenomena and stimulating actions that in turn affect the physical realm. It should be noted that the last definition of smart objects is our main critical concern. Internet of things serves as consumers or providers of information affiliated with the physical world (Hribar, Jernej, Jernej, DaSilva & Luiz, 2019).

The IoT is an environment in which objects, animals, or people are provided with unique infrastructure and the ability to transfer data over a

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network without requiring human-to-human or human-to-computer interaction.

The Concept of University Library

A university library is a part of a university setup. A University Library is defined as a library or library system established, administered, and funded by a university to meet the information, research, and curriculum needs of its students, faculty, and staff (Reitz, 2004). The primary function of the university library is to bring together information or knowledge on the one hand and human beings on the other. Libraries have been categorized according to the mode of services rendered to the readers; libraries are broadly divided into four types:

1. Academic Library,

2. Special Library,

3. Public Library, and.

4. National Library.

An academic library is a library that is attached to a higher education institution and serves two complementary purposes: to support the curriculum and to support the research of the university faculty and students. It is unknown how many academic libraries there are worldwide. An academic and research portal maintained by UNESCO links to 3,785 libraries. According to the National Center for Education Statistics, there are an estimated 3,700 academic libraries in the United States. In the past, the material for class readings, intended to supplement lectures as prescribed by the instructor, has been called reserves. In the period before electronic resources became available, the reserves were supplied as actual books or as photocopies of

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appropriate journal articles. Modern academic libraries generally also provide access to electronic resources (Du, Jia, & Nina, 2011).

Academic libraries must determine a focus for collection development since comprehensive collections are not feasible (Kotur & Mallikarjun, 2018). Librarians do this by identifying the needs of the faculty and student body, as well as the mission and academic programs of the college or university. When there are particular areas of specialization in academic libraries, these are often referred to as niche collections. These collections are often the basis of a special collection department and may include original papers, artwork, and artifacts written or created by a single author or about a specific subject.

There is a great deal of variation among academic libraries based on their size, resources, collections, and services (Nworie, & Unegbu, 2017). The Harvard University Library is considered the largest strict academic library globally, although the Danish Royal Library—a combined national and academic library—has a larger collection. Another notable example is the University of the South Pacific which has academic libraries distributed throughout its twelve member countries. The University of California operates the largest academic library system in the world, managing more than 34 million items in 100 libraries on ten campuses.

Users of University Library

A university library is meant for users and these users include students, staff (academic and non-academic), and researchers. Academic libraries provide an increasing number of online resources, including access to databases, journals, and e-books (Simwa, 2021). You will generally find these

listed in the library catalog, but you may also have direct links to them from electronic reading lists that are put together for your courses.

Functions of Academic Libraries

1. Provision of materials for undergraduate instructions term papers and projects as well as for supplementary reading.

2. Provision of materials in support of faculty Libraries external and collaborating researchers.

3. Provision of materials in support of Postgraduate research.

4. Provision of expensive standard works especially in professional disciplines.

5. Provision of materials for self-development

6. Provision of specialized information on the region within which the University is situated.

7. Cooperating with other academic Libraries to form a network of Library resource sharing to improve our collections and services .

8. Preserving and transmitting knowledge through bibliographical instruction and proper organization of the library collection (Upadhyaya, Sunil Kumar, Sharma & Avantika, 2019).

9. Contributing to the extension of the frontiers of knowledge through the provision of relevant research materials to aid researchers.

10. Enriching University academic program with up-to-date information and helping all categories of users to obtain information from other sources. (Upadhyaya, Sunil Kumar, Sharma & Avantika, 2019).

Concept of Smart Library

A Smart Library is a library that uses advanced information and technology to provide information services. A smart library is one equipped with new technologies to cater for the information needs of citizens and the community at large. A smart library is smart in-service delivery and evolves itself as a knowledge convergence centre, capable of responding remotely to various information-seeking activities (Padhi, 2019). A library fitted with Smart Library technology can be opened to library users without being staffed. It can therefore be deduced that librarians will soon be out of jobs. In other words, a smart library is a threat to employment.

The technology enables remote control of library buildings, including automatic doors, lighting, self-service kiosks, and public computers. Library members can have their library card activated for use when the library is in self-access (Smart Library) mode (Gul & Bano, 2019). A short induction will be required before your library card is activated. This induction will provide all the details you need on how the system works and how to use the Smart Library safely and responsibly. The induction will be available in several ways – in person at the library whilst the library is staffed, or as part of a dedicated induction session in the evening. To access a Smart Library, you scan your library card at the door and enter your PIN. The door will then open and you can use the library in the normal way fifteen minutes before closure audio loudspeaker announcements will begin warning that the library is due to close and the public computers will switch off 10 minutes before closure. Lights will go out once the library is closed (Grant, & Rhind-Tutt, 2019).

What you can do in a smart library

During Smart library hours you can:

1. Borrow, return and renew library items and pay charges using the self-service kiosks.

2. Collect reserved items that are awaiting collection at the reservation collection point and borrow them using the self-service kiosks.

3. Use the public PCs and free library Wi-Fi

4. Print from the public PCs, photocopy, and scan documents.

5. Access and browse the public library catalog on public PCs

6. Meet as a group free of charge in the open library space

7. Hire a meeting room (Simović, 2018).

What you cannot do in a smart library

During Smart library hours you won't be able to:

1. Make general inquiries and access staff support including help to use library facilities such as public computers, self-service kiosks, and photocopiers.

2. Make changes to your library membership details

3. Access public toilets unless you have a radar key. Radar keys enable access to locked disabled toilets for people with a disability.

4. Access meeting rooms unless you have pre-booked them

5. Access local studies reference collections (Panut, Sarmin, Abdullah & Asmahani,2021).

Empirical Review

USAGE OF THE INTERNET OF THINGS AT UNIVERSITY
LIBRARIES

If the Internet of Things connects devices worldwide, then it can equally connect devices at the university libraries for better service delivery. The academic Library is a center for information sharing, an essential part of knowledge, teaching, and scientific research (Nie, 2022). The important role is to disseminate information and mediation access to information (Wojcik, 2014). In recent days, libraries face many challenges in providing information to users in terms of physical resources, shortage of human resources, lack of financial support, etc. (Liang & Chen, 2017).

For handling the physical library challenges, Internet or Information Communication Technology (ICT) leads to improving and innovating the library quality services i.e., mobile services, library notification, on table services (Pera, 2014). Libraries will add more to their services through IoT i.e., managing, monitoring, circulating, security and self-servicing. It helps to improve the collection, disseminate, and make easier decision-making in in-house operations. IoT is an information literacy tool to educate the users to know about the library (Mohammadi & Yegane, 2018).

Libraries are providing information literacy programs for their users offline and online as well. Libraries are following many channels to reach their users about the library and services. Apart from the physical presentation, the libraries are promoting their library services and resources through the internet of things i.e., video display, library website/web-page, social media, video conferencing, etc. Libraries organize library orientation before the academic

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year begins and continuously display the services and resources through the monitor.

Availability of E-Resources at University Libraries

Electronic resources (ERs) in academic libraries have become a global phenomenon due to technological developments, and these resources are changing the expectations of library users as well as the nature of the work of librarians. Although there is an extensive body of literature on the management and usage of ERs in academic institutions, few researchers have taken a holistic view by studying both concepts in a single study to reveal how they are related. Previous studies have investigated only the management or usage of ERs as separate concepts. This study seeks to find out the availability of ERs in academic libraries in Ghana to explore the connection between the two concepts. The aim is to provide better recommendations for practice.

E-resource (ER) workflows require a re-imagining of ERM in libraries. Many librarians attempt to modify existing print workflows to manage ER, although print workflows are not well suited to ERM (Johnson, 2013). Often libraries attempt to fit ER acquisitions and delivery into the print model because when e-content was first becoming available. One of the major flaws in most current models of ERM is that in most libraries "60% of the budget is devoted to electronic resources on average, but only 25% of technical services staff are assigned to work with these resources" (Stachokas, 2009, p. 207). A tipping point has then been reached whereby in many libraries; ERs require the majority of their materials budgets.

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In response, libraries have designed several workflow arrangements to reflect the changing nature of library materials, but what is nearly universal is the role of collaboration and coordination in workflow management. The first model of ER librarianship is one in which there exists an integrated ERM department. In this model, ER is usually managed by at least one librarian and at least one paraprofessional. Electronic resources (ER) librarians and departments, however, have grown (Abraham, 2015)

Library Resource Access and Iot

Library resources are those materials both print and non-print that are found at the library. These items include books, magazines, newspapers, pamphlets, microfiche, or microfilm. Access to these materials is key in library service delivery. A library that is stocked with sufficient useful and golden resources without access or easy access is nothing but a white elephant. Libraries are innately subversive institutions radical notion that every single member of society deserves free, high-quality access to knowledge and culture, (Finch, 2018).

Similarly, every information resource that is given out directly or indirectly by a library, whether in the form of technology or not, or means of delivery should be readily, equally, and equitably accessible to all library users. Equity of library resources should go beyond equality, thus fairness and universal access.

Libraries are major sources of information for society and serve as guardians of the public access to information. The advent of the technological world has revolutionized how the public obtains its information and how libraries provide it. As the digital world continues to change, libraries help to

ensure that people can access the information they need irrespective of age education, ethnicity, language, income, physical limitations, or geographic barriers (Singh, 2018). Core values of the library community such as equal access to information, intellectual freedom, and provision of information should be preserved and strengthened now more than ever.

Digital resources and services allow libraries to significantly expand the scope of information available to users. Just as all resources and services provided by the library, the provision of access to digital resources and services should follow the principles outlined in the Library Bill of Rights to ensure equitable access regardless of content or platform (ALA, 2020).

Library-User Satisfaction and IOT

In recent years, applications of IoT have expanded from industries to education. Colleges and universities are actively constructing wisdom campuses based on IoT to ensure digital resources integration and sharing, including campus personnel identification, library management, campus ID, student management, teaching environment management in class, and the management of teaching instruments and equipment (Wang, Jianxi, & Wang, Liutao, 2021). Wójcik (2016) notes that IoT technology might have the potential to be used in library services, similar to how it is implemented in the commercial sector.

IoT will bring about a series of profound changes for libraries (Du and Liu, 2014; Sun, 2014), particularly transforming the libraries into smartened libraries or digital libraries (Xu, 2014). Li (2013) points out that many library services, such as self-borrowing and self-returning, smart inventory, intelligent query, and a combination of books and information systems, can be achieved

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by IoT. Accordingly, e-resources and digital libraries are becoming increasingly important channels for obtaining information (Hu & Zhang, 2016). Some researchers have explored how IoT can be applied in libraries. For instance, (Andersen, 2002) examines the relationship between communication technologies and the Library and the Information Science concept of knowledge organization from a medium-theory perspective.

IoT is not static but keeps developing. (Liu & Sheng, 2011) present the development direction of IoT in the field of library management and promotion programs. (Ma et al., 2011) presents an integrated management system with multilayer architecture based on IoT for managing study rooms in libraries.

There was improvement on library services (Sun, Mengyu, Zhou, & Zhangbing, 2020) designed the system of smart libraries and used IoT technology to mine, identity, organize and analyze the implied reader behavior to improve the library service, resources, and services, and to achieve the optimum configuration. (Yao & Song, 2014) propose an intelligent control system for saving lighting energy in libraries based on IoT technology and humanized design. (Wei, 2014) discussed the construction of smart library information management systems based on cloud computing and IoT. (Ma et al., 2015) argues that a network based on IoT is important for libraries and that it could be an effective method for improving the work of libraries. (Cheng et al., 2016) present a corresponding handheld device client software to improve the efficiency of book search and management and to save manpower and material resources.

Mobile technologies are characterized by their small size and portability. The concept of combining mobile service and library service was first introduced by scholars in the era of personal digital assistants (Huang, 2015). However, due to the immaturity of mobile devices and wireless communication technologies at that time, the adoption rate of the mobile library was low. With the advancement of wireless networks and mobile devices, acquiring information anytime and anywhere becomes convenient and fast. As a result, the majority of libraries combine wireless communication technologies with their services to develop mobile services compatible with mobile devices (Lai et al., 2014).

As a new platform for knowledge sharing and learning, the mobile library integrates subjects on the library mobile service chain, including the library, database provider, mobile library integrates subjects on the library mobile service chain, including the library, database provider, mobile technology provider, mobile network operator, and mobile terminal manufacturer (Zhao et al., 2015). The mobile library provides comprehensively integrates the library's basic functions and provides intelligent services, such as location-based services, context awareness, and quick response code scanning (Zhao et al., 2015). According to Wei and Yang (2017), the most commonly used mobile library services are Mobile library usage in the IoT era.

For users, the mobile library allows them to check due dates, renew and reserve items, search items in the library effectively, as well as navigate and locate items easily (Paterson & Low, 2011). Libraries can shift from having a fixed location to becoming ubiquitous by combing mobile librarians,

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mobile patrons, and mobile content (Barnhart & Pierce, 2011). Compared with a traditional library, a mobile library frees students from temporal and spatial limitations, enabling them to acquire library resources and services anytime and anywhere (Chang, 2013). For example, Shaoxing, a professional mobile reading platform/app, integrates the Library World Online Patron Access (OPAC) system, digital library portal, cloud sharing service system, information exchange and interaction platforms, and personalized services and is capable of providing users with more than one million e-books and innumerable newspapers, as well as domestic and foreign literature metadata (Hu & Zhang, 2016).

Studies have been conducted to investigate the development of the mobile library. For instance Falk (2005), discovers that using RFID tags can increase the use of e-books and improve library circulation and maintenance. Paterson and Low (2011) examine the benefit of academic mobile library services using quantitative and qualitative data about students' use of mobile devices. Canuel and Crichton (2011), assess how Canadian academic libraries responded to the rapidly evolving mobile environment, identify the service gaps, and suggest future development directions. Wang et al., (2012) investigate mobile web services in terms of due date reminders and renewal by using the Oriental Institute of Technology Library in Taiwan.

Based on the studies reviewed, if library users receive maximum satisfaction from university libraries, it suggests that libraries efficiently and effectively provide services to their patrons. However, most works on IoT do not emphasize patrons' satisfaction. As a result, this study has thrown more light on how vital user satisfaction is, in university library service delivery.

CHAPTER THREE

RESEARCH METHODOLOGY

Introduction

In this chapter, the research procedures used in the collection of field data for the study are outlined. The chapter describes the study area and the study design before presenting the study population, the sample, and the sampling used for the study. The techniques of data collection and data analysis procedures are also explained in the chapter.

Research Design

The research design is the blueprint for the collection, measurement and analysis of data. It determines which established convention has been chosen for conducting a piece of research. The choice of research approach is based on the research problems and questions of a study. Various approaches can be used to study a problem. According to Saunders *et al (*2000), the most often used approaches are exploratory, descriptive and explanatory. The study considered descriptive research because the study seeks to "portray an accurate profile of persons, events or situations" (Robson 2002:59 in Saunders et al., 2007). It involves formalizing the study with definite structures in order to better describe or present facts about a phenomenon as it is perceived or as it is in reality. Again, descriptive design was chosen over experiment design because, the study's purpose was to report existing state of affair regarding the usage of IoT in university library service delivery. The data were basically drawn from primary source by administering questionnaires to the selected four (4) public and private university library attendants such as university of

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Cape coast, university of Ghana, university of Science and Technology and lastly Valley View University in Techiman.

Study area

The study areas are situated in Cape Coast, Accra, Ho and Techiman, all in Ghana. Cape Coast is a city, fishing port, and the capital of Cape Coast Metropolitan District and Central Region of Ghana. It is one of the country's most historic cities, a World Heritage Site, home to the Cape Coast Castle, with the Gulf of Guinea situated to its south. (W en.wikipedia.org/wiki/Cape_ Coast).

Accra is the capital and largest city of Ghana, located on the southern coast at the Gulf of Guinea, which is part of the Atlantic Ocean. Accra covers an area of 225.67 km 2 (87.13 sq mi) with an estimated urban population of 4.2 million as of 2020.

Ho is one of the twelve districts in the Volta Region. It has a population of 61,099 and is the administrative and commercial capital of the Volta Region. It is also the administrative and economic hub of the Volta Region. The recent population growth and urban dependency on the already inadequate infrastructure in Ho has far exceeded acceptable standards. Although some infrastructure provision has been made, these constitute an insignificant proportion of infrastructure needs of the municipality. The city is limited by the poor institutional set-up and regulatory framework for effective municipal management (https://unhabitat.org/ghana-ho-urban-profile).

Techiman is a city and is the capital of Techiman Municipal and Bono East Region of Ghana. Techiman is a leading market town in South Ghana. Techiman is one of the two major cities and settlements of Bono East region.

Techiman has a settlement population of 104,212 people in 2013. Techiman is located at a historical crossroads of trade routes and the Tano River, and serves as capital of the Techiman Municipal District (Wikipedia).

Study Population

The total population for this study is the universities in Ghana. The target population is four universities, namely, the University of Cape Coast, the University of Ghana, Valley View University, and the University of Health and Allied Science. The accessible population is two hundred students from the selected universities in Ghana.

Sample and Sampling Procedure

A sample is a group which is a representative of the population intended to be studied and from which one devises generalization about the population (Bailey, 1994). Sample size constitute the number of respondents selected for interview from a research population. For the purpose of this study, the researcher used two non-probabilistic sampling methods (Quota sampling and Convenience sampling) to arrive at the study sample. Non-probabilistic sampling is distinguished by the fact that it does not consider the overall population when computing research sample. The technique absolutely contrasts to probability sampling, in which the overall population is taken into account when selecting study sample (Attah-Botchwey, 2018). The study employed quota sampling in which various programmes of the selected universities such as Business (Human Resource Management), Accounting, Information Technology, and Education were considered as quotas from which the sample was drawn. The decision to use the quota sampling was

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reached because the researcher wanted to come out with evidence that would be a good representation of the entire population.

Using the convenience sampling technique, 200 respondents who constituted both male and female students were eventually chosen for the study. Because the study's subject matter is to assess the extent to which Internet of Things (IoT) is incorporated in university library service delivery in both public and private universities in Ghana, convenience sampling technique was deemed appropriate. The researcher adopted this technique because students were not patronizing the library as they used to, due to the Covid-19 virus. As a result, only respondents who were available, accessible and willing to participate in the answering of the research questionnaire to form part of the study sample. Eventually, in each university library, the convenience sampling technique was used to sample the 200 respondents for the study.

Data Collection Instruments

Self-made data collection instruments such as questionnaires and interviews were used for data collection. The questionnaire was chosen due to its advantages such as relatively inexpensive, practicability, offering quick results, scalability, comparability and easy analysis and visualization. This was done through the administering of a questionnaire to students and interviewing librarians from the University of Cape Coast, University of Ghana, Valley View University, and University of Health and Allied Science.

The questionnaire, was constructed on the 5-points Likert scale ranging from "Strongly Agree (1) to Strongly Disagree (5)". The questionnaire was the questionnaire used for the study had four sections: the demographic data

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section, usage of IoT in library service delivery, availability of E-resources, and user satisfaction. Gender and age formed the demographic section, while the other sections formed the construct section. The questionnaire had 18 items in total. Out of the 18, 4 of them focused on demographic data, while the remaining 14 were for, usage of IoT in library service delivery, availability of E-resources, and user satisfaction. All the items on the questionnaire were close-ended. The Close-ended questionnaires are easy and straightforward to construct, code, and analyze (Cohen, Manion & Morrison, 2003).

Validity and Reliability of Instruments

The interview guide was given to an expert to ascertain whether it meets the face, construct, and content validity. Concerning the questionnaire, the reliability coefficient was computed using Cronbach's Alpha. The first draft of the interview guide and questionnaire were discussed and pre-tested at the Kwame Nkrumah University of Science and Technology The pretest took place on 30th August 2021.

To determine the reliability of the questionnaire, the data obtained from the pilot testing were analyzed, and the overall Cronbach's alpha value was .824. Items that posed difficulty to the respondents were revised and modified before the actual data collection commenced. The reliability statistics were carried out with "Statistical Product for Service Solutions" (SPSS) version 21.

Data Collection Procedures

An introductory letter was taken to the various university library for the data collection stating the aims and purpose of the study and the need for the participants to give their consent and co-operation. For participants to do

their best to give realistic response to each question, they were assured confidentiality as the researcher articulated the purpose of the research as for purely academic exercise. According to Kelley**,** Clark, Brown and Sitzia (2003), these are the most important ethical issues to adhere to when conducting a survey. Also, they were assured that all information obtained would be used for the intended purpose. The researchers were present to explain how to answer sections of the questionnaire. They student were however guided to answer their questionnaire instantly to avoid misplacement of the questionnaire and other excuses. Every question was thoroughly explained and all doubts were cleared. Room was given for questions and appropriate answers were given. To ensure high return rate of the questionnaires, the researcher did the administration and collection personally. Administering of questionnaires was done on Mondays to Fridays from 2:30 – 5:00pm each day. This time of the day was chosen because the researcher is a professional teacher and could only collect data after close of work.

Fieldwork commenced immediately after the validity of the data collection tools was ascertained after the pretest. Thus, fieldwork started on 1st September and ended on 30th September 2021. Extraneous variables such as intelligence quotient and resources may affect the outcome of the research findings. Also, mediating variables may lead to type one error.

Ethical Clearance

The data collection was preceded by a formal introduction of the researcher with an introductory letter from the researcher's supervisor at the selected universities, where formal permission was sought. The researcher was then introduced to the librarians and the libraries of the selected universities.

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Data Processing and Analysis

Data editing is the process involving the review and adjustment of collected survey data. Data editing helps define guidelines that will reduce potential bias and ensure consistent estimates leading to a clear analysis of the data. Data collected from the field were edited and cleaned.

It is important to manipulate data collected for assessment. According to Sarantakos (2005), the analysis of the data allows the researcher to manipulate the data collected during the study to assess and evaluate the findings and arrive at some valid, reasonable, and relevant conclusions. Each objective of the study had its tool, and any selected research design was justified.

The statistical software which was used in the analysis of the data that were gathered from the field is Statistical Package for the Social Sciences (SPSS). The SPSS is a tool created for complex statistical data management and analysis: it concentrates mainly on the area of education research, health research, and market research. This tool is chosen because it provides the path model that can describe the relationship between variables and indicators. Therefore, this tool can provide an understandable picture and support to demonstrate the results. Also, SPSS provides researchers with a flexible, customizable way to get super granular on even the most complex data set.

The research question one was analyzed using descriptive statistics such as mean and standard deviation. Research question two was analyzed with relative importance index and research question three was analyzed with mean and standard deviation.

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Objective one was measured using mean and standard, objective two was measured using one sample t-test and relative importance index and objective three was measured with mean and standard deviation.

Chapter Summary

The study used an analytical descriptive research design because it was a quantitative study. Two-hundred university students from University of Cape Coast, University of Ghana, Valley View University and University of Health and Allied Science, were chosen for the research using convenient sampling. The researcher went to the four universities' libraries to administer the questionnaires herself to the respondents as they came to the library. The research objectives and questions were investigated using descriptive statistics, such as the mean and standard deviation. Inferential statistics such as one t-test, was also used.

University of Cape Coast   https://ir.ucc.edu.gh/xmlui
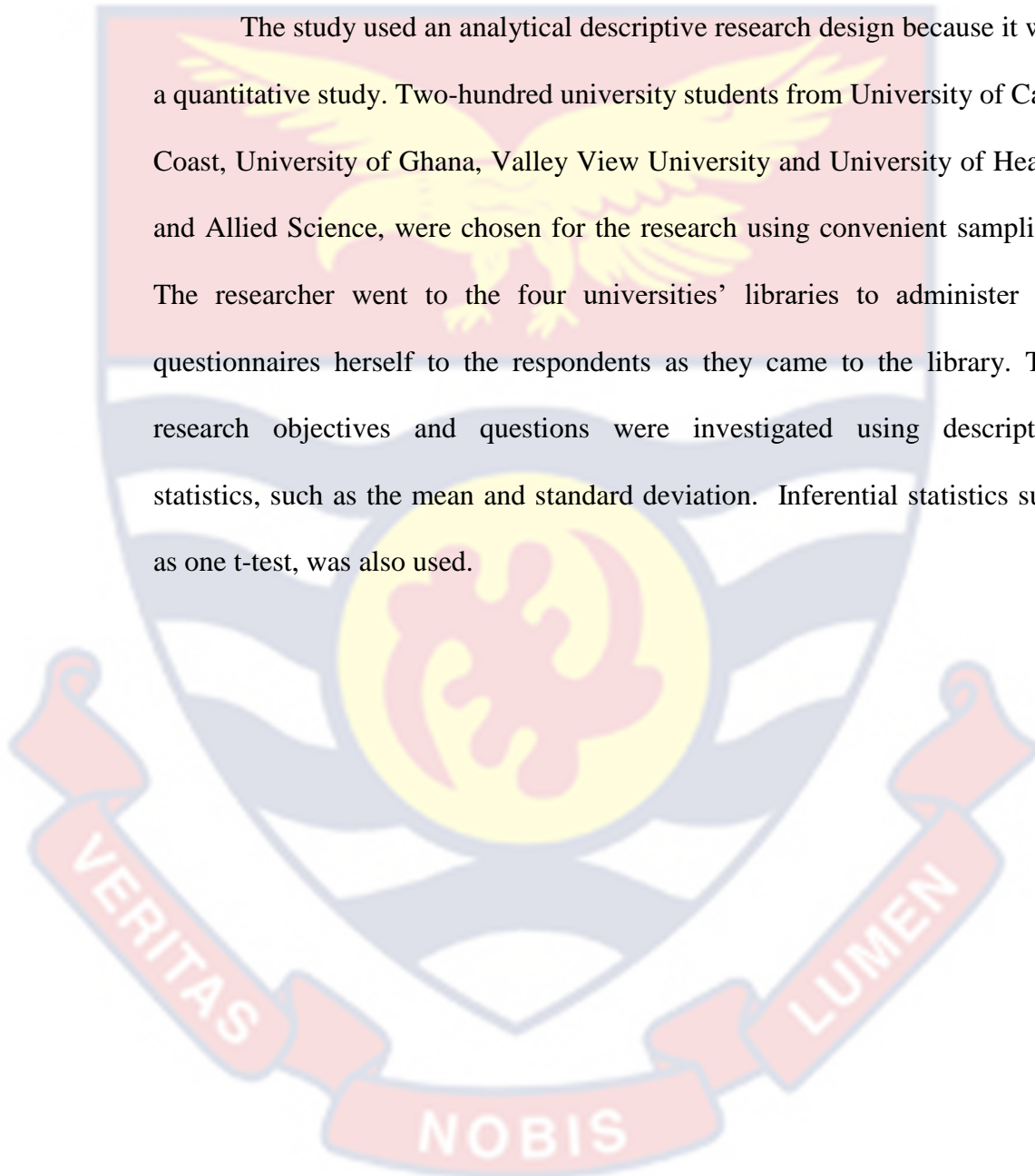
CHAPTER FOUR

RESULTS AND DISCUSSION

Introduction

The purpose of carrying out this study was to explore the usage of the Internet of Things in library service delivery at public and private universities in Ghana. This chapter focused on the quantitative description of the sample. It describes and analyses the demographic elements of the sample and the research objectives guiding the research. The study utilized percentages, mean score, and multiple regression analysis to analyze the data. The analysis of data was categorized into two different sections. The first section illustrated the demographic statistics. The second section presents the results and discussions on the three objectives under study.

This section shows an analysis of data gathered through the use of a questionnaire. This section, therefore, presents the demographic variables such as gender, age, and university attended using a simple percentage method, Further, analysis of the objectives of the study was also presented through the use of mean score, standard deviation, standard error, and relative important Index and T – test analysis.

Demographic Characteristics of Respondents

This section presents information on the demographic characteristics of the respondents, that is, gender, age, name of university attended and educational program study at the university, Table 4.1 shows the demographic data.

Table 4.1: Demographic Data of Respondents (n = 200)

Variable	Categories	Number	Percentage
Gender	Male	128	64
	Female	72	36
	Total	**200**	**100**
Age	18-24	56	28
	25-31 years	79	39.5
	32- 39 years	48	24
	40years and above	17	8.5
	Total	**200**	**100**
University	UCC	51	25.5
	University of Ghana	47	23.5
	VVU	58	29
	Allied Science	44	22
	Total	**200**	**100**
Program of Study	Education	54	27
	Business	63	31.5
	Info. Technology	51	25.5
	Accounting	32	16
	Total	**200**	**100**

Source: Amenyawu (2021)

Table 4.1 presents the results for the demographic characteristic of respondents. These characteristics include gender, age of students, university attended and program studied at the university.

The result is based on the questionnaire survey conducted by the scholar among selected public and private University library in Ghana. The researcher designed 200 questionnaires which were distributed to students at their respective libraries. The outcome as stated in table4.1 reveals male students' dominance which constitute 64% against the female's student who also constituted 34%. This implies that more males participated in the study than females. This result is representative of the internet usage of the selected public and private university library. It is quite cleared that the selected university more male enrollment than female student enrolment.

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In terms of the age of the respondents, the results indicated that respondents between the age of 25-31 years form the majority. They constitute 39.5% of the respondents who participated in the study. This is followed by respondents between the age of 18-24years. This age group also constitute 28% of the sampled respondents. Respondents who are between 32 - 39 years formed 24% of the sampled respondents, with those who are above 40 years forming 8.5% of the sampled respondents.

The study also considered the universities the respondents attend. The result indicates that 29.5% of the sampled respondent are from Valley View University, followed by University of Cape Coast (UCC) which group constitute 25% of the sampled respondents. This group was followed by the University of Ghana which also had 23 %, while that of University of Health and Allied Science constitutes 22% of the respondents. This implies that the researcher spent more days and time at the Valley View University than the other three universities due to closeness to the university.

Concerning the respondents' educational programmes offered at the university, Business had the highest percentage with 31.5%, whilst Education obtained 27%. Information Technology represented 25.5% and Accounting as a course had 16%. This implies that majority of the respondents were Business students and the least was those who studied Accounting.

Usage of Internet of Things (IOT) in a Library Service Delivery

Objective one of this study was to assess the usage of Internet of things (IOT) in a library service delivery at the selected university libraries. The questionnaires were answered based on a five-point rating scale ranging from 5 strongly disagreed (SA), 4= agreed (A), 3=Neutral (N), 2=Disagreed (D) and

1= Strongly Disagree (SD) The study adopted a Mean Score to analyze this part of the questionnaire. The result is presented in Table 1:

Table 4.2: Usage of Internet of things (IOT) in library service delivery

Variables	N	Mean	Std Dev	SD Error
I can use the internet of things to find the information I need at the library	200	3.96	1.24	0.0875
I can use the internet of things to find and download applications that help me to learn	200	4.17	.07	0 . 081
I can access my learning materials through the internet of things devices	200	4.170	1.35	0 .174
It is easy to use internet of things to learn	200	5.0	1.08	0. 076
My university delivers services through the use of internet of things.	200	3.99	1.17	0. 083

Source: Amenyawu (2021)

The data collected was coded as followed 5 strongly disagreed (SA), 4= agreed (A), 3=Neutral (N), 2=Disagreed (D) and 1= strongly Disagreed (SD) The study adopted a Mean Score to analyze this part of the questionnaire.

The illustration on table 4.2 above is made of five survey statements that sought to find responses on the usage of Internet of things (IOT) in library service delivery**.** The results give the mean, standard deviations, and standard errors of the study. The mean values express the perceived measure of the respondent's acceptance that there is a lot of blogs available on the internet which provide the most relevant content and study-related materials for the students by which students can get help and learn relevant and quality content available on the internet at the university library. The standard deviation estimates the spread of the responses around the mean value, and the standard

error is the error of the estimate. A smaller standard error means the mean gives a better estimate of the population.

Concerning the extent of usage of Internet of things (IOT) in library service delivery a**t** the selected university library. the findings shown in Table 4.2 above suggest that it is easy to use internet of things to learn. This attained a highest mean valued of $\pi = 5.0$ standard deviation of 1.08 and at a standard error of mean .076. The study exhibits that majority of respondents strongly agree to this statement. It can be added that it is easy to use the Internet of Things to search for information easily, using smart search engines like Google, which easily anticipate the users' requirement and suggest where to find the most useful information.

On the other hand, sampled respondents agreed that they always use internet of things to find and download applications that help them to learn. The responses were found to be high with a mean score of $\pi= 4.17$, standard deviation = 1.07 and a standard error of the mean = .181. It was also revealed that respondents have access to a full set of IoT intelligent applications. To buttress the above argument, they vehemently agreed that they have access to learning materials through the library service delivery. The statement recorded a third maximum mean value of $\pi = 4.17$ standard deviation of 1.3 and standard error of .174. All respondent agreed that they can access their learning materials by accessing the library. Accessibility of information in the modern library has vital advantage for the learners, emergence of Internet of Things usage in the modern library services is satisfying the fourth law "save the time of the reader and staff" of library. science easy ways not only for libraries but also for users" community and library professionals. Thus, users

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of libraries with internet of things access find it convenient and spend less time in surfing and searching for information.

Furthermore, average responses concluded that the selected university library delivers services through the use of internet of things. The responses achieved a mean score of $\pi = 3.96$ standard deviation .1.24 and at a standard error of mean .088. Sampled respondents showed that the university delivers services through the use of internet of things. None of the respondents shared different views form that. From the study, majority of the respondents were of the view that they can use the internet of things to find the information they need at the library this attained mean valued of 3.96 standard deviation of 1.15 mean error of .149. The implication of this is that internet of things plays a vital role in modern library service delivery and also help students in academic performance.

Table 4.3: Availability of E – Resources at the University Library

Variables	N	Mean	Std. Dev	Std. Error
E - Journal	200	4.08	1.1047	0.143
E - Books	200	4.00	1.17	0.099
E- Magazines	200	4.05	1.212	0.156
E – Thesis	200	4.04	1.07	0.150
E -New papers	200	3.84	1.15	0.163
E – Report	200	4.00	1.00	0.074
Biography	200	4.01	1.07	0.071
Any other	200	4.00	1.07	0.075

Source : Amenyawu (2021).

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The data collected were coded as follows 1 = Strongly Disagree (SD), 2 = Disagree (D), 3 = Agreed (A), 4 = Strongly Agree (SA)

Most of the Library resources in the recent time are being made available in electronic formats such as e-journals, e-books, databases, etc. Libraries are moving from print to electronic resources either subscribing individually or through consortia because of its advantages over print resources. According to Wikipedia, Electronic Resources means "Information (usually a file) which can be stored in the form of electrical signals, usually on a computer; Information available on the Internet".

Electronic resource requires computer access or any electronic product that delivers a collection of data which can be in the form of full text, electronic journals, E book, E thesis or other multimedia products.

The study had E journal achieving the maximum mean scored of $\pi = 4.08$, the standard deviation of 1.10, and standard error of 0.143. Average respondents however agreed that E journals are available in the library and very important for learning. Useful application of information technology enables the library to save space of library and time of the users. E- journals are useful for libraries as well as every user of the society who are starving to get a variety of information on the globe. The average respondent believed that electronic Journal are available and can be accessed at the university library. To buttress this the average responses of E – Magazine had mean score of $\pi = 4.05$ with standard deviation of 1.212 at mean error of 0.156.

Majority of the respondent believed that E- Magazine is available at the selected university libraries and also very easy to access and useful learning materials at the library. On the contrarily, average respondents agreed

that E – Thesis can be access at the university library. Their views achieved a mean valued of π = 3.97, standard deviation = 1.06 and a standard error of the mean = 0.137.

E – thesis is PhD thesis and dissertation published through e-format. Internet is one of the vital tools used for education and research now a days. The more the scholars get exposed to the internet and its applications, the more they start relying on its services. The pop-up valued above had E - Biography achieving a fourth maximum mean scores recorded as π = 4.01 a standard deviation of 1.07 with a minimal standard error of mean 0.071 Average respondents agreed to an extent that E – Biography are available and can be access at the library.

The study had two E - Books, and E – report achieving the same maximum mean scored recorded of π = 4.0, the standard deviation of 1.17, and standard error of 0.099. Sampled respondent agreed to the extent that E – book and E – Report are available at their library. Electronic resources such as E - books and E – report have many formats competing for prime time, including Adobe PDF, Microsoft Reader, eReader, Mob pocket Reader, EPUB, Kindle and iPad.

Moreover, the average responses of E -New papers believe the resource are available and can be accessed at the selected university libraries. This achieved a mean score π = 3.84, standard deviation = 1.15 and a standard error of the mean = 0.163. It implies that all these E-resources exist in the selected library.

The results from the t-test analysis are indicated in Table 4.4 below

The Availability of Electronic Resources at the University Library

The study utilized the Relative Importance Index (RII) to answer objective two. This statistical analysis ranked variables according to the response given by each statement. In this study, indices ranging from 0.80 – 1.00 are classified as high, 0.71– 0.79 as a medium, and below 0.70 are ranked as low.

Table 4.4: Type of E-Resources

Measurement Indicators	RII	Rank
E -journal	0.82	1st
E-thesis	0.81	2nd
E-Research	0.80	3rd
Bibliography	0.79	4rd
E-Book	0.78	5th
E-News papers	0.77	6th
E-Magazine	0.76	7th

Source: Amenyawu (2021).

The relative importance index (R11) is a mean factor which gives its weight in the perception of respondents or relative importance index give the rating at which peoples response to each statement. From Table 4.4, shows the overall relative important index value given for each statement arranges from 0 – 1. The highest valued is 1 the lowest index value is 0.79, which fell within the medium range. E journal has the highest index value of 0.82 followed by E – Thesis 0.81. E- research achieved the third relative importance index of 0.80 which was classified as high. E-Bibliography achieved 4th relative important index of 0.79, fifth is E book which recorded a relative important index 0.78, E – Newspaper attained relative important index of 0.77 and lastly E – magazine had 0.76. It means the respondents of the various selected library

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usage has given more importance to the statement on E – Journal, followed by

E- Thesis. Third is E- research, fourth is E-Bibliography, fifth represent E –

book, followed by E – Newspaper and last is E – magazine. However, ranging

from   E – research to E – Magazine, all considered moderate, which implies

that the respondents' response to the availability of E resources was moderate.

Level of Student Satisfaction on Usage of Online Library at the University

Please indicate the extent at which student are satisfied toward usage of

Internet of thing in library service delivery at the university.

Using a scale, 5=Very High (VH), 4 =High (H), 3=Moderately High (MH),

2=Low (L) and 1=Very Low (VL)

Table 4.2: Student Satisfaction on Usage of Online Library

Variables	N	Mean	Std. Dev	Std. Error
Learning Activities	200	4.17	1.143	0.081
Information Sharing	200	4.16	1.00	0.071
Supports for academic performance	200	4.09	1.078	0.076
Improves learning convenience Self-Independent	200	3.99	1.17	0.083
Strong internet service in the library	200	4.07	1.22	0.072

Source: Amenyawu (2021).

From Table 4.3, the reader may observe that students were asked to

rate their satisfaction on usage of Internet of things (IOT) in their university

library service delivery. Their satisfaction was based on elements such as

Learning Activities, Information Sharing, supports for academic performance,

Improves learning convenience and Strong internet service at the selected

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university libraries. These elements contribute to students' satisfaction and enriched learning environment.

To express the degree of satisfaction of internet of thing in the library of service delivery at the university, the respondents claimed that usage of Internet of things support Learning activities and this had a mean score of $\pi = 4.17$, standard deviation = 1.143 and a standard error of the mean = .081. To Juxtaposed this, respondents believed that internet of things contributes to an effective learning climate that achieve higher levels of satisfaction in library service delivery. However, student satisfaction with online learning corresponds with information Sharing which recorded highly satisfactorily, with an average means score of $\pi = 4.16$, standard deviation = 1.00 and a standard error of the mean = 0.071.

In terms of academic supports average respondent collectively agreed that, they are satisfied when using modern library to disseminate information. Online library services could effectively reach the respondents through library website and social media. From the table, an average response of students 'achieving a mean value of $\pi = 4.09$ a standard deviation =1.078, and a standard error of mean =.178 are satisfied with the views that internet of things in the library service delivery help them to send and received vital information from the library.

Lastly average respondent agreed to assertion that internet of things Improves learning convenience and self-independence of student that encourages private studies. This attained an average mean valued of $\pi = 4.00$, standard deviation = 1.17 and a standard error of the mean = 0.083.

The implication of this is that all respondents were satisfied with Internet of things (IOT) in online library service delivery at the university libraries. No respondent clearly shows any level of dissatisfaction. The study therefore concluded that satisfaction is justified by learning convenience combined with the effectiveness of e-learning tools and this is in total agreement with Dziuban, Moskal, Brophy-Ellison and Shea (2007) found key elements that contribute to students' satisfaction and enriched learning environment in online library service delivery

CHAPTER FIVE

SUMMARY, CONCLUSIONS AND RECOMMENDATIONS

Introduction

The objective of this research was aimed at assessing the extent to which Internet of Things (IoT) is incorporated in university library service delivery in both public and private universities in Ghana. The chapter highlights the summary, conclusions, recommendations and suggestions for further research.

Summary

The study was necessary owing to a lack of research on the usage of IoT in library service delivery at the public and private universities in Ghana. Understanding the level of satisfaction students derive from library service delivery that incorporate Internet of Things (IoT) will inform university library authorities in Ghana as to what resources to provide at the libraries in order to meet the satisfaction of users in terms of service delivery. To achieve the research objectives, the following research questions were formulated:

1. How does IoT usage affect library service delivery in the public and private universities in Ghana?

2. What is the available e-resources for library service delivery in public and private universities in Ghana?

3. What is students' satisfaction regarding the usage of IoT to deliver library services at public and private universities in Ghana?

The study assesses the effect of Internet of things (IOT) in library service delivery. The study was quantitative research and utilized a descriptive research design. The study utilized two non-probabilistic sampling methods

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(Quota sampling and Convenience sampling) to arrive at the study sample. Non-probabilistic sampling is distinguished to choose 200 respondents from the selected public and private university library usage. The relative important index was employed to analyze the level of importance of how each statement was rated at the selected university libraries. Further analysis was done using mean and standard deviation which determined the average response for each statement.

Key Findings

Objective one sought to assess usage of Internet of things (IOT) in library service delivery at the selected university library. The study discovered that modern library service delivery has been very useful to students. The library has an immense amount of knowledge which can be searched easily, using smart search engines like Google, which easily anticipate the users' requirement and suggest them where to find the most useful information. Further finding revealed that librarians and library professionals find it convenience to access information through internet, easy access to information and enabled them to spend less time in surfing and more time upon reflection and experiment.

Objective two sought to identify the availability of E – Resources at the university library. The study revealed that E – Journal, E – Books, E-Magazines, E – Thesis, E -New papers, E – report and E- Biography are available and are easily accessible, well-functioning and prioritized at the university libraries in Ghana. Though E -New papers is available, it is the least often used at the library.   Further finding revealed that E- resources are very important for learning and useful application of information technology

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through the internet of Things enable the library to save space of library and time of the users. E journal is having the highest index value followed by E – Thesis. E – research, E-Bibliography, E book, Newspaper and E – magazine are classified as moderately used in terms of how they were rated based on how beneficial each electronic resource are to the usage of internet of thing in library service delivery.

Objective three determines the level of student satisfaction on usage of Internet of thing in library service delivery at the selected university libraries. The results of the finding reveal that internet of things contributes to an effective learning climate and that resulted in higher levels of satisfaction. Student are satisfied with online information from the modern library. The Internet of Things improves learning convenience and self-independent of student which in turn encourages private studies.

Conclusions

The findings of the study led to the following conclusions:

In conclusion, it can be said that with the advent of IoT, library service delivery at the universities in Ghana has changed from the traditional mode to a modern mode. As a result, accessibility, self-independence, credibility, the internet and e-resources have gradually changed the way people communicate, interact, acquire, share knowledge, search, investigate and participate in creation and re-use of information in E – resources in libraries. Modern academic libraries have met users' needs by way of implementing the innovative services and resources through IoT. However, our findings reveal that the surveyed respondents are highly satisfied with IoT based resources and services. The study concluded that IoT is important with collection library

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programs, effective utilization of online learning e-resources enable the library usage to save space and time. All students in the university should cultivate the habit of embracing new technologies when these technologies emerge.

Recommendations

The following recommendations were made based on the results and conclusions:

1. Librarians and library professionals should possess in-depth knowledge of the information seeking behaviors of the users of modern library as well as improving the various E – resources at the libraries.

2. Online library should be incorporated into all the university libraries in Ghana with viable electronic resources to facilitate and motivate students learning without any hindrance or barriers.

3. University library management should place more priority on electronic resources such journal E – Thesis E – research, E-Bibliography, E - book, which shows more rating with regard to their availability and accessibility by the users.

4. Librarians should therefore educate, students at the university on the essence of proper usage of internet of things on library service delivery.

5. Students should be educated on Library anywhere and anytime. This means distance can no more be a barrier to accessing and utilizing information from a university library.

6. The libraries, librarians and library professionals should use the Facebook, Instagram, LinkedIn, Twitter and YouTube more often to disseminate information to users.

Suggestions for Further Research

It is recommended that upcoming researchers should do further research to look into usage of IoT in community libraries in Ghana and also assess the challenges facing the implementation of IoT in the university libraries in Ghana.

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APPENDICES

APPENDIX A: Self-Administered Questionnaire for Respondents

UNIVERSITY OF CAPE COAST

COLLEGE OF DISTANCE EDUCATION

Department Of Mathematics and Science

INTERNET OF THINGS AND UNIVERSITY LIBRARY SERVICE DELIVERY QUESTIONNAIRE

Introduction

I am researching the topic, "Internet of Things and Library Service Delivery in Selected Public and Private Universities in Ghana", to find out the extent to which the Internet of Things (IoT) is incorporated in university library service delivery in both public and private universities in Ghana.

Your responses to the questionnaire items are kindly solicited because they are crucial to the success of this study. All individual responses will remain confidential.

SECTION ONE: DEMOGRAPHIC DATA

Please Tick where Appropriate

1. Gender

   a) Male   [   ]

   b) Female   [   ]

2. Age

   a) 18– 24   [   ]

   b) 25 – 31   [   ]

   c) 32 – 39   [   ]

3. d 40 and above [   ]

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4. Name of University

UCC   [   ]

University of Ghana   [   ]

Valley View University   [   ]

The University of Health and Allied Science   [   ]

5. Program of study

Education   [   ]

Business   [   ]

Information Technology [   ]

Accounting   [   ]

Other   [   ]

SECTION TWO: Usage of IoT in library service delivery

Please select the most appropriate response that indicates your level of

agreement or disagreement on the usage of IoT in your university.

Response Key: 1 = Strongly Disagree

               2 = Disagree

               3 = Neutral

               4 = Agree

               5 = Strongly Agree

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	ITEM	1	2	3	4	5
6	I can use the Internet of Things to find the information I need at the library.					
7	I can use the Internet of Things to find and download applications that help me to learn.					
8	I can access my learning materials through the Internet of Things devices.					
9	It is easy to use IoT things to learn					
10	My university delivers services through the use of IoT.					

SECTION THREE: Availability of E-Resources at the university library

Please select the most appropriate response that indicates the level of your agreement or disagreement with each item listed on the availability of E-Resources at the university library.

Response Key: 1 = Strongly Disagree

2 = Disagree

3 = Neutral

4 = Agree

5 = Strongly Agree

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S/N	ITEM	1	2	3	4	5
11	E-Journals					
12	E-Books					
13	E-Magazines					
14	E-Thesis					
15	E-Newspaper					
16	E-Research Report					
17	Bibliography Database					
18	Any other					

SECTION FOUR: Library resource access and IoT

Please select the most appropriate response that indicates the level of your agreement or disagreement with each statement on the relationship between library resources access and IoT.

S/N	ITEM	1	2	3	4	5
19	IoT helps me to easily access library resources					
20	With IoT, I spend less time accessing library resources					
21	There is a positive relationship between library resource access and IoT					

SECTION FIVE: University Library -User satisfaction and IoT

22. On a scale of 1 to 5, how will you rate your satisfaction regarding the usage of IoT to deliver library services at your university?

……………………………………………………………………………

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