

**ROLE Of INTERNET Of THINGS (IOT) In THE EDUCATIONAL OUTCOME
Of DIU STUDENTS**

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This Report Presented in Partial Fulfillment of the Requirements for the
Degree of Masters of Science in Computer Science and Engineering

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APPROVAL

This Project/Thesis titled "ROLE of INTERNET of THINGS (IOT) In THE EDUCATIONAL OUTCOME of DIU STUDENTS", submitted by Sadia Hassan Ahmed Mohamud, ID No: 183-25-701 to the Department of Computer Science and Engineering, Daffodil International University has been accepted as satisfactory for the partial fulfillment of the requirements for the degree of M.Sc. in Computer Science and Engineering and approved as to its style and contents. The presentation has been held on September 2019.

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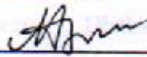
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DECLARATION

I hereby declare that, this thesis has been done by me under the supervision of **Ms. Nazmun Nessa Moon**, Assistant Professor, Department of CSE Daffodil International University. I also declare that neither this thesis nor any part of this thesis has been submitted elsewhere for award of any degree or diploma.

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DEDICATION

I dedicate my dissertation work to my family and my friends. A special feeling of gratitude to my loving parents, My beloved Mother **Dahaba Hassan mohamed** a strong and gently soul who taught me to trust in Allah, believe in myself, dedication, hard work and that so much could be done with little and that her words of encouragement and push for tenacity ring in my ears each second.

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ABSTRACT

In the recent years, innovation is affecting the learning knowledge from numerous points of view. Internet of Things (IoT) keeps on affirming its critical position with regards to Information and Communication Technologies (ICT) and the advancement of society. The motivation behind this research is to discover the capability of IoT in advanced education particularly in smart university campuses and how to expand its advantages and lessening the dangers associated with it. This research carried out a survey that examined the awareness of IoT and smart learning environment among university students. And this survey also evaluated the Role of IoT on the educational outcome of DIU students. The students expressed the necessity of IoT in education for a smart learning environment. Finally, IoT-driven learning enhances the student's outcome and academic achievements,

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CHAPTER 1

INTRODUCTION

1.1 Introduction

The concept of connected devices has given a new rise of the Internet, anything, anywhere can get connected with the Internet and becomes 'Smart.' Connected devices can communicate with each other and share information which can then further be processed to take some decisions. This whole concept is named as 'Internet of Things.' According to Mark Weiser, "The most profound technologies are those that disappear. They weave themselves into the fabric of everyday life until they are indistinguishable from it" [1]. Kevin Ashton first used the term Internet of Things in 1999. Since the beginning of Internet of Things (IoT) many researchers have tried to define IoT in various ways like Internet of Everything, Internet of Anything, Internet of People, Internet of Signs, Internet of Services, Internet of Data or Internet of Processes [2]. According to [3], IoT represents 'anything at all, depending on requirements.' Cisco defines IoT as a network of connected physical objects. Cisco also uses the term Internet of Everything for both physical and virtual objects. Cisco states that "IoE brings together people, process, data, and things to make networked connections more relevant and valuable than ever before—turning information into actions that create new capabilities, richer.

Today, because of the fast advancement and the rapid developments in technology, objects around us are getting to be more smart or connected and different businesses are getting disturbed. In any case, when focused areas like home automation, modern digitalization, industrial revolution, financial institutions and so on educational sectors has not been in the front edge of adopting IoT.

In any case, today, this began changing rapidly as many educational organizations are currently accepting the importance of adopting IoT into their continuous strategies and teaching activities, Very soon, most of educational institutes will implement IoT into their educational scenarios [3].

The concept of smart university (SU), connected campus (CC), intelligent classroom (IC), Smart learning environment (SLE), and related topics turned into the basic topics of

different growing global and national occasions, administrative and industrial activities, institutional motivation, and key plans. Smart Universities can make various open doors for scholars and researchers to learn material in different ways.

1.2 Motivation

In the light of the new developments in Internet of Things (IoT) made the degree it covers progressively increasing. With the increase of the number of the institutions that have adopted or started implemented IoT based solutions and remaining will adopt it. Internet of Things (IoT) advantages to all, for example people, social, organizations, businesses instruction divisions and so on.

Internet of Things (IoT) is labeling our daily items and objects with the help of machine-readable tags. Universities seem to be the perfect spot for making of smart environment.

1.3 Rationale of the Study

While thousands of researches have been recently done to study various applications of IoT and its role in education, this topic as far from being hot as a research area. Specifically, new studies can be conducted in the area of IoT in education to analyze the role of intelligent devices, connected objects and the overall emerging technology on education. The practical implications of this research relates to assisting high educational institution aiming to enter the new ere of smart educational environments by reducing costs, increasing revenue, engaging faculty and improving their contribution the scientific research. I associate my career aspirations with becoming an IT professional, and accordingly, conducting a research in this topic can lead me gaining in-depth knowledge and motivation in this field to contribute my chances of success in this chosen career path.

1.4 Research QuestionsWhat is the role of IoT in education?

1. What are the existing IoT applications implemented by Daffodil International University?
2. How IoT can enhance the educational outcome of the students?

1.5 Expected Out Come

- To understand what IoT and Smart University are?

- To improve the students' awareness of IoT and smart education.
- To examine how students are comfortable with IoT based education
- To determine the role and impact of IoT based university education among DIU students.
- To get the students recommendations about what they would appreciate to be implemented in DIU.
- To know what the teachers expect about IoT in education.

1.6 Report layout

Report layout will discourse about the chapters of this thesis and their sub topics as follows:.

- **Chapter one:** we discuss about introduction of Role of IoT in education, Motivation, Rationale of the study, Expected Outcome, and Report Layout.
- **Chapter two:** We will discuss chapter two Background, Introduction, Related Works, Research summary, Scope of the Problem and Challenges.
- **Chapter three:** Research methodology will discusses Research Subject and Instrumentation, Data Collection Procedure, Statistical Analysis and Implementation Requirements
- **Chapter four:** Experimental results and discussion of the Experimental Results, Descriptive Analysis and summary.
- **Chapter five:** Summary, Conclusion, Recommendation and Implication for Future Research.

CHAPTER 2

LITERATURE REVIEW

2.1 Introduction

This chapter will discuss about the literature review and the background of the study, where I will take some of the most recent topics of IoT in education that has been conducted by researchers.

2.2 Related Works

The education can be defined as a way of making people better informed and wiser through acquiring knowledge and skills. As such, human pose awareness of responsibility and capability to significantly contribute to the world progress. In other words, the education outcome – research, invention, innovation and adaptation enhance the processes of recognizing and dealing with the challenges and solving the problems of the world. Hence, the education is the most effective mean of making the world better, safer and more sustainable place to live, what makes it the best investment (UNESCO, 1997)[4].

The role of education in all spheres of life and society progress implies the demand for continuous betterment of education sector. The technology progress has a profound effect on education, remarkably transforming the manners of teaching and learning on a worldwide scale (Advanced MP Technology, n.d). The technology utilized in education makes the educational activities more effective, student-focused and issue-focused (Gupta and Fisher, 2012)[5].

In recent years novel Information and Communication Technology (ICT) solutions completely change the traditional educational process leading to the significantly improved modern and quality education systems at various levels of learning. There are currently seven categories of technologies, tools, and strategies that revolutionize the education sector: consumer technologies, digital strategies, enabling technologies, Internet technologies, learning technologies, social media technologies and visualization technologies (Johnson et al., 2015). As a part of Internet technology, the Internet of Things (IoT) has enabled that every device/„thing“ becomes connected to the Internet opening a whole world of potentially remarkable improvements in all spheres of life. In other words,

the IoT inclusion in the educational environment successfully overcome the gap between the traditional education system and modern education system requirements by transforming traditional classrooms separated by location and time into the connected classroom unified by the Internet and communication tools. Hence, the educational practice has been dramatically influenced by the IoT advances. This technology progress has significantly improved the delivery method of courses' content as well as the content of the delivery, by adding more resources and tools to the classroom, physically or online, and making the learning more dynamic and interactive (Advanced MP Technology, n.d.; Vujović and Maksimović, 2015). Therefore, the IoT brings completely new levels of connectivity and advanced learning approaches in the educational practices. However, the IoT also brings certain challenges and concerns, mostly privacy and security issues regarding students' personal and grade information (Advanced MP Technology, n.d.) [6].

The IoT is a global physical network which connects devices, objects and things to the Internet infrastructure to communicate or interact with the internal and the external environment as illustrated in Figure 1, and for the purpose of exchanging information through the information sensing devices according to specific protocols. Thus, IoT is enabling connectivity for anything and for anyone to be networked around the world anytime, and anywhere using any network or any service to achieve the goal of intelligent identifying, tracking, and managing things. It is an extension and expansion of Internet-based network, which expands the communication between human to human (H2H), human to things (H2T) or things to things (T2T) [6] as presented in Figure 2 [2].

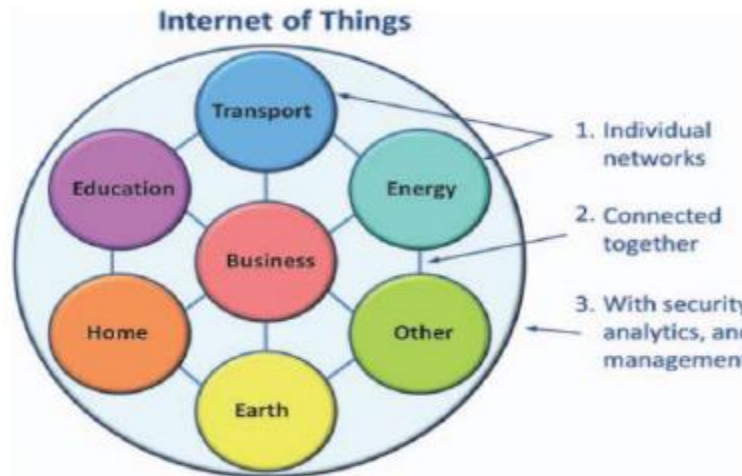


Figure 2.1 Internet of Things

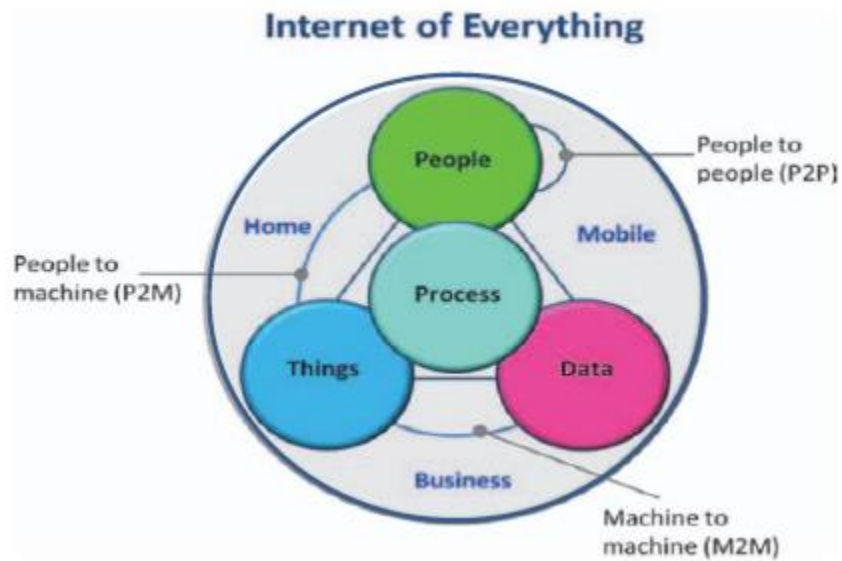


Figure 2.2 Internet of Everything

Technology in education has played a significant role in connecting and educating the students. IoT technology has an important impact on education field. IoT has not only changed the traditional teaching practices but has also brought changes in the infrastructure of educational institutions [8]. The term Internet of Things in Education is considered two

faceted because of its use as a technological tool to enhance academic infrastructure and as a subject or course to teach fundamental concepts of computer science [9].

Another way to understand the impact of IoT on education is through the use of sensors. For example, Super Mechanical's Twine7 product—a small box described as “the simplest way to connect stuff to the Internet”—allows users to link almost any physical object to a local area network. Twine integrates sensors with a cloud-based service, allowing for easy setup. Just point Twine to a Wi-Fi network and sensors are immediately recognized by the web app, which reflects what the sensors see in real time. Even people with no knowledge of software coding can receive text and email updates on whatever items or environments the box is sensing [10].

2.3 Research summary

From the related works above we can deduce, the following summary. The Internet of Things (IoT) has the potential to transform education by profoundly altering how schools, colleges and universities gather data, interface with users and automate processes. IoT refers to the networking of physical objects through the use of embedded sensors, actuators and other devices that can collect and transmit information about real-time campus activity. When IoT is combined with technologies such as user mobility and data analytics, it brings a new paradigm in education. IoT enables institutions to:

- Create new ways for students to learn by supporting more personalized and dynamic learning experiences such as immersive digital textbooks and game-based learning.
- Change how teachers deliver lessons and test achievement with smart audio-visual equipment, digital video recorders for lecture capture, and online testing.
- Simplify operations for school administrators by proactively monitoring critical infrastructure and creating more efficient, cost effective processes for HVAC, lighting and landscape management.
- Provide a safer environment for students and teachers with digital surveillance cameras, smart door locks and connected school buses.

2.4 Scope of problem

The main problem we are trying to tackle is ability to incorporate and include Iot in the current education system so as to improve or better it. We will be also looking into the effects of Iot on student, teachers and all those involved whether it's for the better or worse and try to fix issue that might arise from that

2.5 Challenges

I. Security and privacy

Higher education is vulnerable around the security and privacy of the IoT ecosystem. Although there has been greater momentum to deal with the security of the IoT infrastructure, there is still no strategy to identify business risks associated with data breaches.

II. Financing

The cost of information technologies continues to expand every year as content and application stacks escalate. These application stacks continue to grow both horizontally and vertically on instructional technologies, research computing and enterprise technologies. Beside the information technology fee and laboratory fee, most universities do not have a strategy for sharing costs and identifying the total cost of ownership (TCO) for an IoT infrastructure.

III. Quality and ethics

The quality of education both online and on campus and the rising cost of higher education has been hotly debated in recent years. The IoT offers unique opportunities to deliver digital courses but also introduces challenges to maintain the quality of instruction and evaluation of students' work. This instructional digital disruption illuminates students' ethics around academic honesty and plagiarism—especially data fraud and publication within scientific communities.

CHAPTER 3

RESEARCH METHODOLOGY

3.1 Introduction

This chapter discusses the research methodology and it will include the research subject and instrumentation, data collection procedure, statistical analysis, reliability, validity and research design of this thesis and the methods used for gathering the data.

3.2 Research Subject and Instrument

Research instrument is defined as the tools to be used for collecting data and how those tools will be developed. The most common instruments for data collecting in educational researches are questionnaires, interviews, observation, and document analysis. However, the researcher in this thesis used questionnaire instrument as main tool for collecting data, which is used in quantitative research.

Questionnaire may be defined as a technique of data collection in which each person is asked to respond to the same set of questions in predetermined order.

The questionnaire in the survey research process is a critical stage and must be relevant and accurate in trying to capture the essence of the research objective. To achieve these goals, a researcher will be required to make several decisions and ask his self the following questions:

- ❖ What should be asked?
- ❖ How should each question be phrased?
- ❖ In what sequence should the questions be arranged?
- ❖ What questionnaire layout will best serve the research objectives?
- ❖ How should the questionnaire be pre-tested?
- ❖ Does the questionnaire need to be revised?

The selection of this tool has been guided by the nature of data to be collected, the time available as well as by the objectives of the research and the overall aim of study.

3.3 Data Collection Procedure

The data collection procedure of this study is a questionnaire which contains questions derived based on the questions of the research, literature review and the theoretical positioning presented in the previous chapter of this study.

After the pilot testing and all necessary modifications, the questionnaires were administered directly to the chosen sample for the study for and collected data were quantified.

3.4 Statistical Analysis

Descriptive statistical measures such as frequencies, percentages and central tendencies was used to analyze close ended questions. The results was presented in tables, there after data was tabulated and analyzed using frequencies and percentages with the help of SPSS computer software application (Statistical Package for Social Sciences). Cross-tabulation analysis and Pearson's correlation tool was also used to establish applicable relationships among the identified Dependent and independent variables.

3.5 Validity and Reliability

Validity refers to the degree to which data collection method accurately measures what it was intended to measure or to the extent to which research findings are about what they are claimed to be about and the extent to which research results can be accurately interpreted and generalized to other populations. Reliability is "The extent to which results are consistent over time and an accurate representation of the total population under study is referred to as reliability and if the results of a study can be reproduced under a similar methodology then the research instrument is considered to be reliable. So that validity and reliability are very important aspects for this research to be accurate. Therefore, the researcher used adapted questionnaire which has already been tested by other researchers.

3.6 Research Design

A research design is the overall plan or strategy for conducting a research. The researcher chose a survey research design because it best served to answer the questions and the purposes of the study.

The survey research is one in which a group of people or items is studied by collecting and analyzing data from only a few people or items considered to be representative of the entire group.

The following criteria indicated that the approach is best when...

- ❖ Data are best obtained directly from the respondents.
- ❖ Data can be obtained by brief answers to structured questions.
- ❖ Respondents are expected to give reliable information.
- ❖ How to use the answers is known.
- ❖ An adequate response rate is expected.

The questionnaire was determined by the literature reviewed, the aims and the research questions of this study as well as by the theoretical positions. Data were collected based on the structured questionnaire distributed to the students of DIU as the selected sample. The data collected were managed using the Statistical Package for Social Science (SPSS).

CHAPTER 4

EXPERIMENTAL RESULTS AND DISCUSSION

4.1 Introduction

This chapter will cover the results of the study. Data analysis and interpreted results of the survey will also be presented and discussed. The data analysis and interpretation will be based on the aim and objectives of the research carried out which was entitled “Role of IoT in the Educational Outcome of DIU Students”.

Analysis of the collected data was computed using frequency and percentages and the results were presented using tables, graphs and charts.

4.2 Experimental Results

As stated in the previous chapter, the researcher selected a sample of 250 respondents. A survey of questionnaire was carried out to find the extent of awareness of IoT and its role in the educational outcome of DIU students. This survey questionnaire consisted of background information, awareness scale, importance of IoT and problems or scares related to privacy and security issues.

For the better understanding the results of the students' questionnaire were divided into the following:

1. Background information.
2. Awareness of IoT
3. Role of IoT in the education.
4. Rating how IoT technologies will invade students' privacy.

4.3 Descriptive Analysis

A descriptive analysis is a summary statistic that quantitatively describes or summarizes features of a collection of information.

Descriptive statistics provide simple summaries about the sample and about the observations that have been made. Such summaries may be either quantitative, i.e. summary statistics, or visual, i.e. graphs.

4.3.1 Gender Response

Table 4.1 gender Distribution

	Frequency	Percent	Valid Percent	Cumulative Percent
Male	174	69.6	69.6	69.6
Female	76	30.4	30.4	100.0
Total	250	100.0	100.0	

The above table 4.1 presents the sex distribution of the respondents and shows that 69.6% of respondents were male students while 30.4% of the respondents were female students, this indicates that the majority of the respondents were male students. The following figure 4.1 shows the graph of the table 4.1.

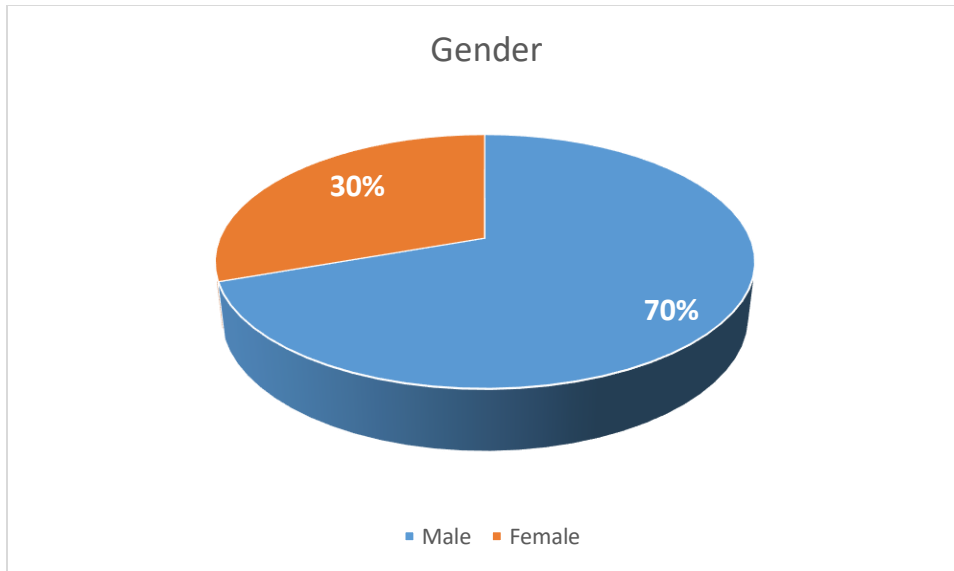


Figure 4.1 gender distribution

4.3.2 Age distribution

Table 4.2 shows the age distribution

	Frequency	Percent	Valid Percent	Cumulative Percent
Between 15-25	187	74.8	74.8	74.8
Between 26-35	63	25.2	25.2	100.0
Total	250	100.0	100.0	

The above table 4.2 shows the age distribution of the respondents and indicates that 74.8% of the students were aged between 15 and 25 years while 25.2% of the respondents were aged between 26 and 35 years. The below figure shows the graph of table 4.2

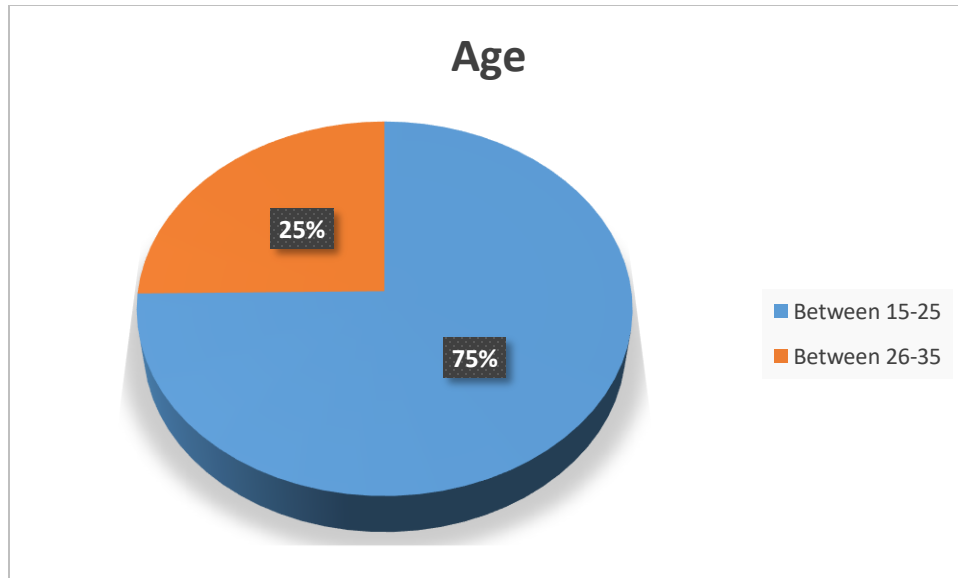


Figure 4.2 Age Distribution

4.3.3 Program of study

Table 4.3 Program of study

	Frequency	Percent	Valid Percent	Cumulative Percent
Undergraduate (Bachelor)	125	50.0	50.0	50.0
Graduate (master)	125	50.0	50.0	100.0
Total	250	100.0	100.0	

The above table 4.3 shows the study programs that the students are enrolled in 50% of them were undergraduate students and 50% of the respondents were graduate students. The below figure 4.3 shows the graph of table 4.3

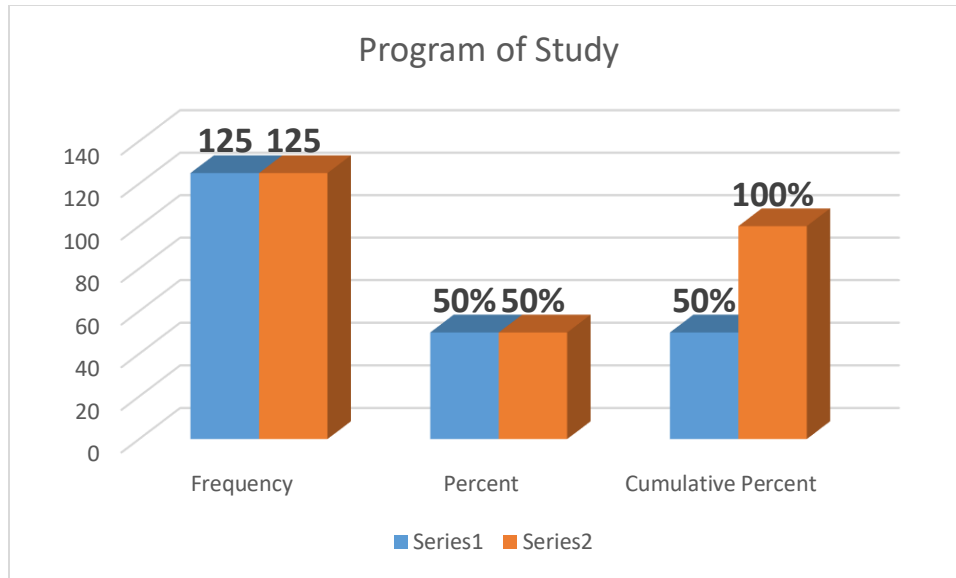


Figure 4.3 Study program

4.3.4 How familiar are students with the term IoT

Table 4.4 How familiar are students with the term IoT

	Frequency	Percent	Valid Percent	Cumulative Percent
Never heard of it	8	3.2	3.2	3.2
General idea (read about it online, heard about it on the news, etc.)	147	58.8	58.8	62.0
Read some research papers, heard about it in courses.	76	30.4	30.4	92.4
Doing research in this area	19	7.6	7.6	100.0
Total	250	100.0	100.0	

The above table shows how familiar the students are with the concept of IoT. 3.2% of the respondents answered that they never heard of the term IoT, 58.8% of the respondents have

a general idea about this technology, 30.4% of the respondents read research papers and course notes about IoT and 7.6% of the respondents are doing research in this field.

The below figure 4.4 represents the graph of table 4.4.

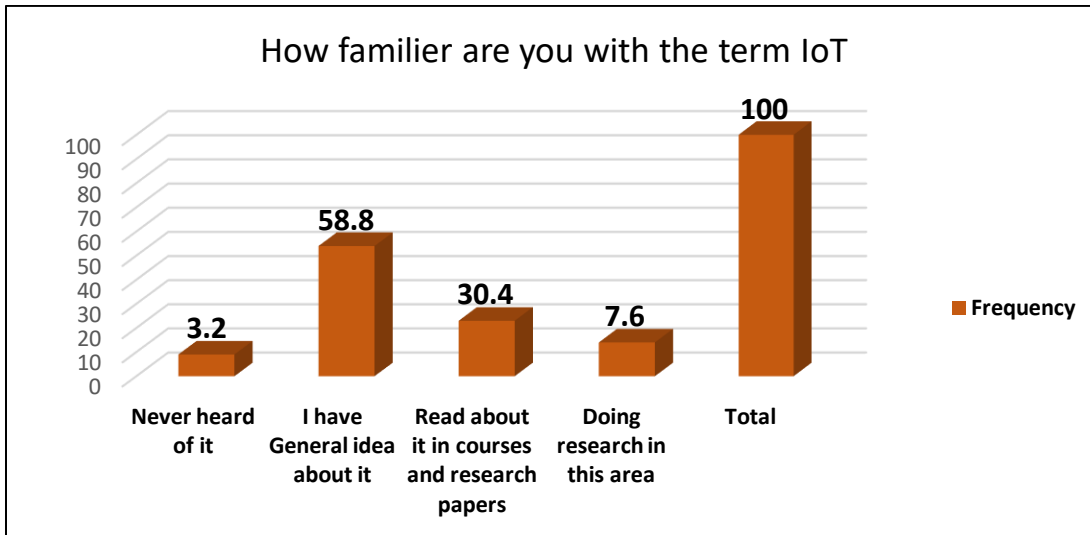


Figure 4.4 How familiar are you with the term IoT?

4.3.5 What is IoT?

Table 4.5 which word do you associate most with the term IoT

	N	Percent	Percent of Cases
Connected device to the internet	218	54.9%	87.6%
Futuristic	8	2.0%	3.2%
Smart	63	15.9%	25.3%
Intelligent	59	14.9%	23.7%
Data stream	18	4.5%	7.2%
Security	31	7.8%	12.4%
Total	397	100.0%	159.4%

The above table shows the answer of the question “which word do you associate most with the term IoT, 54.9% answered that IoT means “*Connected devices to the internet*”, 2% of the respondents answered that IoT means “Futuristic, 15.9% said that IoT means “smart”, 14.9% said that IoT means “intelligent”, 4.5% answered that the term IoT associates most with “data stream” and 7.8% answered that the term “security” associates most with the term IoT. The below figure shows the graph of table 4.5

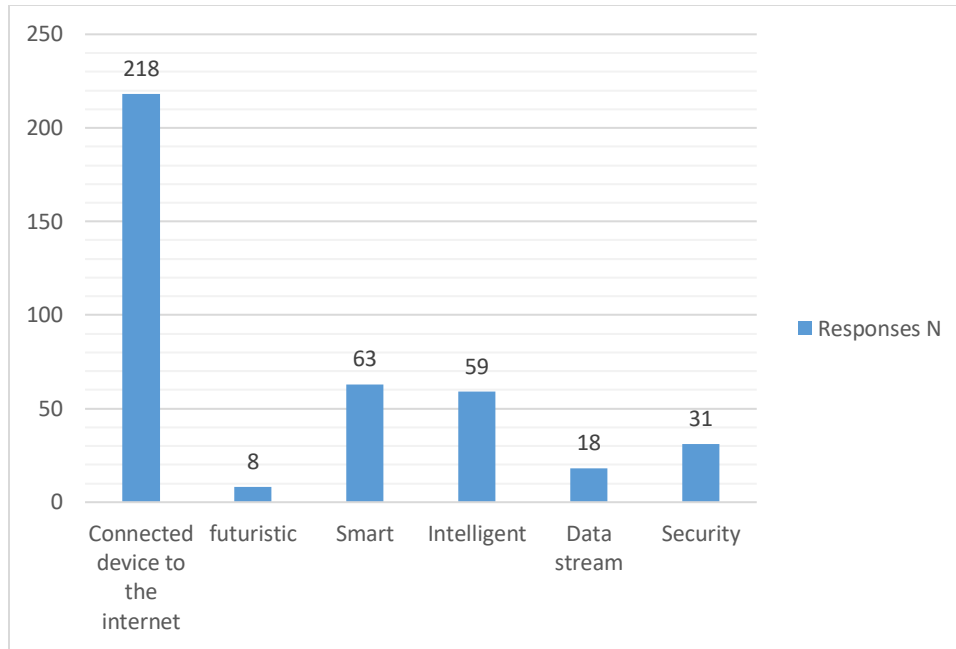


Figure 4.5 which word do you associate most with IoT

4.3.6 How IoT fits within the education?

Table 4.6 How IoT fits within the education?

	Frequency	Percent	Valid Percent	Cumulative Percent
Separate and distinct	53	21.2	21.2	21.3
Enhances teaching and learning	147	58.8	58.8	80.3
Don't Know	50	20	20	100.0
Total	250	100.0	100.0	

The above Table 4.6 shows how IoT fits with in education sector, as per the answer of the population, 58.8% of the respondents said it “Enhances learning and teaching”, 21.2% of them answered it is Separate and distinct and 20% answered “I don’t know, figure 4.6 below illustrates table 4.6

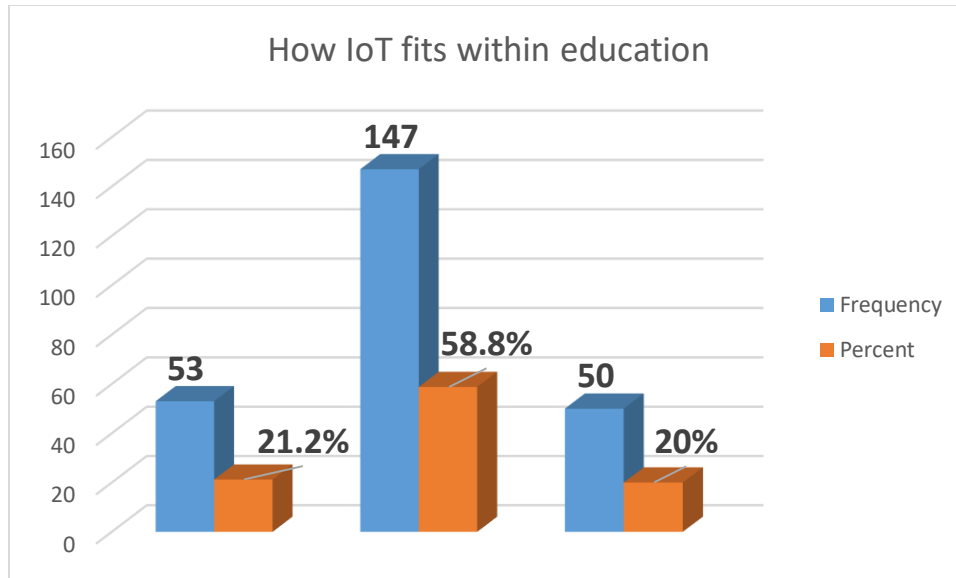


Figure 4.6 How IoT fits within education

4.3.7 Do you think your current institution can handle emerging technologies?

Table 4.7 Do you think your current institution can handle emerging IoT technologies?

	Frequency	Percent	Valid Percent	Cumulative Percent
Yes, it can support	171	68.4	68.4	68.4
No, it cannot support	36	14.4	14.4	82.8
Do not know	43	17.2	17.2	100.0
Total	250	100.0	100.0	

Table 4.7 shows if current institutions can handle emerging technologies. 68.4% of the respondents said it can support, another 14.4% said it cannot support and about 17.2% said it Do Not Know.

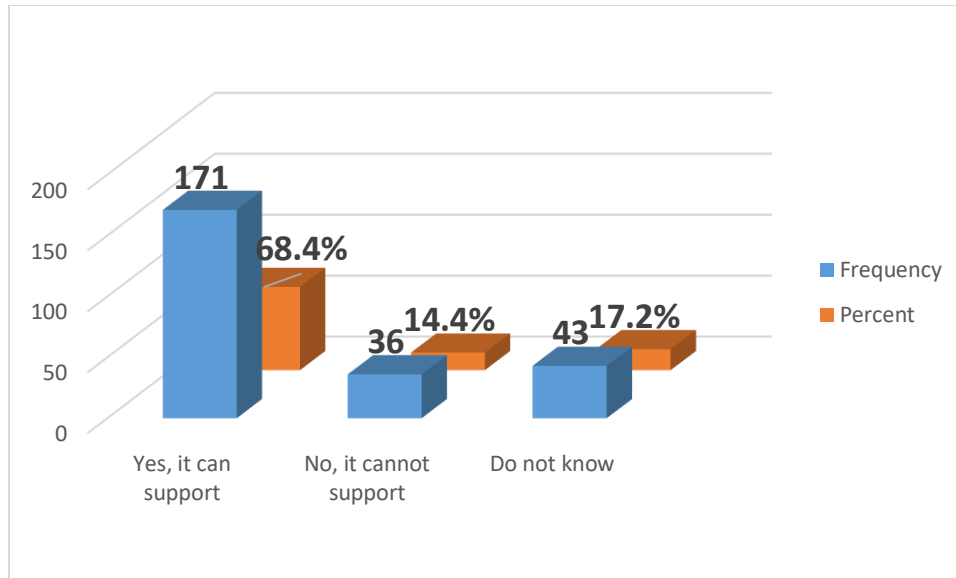


Figure 4.7 How current institution can handle emerging technologies

4.3.8 Do you think that IoT based education has more benefits that traditional

Table 4.8 Do you think that IoT based education has more benefits that traditional

	Frequency	Percent	Valid Percent	Cumulative Percent
Yes	235	94.0	94.0	94.0
No	15	6.0	6.0	100.0
Total	250	100.0		

Table 4.8 above shows illustrates the answer of the question of IoT based educational benefits over traditional education, 94% of the respondents answered that IoT-based education is beneficial than traditional education while 6% others said it has no benefits.

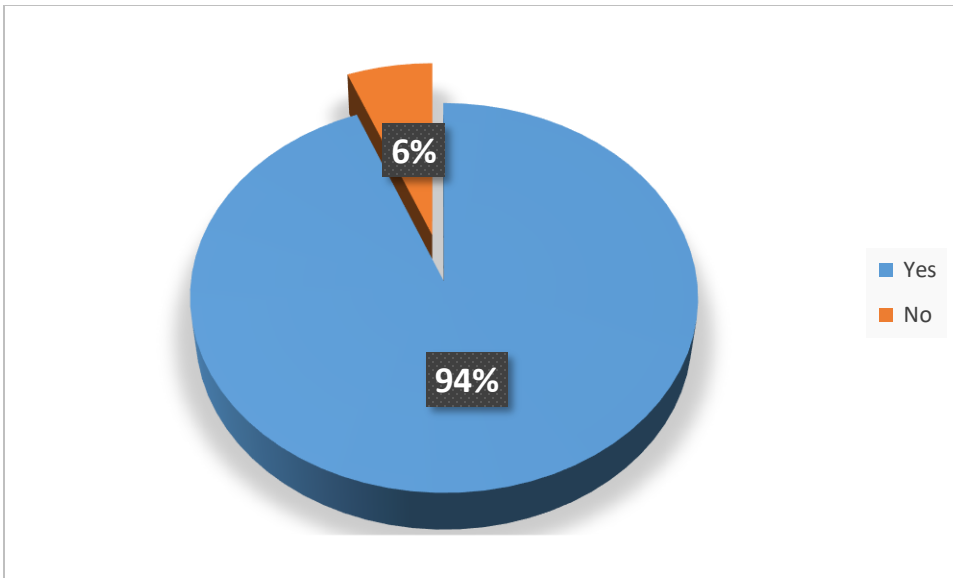


Figure 4.8 Do you think that IoT based education has more benefits than traditional?

4.3.9 Do you believe that IoT based education can enhance your academic?

Table 4.9 Do you believe that IoT based education can enhance your academic?

	Frequency	Percent	Valid Percent	Cumulative Percent
Yes	247	98.8	98.8	98.8
NO	3	1.2	1.2	100.0
Total	250	100.0	100.0	

Table 4.9 above shows the answer of the question Can IoT based educational enhance the student's academic achievements, 98.8% of the respondents answered yes it enhances, while 1.2% others said it has no it cannot enhance.

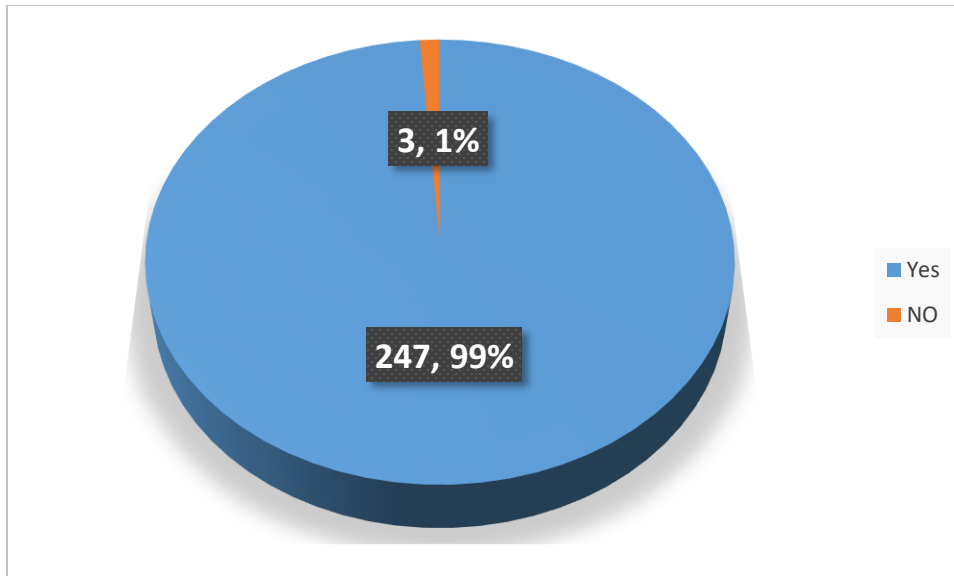


Figure 4.9 Do you believe that IoT based education can enhance your academic?

4.3.10 how do you rate the importance and significance of IoT in education?

Table 4.10 how do you rate the importance and significance of IoT in education?

	Frequency	Percent	Valid Percent	Cumulative Percent
Not important	30	12.0	12.0	12.0
Some what important	47	18.8	18.8	30.8
Neutral	36	14.4	14.4	45.2
Very important	36	14.4	14.4	59.6
Important	101	40.4	40.4	100.0
Total	250	100.0	100.0	

Table 4.10 above shows the answer of the question how do you rate the importance and significance of IoT in education? 12% of the respondents answered Not important, 18.8% said Some what important, 14.4% said they have Neutral opinion about that, 14.4% others said its very important while 40.4 answered its important.

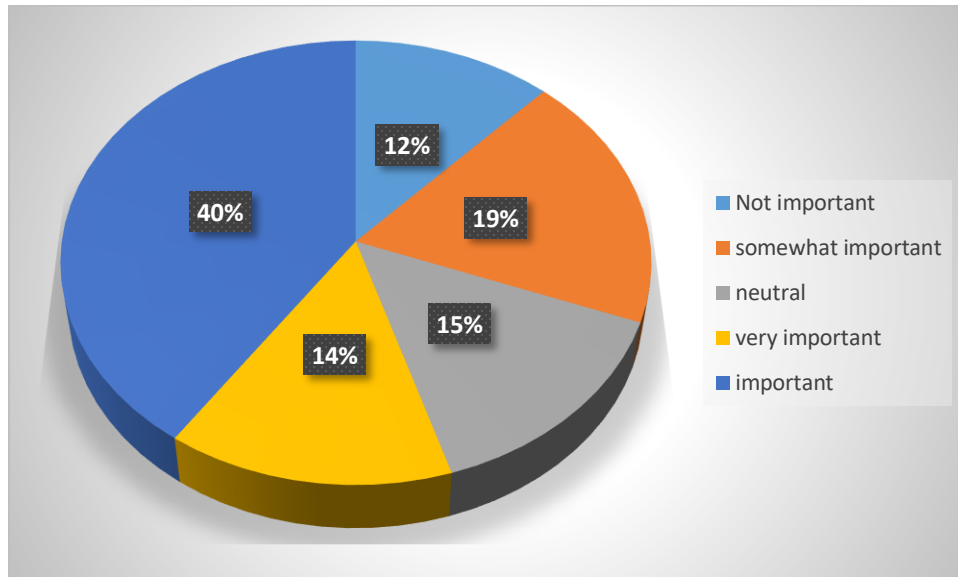


Figure 4.10 how do you rate the importance and significance of IoT in education

4.3.11 How important do you think it is necessary to change from the traditional

Table 4.11 How important do you think it is necessary to change from the traditional

	Frequency	Percent	Valid Percent	Cumulative Percent
Not important	4	1.6	1.6	1.6
Some what important	61	24.4	24.4	26.0
Neurtal	38	15.2	15.2	41.2
Very important	55	22.0	22.0	63.2
Important	92	36.8	36.8	100.0
Total	250	100.0	100.0	

Table 4.11 above shows the answer of the question How important do you think it is necessary to change from the traditional teaching style? 1.6% of the respondents answered Not important, 24.4% said it is Some what important, 15.2 said they have Neutral opinion about that, 22% others said its very important and 36.8% answered its important.

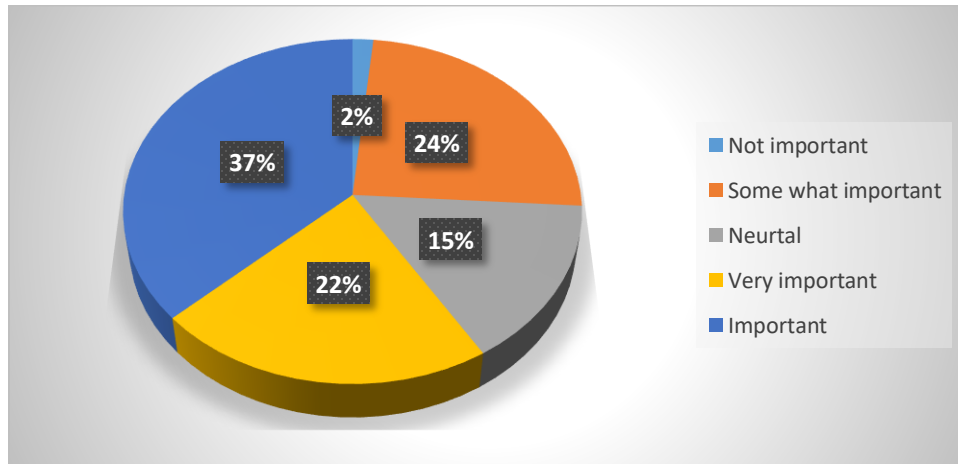


Figure 4.11 How important it is necessary to change from the traditional teaching style

4.3.12 online courses (e-learning)

Table 4.12 online courses (e-learning)

	Frequency	Percent	Valid Percent	Cumulative Percent
They should not be used at all	8	3.2	3.2	3.2
They should be used only as a complement to contact lessons	54	21.6	21.6	24.8
From time to time they should be used instead of contact lessons	130	52.0	52.0	76.8
They should be used instead of contact lessons very often	50	20.0	20.0	96.8

they should replace contact lessons	8	3.2	3.2	100.0
Total	250	100.0	100.0	

Table 4.12 shows the responses to the online courses. 3.2% of the respondents answered that they should not be used at all, 21.6% of the respondents answered that they should be used only as a complement, 52% of the respondents answered that they should be used instead of contact lessons and very often, and 3.2% of the respondents answered that they should replace contact lessons. The below figure show the graph of table 4.12.

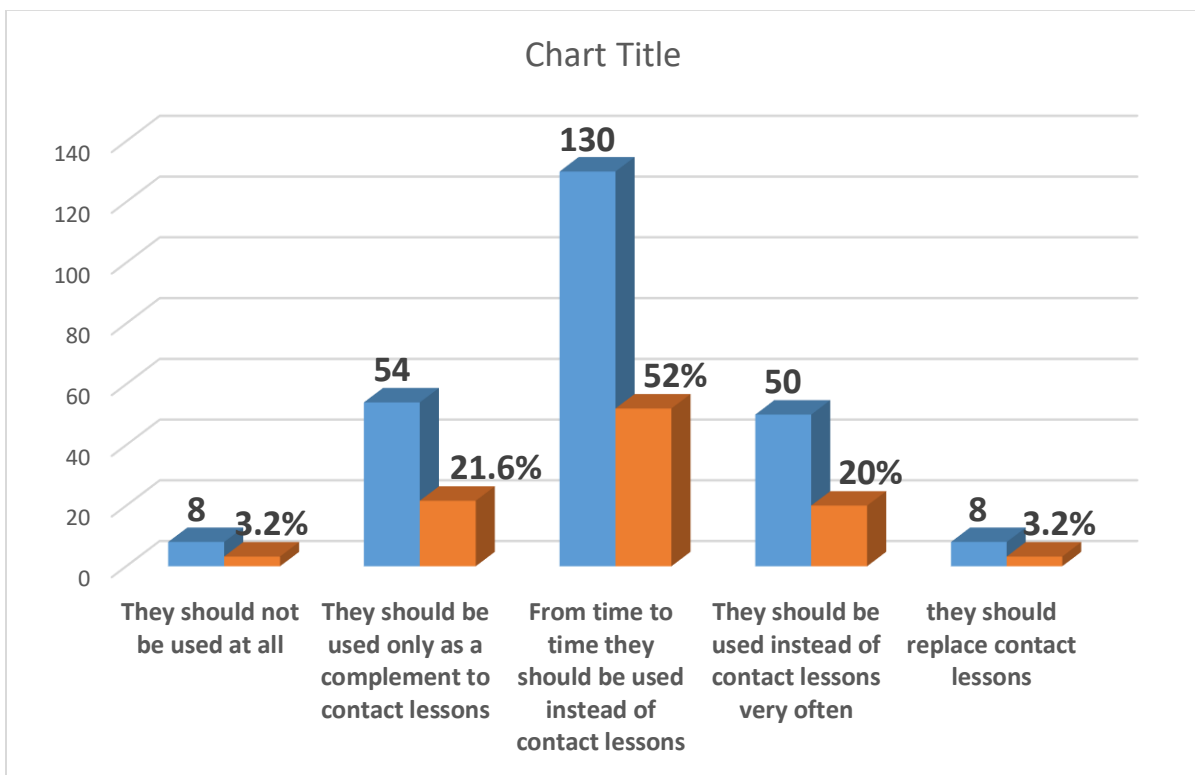


Figure 4.12 Online Courses

4.3.13 Smart technology in education and privacy

Table 4.13 Smart technology in education and privacy

	Frequency	Percent	Valid Percent	Cumulative Percent
Not at all	10	4.0	4.0	4.0
A bit	89	35.6	35.6	39.6
Neutral	35	14.0	14.0	53.6
pretty much	110	44.0	44.0	97.6
Completely	6	2.4	2.4	100.0
Total	250	100.0	100.0	

The above table 4.13 shows the responds of the question “How smart technology will invade privacy?” 4% of the respondents answered it will not invade at all, 35.6% of the respondents answered it will invade a little bit, 14% of the respondents answered that they have a neutral opinion about this question, 44% of the respondents answered it will invade pretty much, 2.4% of the respondents answered that it will invade completely. The below figure shows the graph of table 4.13.

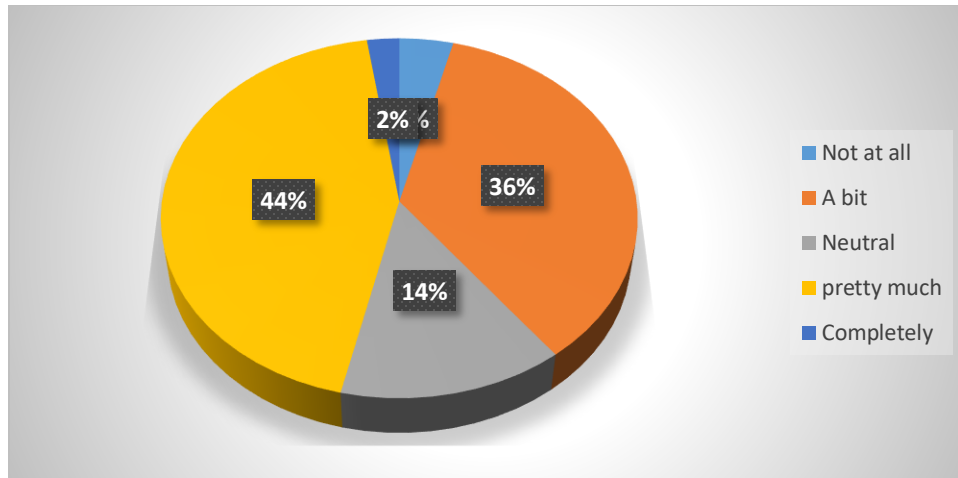


Figure 4.13 smart technology in education and privacy

4.3.14 Applying IoT in higher education has a significant role

Table 4.14 Applying IoT in higher education has a significant role

	Frequency	Percent	Valid Percent	Cumulative Percent
strongly agree	47	18.8	18.8	18.8
Agree	173	69.2	69.2	88.0
Not Sure	19	7.6	7.6	95.6
Disagree	7	2.8	2.8	98.4
Strongly Disagree	4	1.6	1.6	100.0
Total	250	100.0	100.0	

Table 4.16 above presents the degree of agreement or disagreement that if one can say I would not prefer use of IoT in education because of privacy concerns. About 17.6% of the respondents said they strongly agree, 50% of the respondents said they agree, about 20.8%

of the respondents said they are not sure about, 9.2% of the respondents said they disagree. And 2.4% remaining of the participants answered strongly disagree.

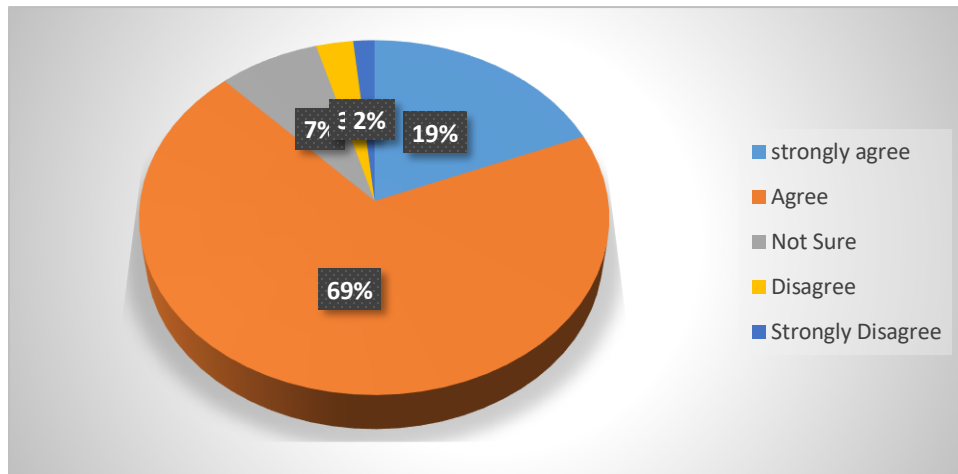


Figure 4.14 Applying IoT in higher education has a significant role

4.3.15 IoT can have negative impact and distractions

Table 4.15 IoT can have negative impact and distractions

	Frequency	Percent	Valid Percent	Cumulative Percent
strongly agree	28	11.2	11.2	11.2
Agree	54	21.6	21.6	32.8
Not Sure	78	31.2	31.2	64.0
Disagree	58	23.2	23.2	87.2
Strongly Disagree	32	12.8	12.8	100.0
Total	250	100.0	100.0	

Table 4.15 above presents the degree of agreement or disagreement that if IoT can have negative impact and distractions. About 11.2% of the respondents said they strongly agree,

21.6% of the respondents said they agree about 31.2% of the respondents said they are not sure about, 23.2% of the respondents said they disagree. And 12.8% remaining of the participants answered strongly disagree.

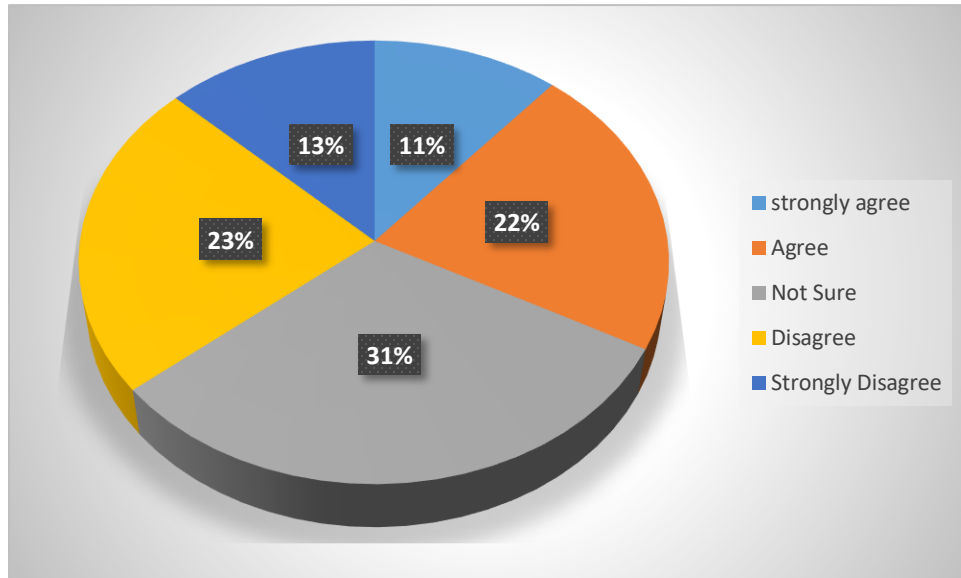


Figure 4.15 IoT can have negative impact and distractions

CHAPTER 5

DISCUSSION, CONCLUSION AND RECOMMENDATION

5.1 Introduction

This chapter presents the summary of the findings, discussion, conclusion and recommendations based on the data analyzed in the previous chapter. First the major findings of each study will be discussed confirming the research objectives, second the conclusion from the findings of the study will be presented and lastly the researcher will suggest recommendations of this study and for future work.

5.2 Summary and Discussion of the Research

5.2.1 Familiarity of students with the term IoT?

About 59% of the students answered that they have a general idea about IoT, and 30% said they are doing research in that field.

5.2.2 Which word do you associate most with the term IoT?

Asking what is IoT, based on their understanding to the term, more than 50% of the students said it is connected devices to the internet

5.2.3 How IoT fits within education

This question asked to the students How IoT fits within education About 58% believe that IoT Enhances learning and teaching

5.2.4 Do you think that IoT based education has more benefits than traditional education system?

More than 94% of the students answered that IoT-based education is beneficial than traditional education.

5.2.5 Do you believe that IoT based education can enhance your academic achievements?

Answering the above question 98.8% of the respondents answered that IoT technology based education system enhances they academic achievements.

5.2.6 Importance and significance of IoT in education

The answer of the question how do you rate the importance and significance of IoT in education? Showed that about 58% of the respondents answered it is important and about 14.4% others said it is very important. This underlines that IoT is important in education.

5.2.7 Online courses (e-learning)

The answer of the above question showed that 21.6% of the respondents answered that online courses should be used only as a complement to contact lessons, and 52% of the respondents answered that they should be used instead of contact lessons

5.2.8 How IoT devices can invade privacy

With the assumption that IoT devices are not built with the appropriate security precautions or features such as identity protection in an effort to keep costs low and save time due to their increasing demand, one may worry about his/her privacy, regarding to this aspect, students were asked about, how they perceive that IoT can invade their privacy. Around 44% of the students believe that IoT will violate their privacy issues.

5.2.9 Applying IoT in higher education has a significant role on the general cognitive aspect of learning

The above question presents the degree of agreement or disagreement that if Applying IoT in higher education has a significant role on the general cognitive aspect of learning.

About 18.8% of the respondents said they strongly agree and 69.2% of the respondents said they agree, this underlines that using IoT technology in education can play an important role on the general cognitive aspect of the learning.

5.2.10 IoT implementation in higher education institutes can increase opportunities for teacher and student

About 92% of the respondents said that IoT in education can increase research opportunities for students and researchers.

5.2.11 IoT can have negative impact and distractions

Assessing how IoT can have negative impact and distractions in the educational outcome of the students, 32% of the respondents said it can have negative impact while 31% others said they are no sure, and about 35 respondents said it has negative consequences in the student's education outcome.

5.3 Conclusion

This research aimed to carry out a study on the Role of IoT on the Educational Outcome of DIU Students, through determining the extent of knowledge that all university student have about IoT technology, and asking how IoT based education can improve learning and teaching skills. From our work along this study and from the outcome of the survey shown that in terms of awareness of IoT majority of the students have a general concept about what IoT is. Students also expressed that their campus is not smart enough, students are interesting about IoT based learning environment and showed their willing towards digitalized university and mentioned that Smart technologies can enhance their learning and can also increase research opportunities for both students and researchers.

Students also expressed their needs to have smart technologies in classroom and labs for easy and comfort learning and that also helps teachers to support their career and skills and facilitate their interaction and guidance to their students. Finally underlined the necessity of changing from the traditional teaching style into a new way of collaborative learning for smart IoT based campus to adopt with this rapidly growing digital world.

5.4 Recommendations

The research that has been undertaken for this thesis has underlined a number of topics on which the researcher recommends for example:

- Empowering students, teachers and staff with trainings and workshops to fill the gap of lacking information about digital world and IoT.
- Also students and teachers in faculties other than CSE and Engineering should be given courses and seminars about ICT to be able to interact in the smart environment.

5.5 Future Work

The researcher recommends some future study or research ideas for further improvements.

Designing generic frameworks of context aware ubiquitous learning environment dealing with the IoT emerging technologies.

Learning analytics and educational data mining.

Creation of new innovative ways to assess students' achievements.

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APPENDIX

Daffodil International University

Department of Computer Science and Engineering (CSE)

Thesis Title:

The Role of Internet of Things (IoT) in the Educational Outcome of DIU Students

Questionnaire

Demographic Information

1. What is your sex/gender?

Male

Female

2. How old are you?

Between 15-25

Between 26-35

Between 36-45

Between 46-55

56 and above

3. Which study program are you enrolled in?

Undergraduate (Bachelor)

graduate (Master)

Diploma

Concept of Internet of Things (IoT).

4. How familiar are you with the term "Internet of Things" (IoT)?

Never heard of it

General idea (read about it online, heard about it on the news, etc.)

Read some research papers, heard about it in courses.

Doing research in this area

Brief Description of IoT:

The Internet of Things is simply "A network of **Internet** connected objects able to collect and exchange data. For example. Lets imagine you have a "Smart air conditioner" in your home that is connected

5. What is Internet of Things (IoT)? Which word do you associate the most with it?

Connected devices to the internet

Futuristic

Smart

Intelligent

Data stream

Security

Other (please specify) _____

6. How IoT fits within the education?

Separate and distinct

Enhances teaching and learning

Don't know

Other (specify) _____

7. Do you think your current institution can handle emerging IoT technologies?

Yes, it can support.

No, it cannot support.

Do not know.

8. Do you think that IoT based education has more benefits than traditional education system?

Yes

No

9. Do you believe that IoT based education can enhance your academic achievements?

Yes

No

10. How do you rate the importance and significance of IoT in education?

Not important

Somewhat important

Neutral

Important

Very important

11. How important do you think it is necessary to change from the traditional teaching style (teacher in front of a class) to a new way of teaching - cooperation (teacher as a moderator, team work, flipped learning).

- Not important Somewhat important Neutral
 Important Very important

12. What is your opinion of online courses (e-learning)?

- They should not be used at all.
 They should be used only as a complement to contact lessons.
 A time to time they should be used instead of contact lessons.
 They should be used instead of contact lessons very often.
 They should replace contact lessons.

13. Rate how much you perceive or feel the use of "IoT" technologies in education will invade your privacy.

- Not at all
 A bit
 Neutral
 Pretty much
 Completely

(In the following questions please rate your level of agreement or disagreement by circling the appropriate number)

14. Applying IoT in higher education has a significant role on the general cognitive aspect of learning

- 1-Strongly agree, 2-Agree, 3-Not Sure,
4-Disagree 5-Strongly Disagree

15. IoT connectivity can improve learning

- 1-Strongly agree, 2-Agree, 3-Not Sure,
4-Disagree 5-Strongly Disagree

16. IoT implementation in higher education institutes can increase research opportunities for teachers and students.

1-Strongly agree, 2-Agree, 3-Not Sure,
4-Disagree 5-Strongly Disagree

17. I would not prefer use of IoT in education because of privacy concerns

1-Strongly agree, 2-Agree, 3-Not Sure,
4-Disagree 5-Strongly Disagree

18. IoT can have a negative consequence and distractions

1-Strongly agree, 2-Agree, 3-Not Sure,
4-Disagree 5-Strongly Disagree

Role of IoT

ORIGINALITY REPORT

30%	28%	10%	%
SIMILARITY INDEX	INTERNET SOURCES	PUBLICATIONS	STUDENT PAPERS

PRIMARY SOURCES

1	paper.ijcsns.org Internet Source	6%
2	www.ibmbigdatahub.com Internet Source	3%
3	Hanan Aldowah, Shafiq Ul Rehman, Samar Ghazal, Irfan Naufal Umar. "Internet of Things in	2%