A STUDY ON GREEN IT AWARENESS AMONG UNIVERSITY MALAYSIA PAHANG STUDENTS

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A Study on Green IT Awareness Among UMP Students.

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Thesis submitted in fulfilment of the requirements for the award of the degree of

Bachelor of Computer Science (Graphics and Multimedia)

Faculty of Computer System and Software Engineering

UNIVERSITI MALAYSIA PAHANG

May 2018

ACKNOWLEDGMENT

I would like to express my sincere appreciation to the following people who had directly and indirectly given generous contribution towards the success of this project.

I wish to express my sincere gratitude to my final year project supervisor, Prof. ' Dr. MAZLINA BINTI ABDUL MAJI for her guidance, suggestion, and constant support in making this research possible. The contribution made by her towards my educational experience, professional development during this study are gratefully acknowledged.

Lastly, I owe special debt to my family and friends who dedicated their love and support me, especially my mother who encouraged me throughout the journey in getting the report completed.

ABSTRACT

This current study Investigate and Assessment the awareness of Green IT Practices Among University Student. Green IT acts as a fundamental vector that can contribute greatly towards productivity. Its sectors have been greatly responsible for energy consumption, waste generations and gas emissions. Green IT approach can seriously answer these problems and improve organizational sustainability by increasing environmental performance. There are many practices has been done to achieve sustainability, the most practiced of these are reduce, reuse, and recycle. The aim of this study is, to assess the green IT awareness among UMP students through survey method, and to develop a green IT website for rising the awareness of green IT concept. This study finds that the awareness of Green IT Practices Among UMP Students is low. So that this study develops a green IT website for rising the awareness of green IT concept.

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CHAPTER 1

INTRODUCTION

1.1 Introduction

The main aim of this thesis is to investigate and assess the awareness of Green Information Technology (IT) among university students

This chapter is divided into four parts. it starts with explanation of the motivation and background of study, problem statement, objectives and the scope.

1.2 Background and motivation

The word 'green' has been used and defined many times over decades by different organizations and industries to understand and implement it. So, what is green? "Green" can be a metaphor that encompasses what is best for the environment and business (Miller & Szekely, 1995)When we try to determine which products and practices are good for the environment we need also to determine which ones are sustainable over time, that time might be not defined. This is embodied in the definition of sustainability adopted by the United Nations in its Agenda for Development: Best quality is achieved through sustainable development that helps improve the quality of life. Social, economic and environmental constraints mutually benefit in sustainable development (Kuhlman & Farrington, 2010).

1.2.1 Green IT and sustainable Developments

There is very less research done on environmental governance and regulation. An overarching agenda comes into play when social, economic and environmental based sustainable development becomes unavoidable tradeoff. Sustainable developments is treated as the major orthodox environmental or economic policy (Barry, 2009).

Green IT acts as a fundamental vector that can contribute greatly towards productivity. Its sectors have been greatly responsible for energy consumption, waste generations and gas emissions. Green IT approach can seriously answer these problems and improve organizational sustainability by increasing environmental performance. It is a fact that, sustainable development can be achieved by improving IT and IT related amenities (URSĂCESCU, 2011).

Sometimes, organizational policy issues related to green IT may help in attaining sustainable development. The advent of big data and Internet of Things (IoT) contribute greatly to establish a strong network to support this green IT agenda and work towards eco-innovative sustainability (Baek & Park, 2015).

There are many practices has been done to achieve sustainability, the most practiced of these are reduce, reuse, and recycle. The term reduce has been applied by companies, industries, also by people by reducing consumption of material, waste and energy sources. Some people get confused by the terms reuse and recycle thinking that it has the same meaning. However, The EU waste strategy distinguishes between reuse and recycling. Without changing the structure or composition of raw material, the recycling process of waste is undertaken (Glavič & Lukman, 2007). This is the way how it goes Green and for the good of environment.

The green concept has entered almost every field so now we can hear about green houses, green management, green chemistry, green campus, and green IT. According to the International Alliance of Research Universities (IARU), eleven universities from nine countries are striving to collaborate towards sustainability. This project will focus on the green IT in university campus.

Technology now become part of our life, since we are using it in form of smart phones, laptops, headphones, smart watch, printers, etc. while the amount of these IT and smart devices are increasing today than the day before, we need to know how to ensure that the usage of these technologies can also support the green campus?

Having been conceptualized in several ways, Green IT, in general, focuses on designing, manufacturing, using and disposing of computer, servers and associated subsystems efficiently and effectively with minimal or no impact on the environment (Bose & Luo, 2011). There are many ways to achieve the minimal or no impact on the environment goal, different organizations

have their own perception to achieve it and go green. Their explanation of the meaning of being "green" depends on their preference for the path ranging from e-waste management to electrical power control they would like to pursue. Thus, for some organizations, it might mean buying technology that is more energy-efficient than what they have. Whereas others might suggest that it is an issue of reducing the amount of electricity their datacenter consumes. For some others, it might mean buying hardware that is made of environmentally friendly components. Yet for others they might look at the end of hardware life and suggest that Green IT means proper disposal of them. (Bose & Luo, 2011).

1.3 Problem statement

The information and communication technologies (ICTs) have a profound impact on economy and environment. The performance improvements in ICT leads to increased consumption of ICT products and services, which has numerous environmental implications on different levels.

The multilevel rebound effects produced due to the usage of ICT has a great impact on the environment. Either it is the life cycle of the hardware used in ICT or it is the applications of those hardware. Human behaviour can have drastic effect on this percentage of impact under various situations and have strong environmental implications in today's socio-economic system (Plepys, 2002).

In an environment like University, the problem is that the students become addicted to IT equipment's and smart devices. And the number of technologies and smart devices being used inside the university campus is increasing (Aljomaa, Qudah, Albursan, Bakhiet, & Abduljabbar, 2016; Lee, Cho, Kim, & Noh, 2015). So, how to ensure that the usage of these technologies is contributing toward green. Students spend so much time on smart devices, sleeping late, with ear phones, or letting their laptops and chargers on without using for days which cost the university expensive electric bills and other hazards (Murugesan, 2008). Thus, there should be a way to assess the awareness and the understanding of the green IT among these students. This can be achieved by developing a tool such as, a website to evaluate their practices.

Green IT directly contributes in decreasing expenses, creating good corporate image and mitigates the climate change. In some cases, green IT are still not that prevalent. Young generations can help to cope with green IT related problems. Therefore, by studying the green IT awareness

among university students the extent of knowledge on green IT can be assessed based in three major constraints or indirect variables in the system. Such as, environmental, social and economic sustainable green ICT. As per Thongmak (2012), this can help us to develop a green IT tool in the form of website to create more awareness of green IT among the university students.

1.4 Objectives

- To study on the sustainability principles for the awareness questionnaire development.
- To assess the green IT awareness among UMP students through survey method.
- To develop a green IT website for rising the awareness of green IT concept.

1.5 Scope

The scope of the study of this project focuses on understanding and evaluating the awareness about green IT among the university. The sample will be collected from UMP students and there will be a list of questions related to this. The questionnaire is based on three constructs of sustainability (Environmental, Social and Economic). And the results would show how much is the level of percentage of green IT awareness among university students with respect to those three constraints of sustainability.

The respondents would be contacted through a google form. The link shall be circulated either through online social platforms or will be sent to their mails. The total number of respondents would be between 100 and 120. Only the UMP students would be considered for this study. The questionnaire is based on the four-point Likert's scale where the average is taken as the final value of all the other data and the data analysis is done in excel worksheet.

CHAPTER 2

LITERATURE REVIEW

2.1 Introduction

In this part, researcher will cover on the literature review of the research. Literature review helps to analyze research source, or literature, on a certain topic. It is a systematic process provides a summary, classification, comparison and evaluation. It also gives a fundamental basis of the research and assist researcher to further understand the nature of the research. The research work is divided into several sections which include, the definition of each variable which include sustainability, green campus practices towards sustainability, green IT, and existing method to check the awareness.

2.2 Sustainability

It was not simple as it seems to define sustainability or sustainable development, since there are over hundreds of definitions are available yet there is no universal agreed definition for it. However, the principle of these definitions remains similar to the one defined by Brundtland in 1987 as, the ability of reaching the present's needs without affecting the future generations' ability to reach their needs(McChesney, 1991)

Sustainable development evaluates the human society from an economical and environmental point of view (Glavič & Lukman, 2007). As the populations growth rapidly, the pressure on the resources can be increased and the rising in living standards will be slowed down(McChesney, 1991) Thus, sustainable development model considers the limitations of economic, societal and environmental resources in order to share in the welfare of the present and future generations(Glavič & Lukman, 2007).

Developing a system that is sustainable helps in reducing the danger of environmental and economic damages. Since, sustainable system can contribute to sustainability if it's products, processes, or services limits the consumption of natural resources and waste generation to a reasonable limit(Fiksel, 2003). By including sustainable production and sustainable consumption to achieve sustainable system, changes on the lifestyle and thinking patterns of people need to be made.

Organizations or industries that creates goods in non-polluting, energy and natural resources conserving way with economically viable, safe and healthy ways for employees, communities, and consumers are sustainable productive. Consumption is connected to products life cycle, starting from production then distribution, use, until disposal. Sustainable consumption is to balance between social and environment by reducing the exhaustion of materials and energy and avoiding the environmental harm(Glavič & Lukman, 2007)

2.2.1 Environmental Sustainability and Green It

Organizations are responsible towards environmental conservation and hence now they are implementing green IT. There is a need for new green and clean technologies which are eco-friendly (Agrawal & Agarwal, 2012). Many governmental bodies are taking care of measures towards controlling climate change (Chowdhury, 2012).

The environment is already degrading towards a state of global warming and now ICT and items related to ICT have started contributing towards it. There is a pressing need for the IT sector to adopt green agenda compulsorily in their strategic goals. Green IT takes time and needs precise planning. Green IT is a very good option to attain environmental sustainability (Molla, Cooper, & Pittayachawan, 2009; Murugesan, 2008).

2.2.2 Social Sustainability

Social sustainability is one of the benefits for green IT (Suryawanshi & Narkhede, 2013). IT based hardware or equipment change the way the people interact and cooperate with each other (B. Brown & Green, 2012). Green IT delivers social and economic values and considers it a major norm that shall affect the behavior of the people. Social sustainability is a major criteria among those values and the budgeting towards IT is done considering this green effect (Chou & Chou, 2012).

2.2.3 Economic Sustainability

Economic growth of the late twentieth century was designed mainly by controlling the economic sustainability (Peattie, 2016). Greening the system can lead to unquestionable economic growth to attain the economic sustainability (Jänicke, 2012). Green resources and infrastructure may help build sustainability assessment systems that lead to economic wellbeing (Reith &

Orova, 2015). The inbuilt environment oriented system that is present to improve environmental and operational performance and also achieve economic and environmental sustainability economic sustainability (Raisinghani & Idemudia, 2019)

2.2.4   Green Campus Practices towards Sustainability

Sustainable campus is a good way to raise the awareness of coming generations towards sustainability. Imam & Reza, 2016 The implementation of sustainability in university campus will establish the culture of green and sustainable lifestyle among the students. Moreover, it will help to spread the principle of green and sustainability in the society. This made many universities to direct their attention toward the green sustainable campus specially in Malaysia. Peter & Libunao, 2016 stated that many Malaysian universities like UKM, UM, USM, etc. Are promoting to sustainability through programs such as "green campus initiative" or "sustainable campus".

Before discussing the practices that have been done by universities to achieve sustainability in campus, we need to define what is sustainable campus is. (Cole, 2003) defined it as "A sustainable campus community acts upon its local and global responsibilities to protect and enhance the health and wellbeing of humans and ecosystems. It actively engages the knowledge of the university community to address the ecological and social challenges that we face now and, in the future,". Therefore, a sustainable campus is about reducing the unfavorable influence on environment, economic, community, and health in university (Bakhshi, Othman, & Wahab, 2015).

Universities adopted different ways to practice sustainability in their campus. University Sains Malaysia (USM) focused on the daily used materials to encourage sustainable consumption. First, they identified and categorized the stakeholders and identified the material used by them. Then, they offer programs to enhance the awareness about sustainable consumption and have the basic skills of making the right decision to attain the sustainable consumption. At last, they conducted an evaluation process to check the level of achievement and helps the stakeholders to identify the efficient activities to be carried on. (Rahim et al., n.d.)

University Technology Malaysia (UTM), Kuala Lumpur Campus followed another path to achieve sustainable campus. Focusing on air pollution reduction by increasing the green open spaces in the campus. Which contribute in other benefits to the ecosystem such as noise reduction,

ambient temperatures, air filtering regulation; carbon sequestering and storm-water attenuation. It also can be a good place to escape from university stress (Bakhshi et al., 2015).

30 years ago, until now, University Technology MARA (UiTM) Pahang is aiming to be the sustainable campus in Malaysia. Working on the construction of a compact campus by using 'infill' development to construct buildings within the current campus area rather than developing new one. This will be advantageous in reducing land usage, minimize the reliance on vehicle, reduce utilization of resource and emission of pollution, encouragement of public transportation, walking and cycling, better access to facilities and services, efficient provision of infrastructure and utilities and lastly is redevelopment of existing areas(Paper, Universiti, & Mara, 2016).

2.3   Green IT

As IT plays an integral role in almost all facets of life, and each stage of the IT lifecycle from manufacturing to usage and disposal can pose environmental damages(Elliot & Binney, 2008). and as the consumption of energy and electricity by IT services is increasing, which made IT equipment are important source of greenhouse gases (Harmon & Auseklis, 2009) the implementation on eco-sustainability and green computing need to be embedded with every phase of IT development and deployment phases (Molla et al., 2009)

Greening the IT is a process and practices to design, manufacture, use and dispose the IT equipment such as, computers laptops, monitors, smart phones, printers, etc. with minimal or no impact on the environment (Murugesan, 2008). Molla et al., 2009defined green IT as the ability of organization to systematically apply environmental sustainability criteria (such as pollution prevention, product supervision, use of clean technologies) to the design, production, sourcing, use, and disposal of the IT technical infrastructure as well as within the human and managerial component of the IT infrastructure.

Most of the definitions of green IT focuses on the emission of the carbon footprint from the IT infrastructure and how to efficaciously use the resources to reduce the environmental impact. Less attention was paid to individual users, although they also can influence the green IT by their daily practices (such as switching off monitors, minimizing printing, or using recycled paper and toner) (Unhelkar, 2011) Thus, the individual awareness toward green IT can contribute to environmental and economic sustainability.

(Unhelkar, 2011) discussed some implementations to apply green IT which are, using a software that automatically turn off the devices when it's not in use, using smart meters that measures the emissions and encourage efficient use of equipment to reduce it, efficient usage of printers by printing double side and recycling ink cartridges, replacing the old devices with low-power-consumption and low-carbon-emitting one, and raising awareness among user groups of environmental sustainability and green IT through basic training.

2.4 The Awareness on Green IT practices

Awareness is being conscious to the external stimuli without paying attention to it (K. W. Brown & Ryan, 2003), people become aware of something when they expose to a certain situation or information through daily events such as, conversation with others, social media, TV, news or any other sources(Ahmad, Bello, & Nordin, 2013). Checking the awareness on green IT is measuring the familiarity with the vocabulary, principle, and practices of it or even having heard about it.

Many methods have been applied to check or measure the awareness of people. Ahmad et al., 2013 explored the awareness of green computing among university students. They gathered a sample of 224 student enrolled in ICT and non-ICT related field of study, 43% under ICT fields and 57% under non-ICT related fields. They developed a questionnaire consisting of three sections (A, B, and C), section A is on personal information, section B is about measuring the awareness of green computing vocabulary (heard about it or not heard about it), section C is about rating the degree of familiarity with the issues related to the topic. The questionnaire was distributed personally by hand, via e-mail and in the classes, the data was collected either directly or after few days and the data was analyzed with different methods for different set of questions.

University of technology, Mauritius has adopted similar way of measuring awareness of their students about green computing. They have developed a survey questions of three sections (A, B, and C). section A personal questions, section B about the way student use their computers. Section C was observational questions, the questions were designed to monitor the student's behavior toward the environment and measuring their intent to practice green computing(Dookhitram, Narsoo, Sunhaloo, Sukhoo, & Soobron, 2012).

2.5 Summary

In chapter 2, the researcher has discussed on all the variables sustainability, sustainable green campus and green IT based on past or existing journals, research papers, reports and articles. The relationships between all the variables are also discussed in the study.

CHAPTER 3

METHODOLOGY

3.1 introduction

This chapter described the methodology that has been used for this study. The research methodology is a part of research which is very important Research objectives and research questions were answered by research methodology accurately and precisely. The methodology used in conducting the research were discussed, which covered the research method, population and sampling, data collection technique, questionnaire design, pre-test of questionnaire, pilot study and data analysis. It allowed greater understanding on how this research is conducted that explains on the research process as well as respondents' selection technique to collect relevance data Al the same time, analyzing of data using reliable software shall help researcher answered research objectives and research questions by using the method precisely and correctly for easier data interpretation.

3.2 Flowchart
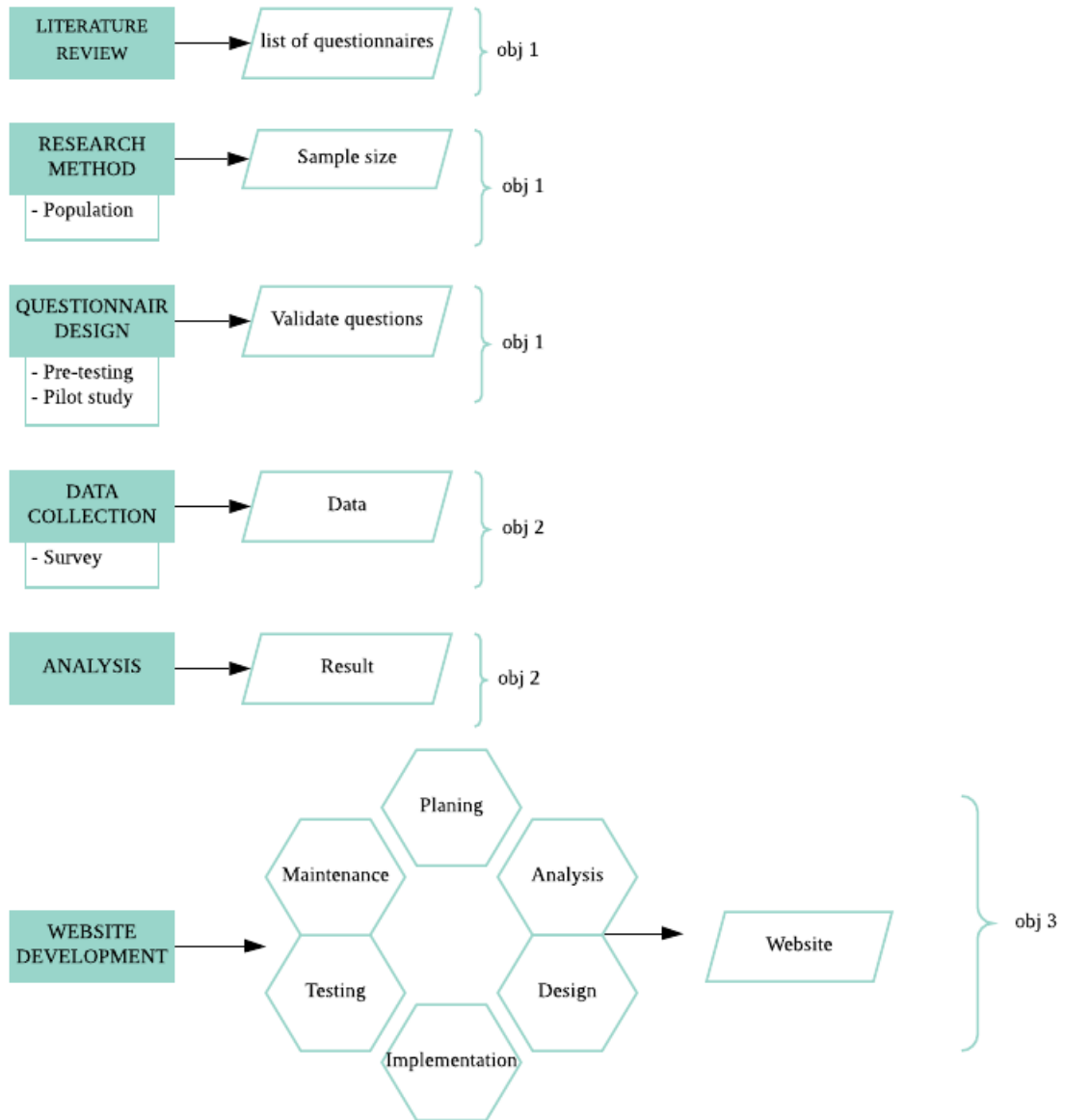
Figure 1 *Flowchart*

3.3 Research Methods

This study collected data on the interested relevant variables by using questionnaire method. A questionnaire survey approach was adopted, which given the empirical nature of the investigation, with aspiration to reach a slightly wide range of respondents located within a small geographic area taking into consideration the time constraints. This method is believed to be a convenient means of collecting data from different type of student with different level of education.

3.3.1   Population and Sampling Procedure

Since the proposed research is conducted in the Malaysian environment and within its universities, the university students are the target population being the largest group living in the universities' campuses. Universities of the 21st century are almost powered by IT (Matthews, Osuoyah, Popoola, Adetiba, & Atayero, 2017), therefore it was selected. A report for the JISC (Joint Information Services Committee) in 2008 stated that universities and colleges in UK used around 1,458,000 computers, 249,000 printers, and 240,000 servers; which consumed around 512,000 MWh of electricity annually, with the expectation that it will cost around £121 million (193,600,000 USD) in 2009 for the electricity bills, the CO2 emissions from the electricity used was estimated to be around 500000 metric tons. Malaysian universities' campuses are occupied with IT equipment used by student, thus the need of investigating and raising their awareness towards the Green IT campus is increasing.

The decision was taken to focus on University Malaysia Pahang; to negate the need for more complex situation involving other universities, which would need to be highlighted by a more complex research design and a larger sample. The survey focuses on UMP students as they were selected as the sample of this study.

There are two sampling methods which probability and non-probability sampling. Choosing one of the two types of methods is a matter of determining weight the requirement for validity and credibility against a realistic assessment of the requirement for effort of the alternative methods, comparing to non-probability sampling, the probability sampling if carefully designed and carried-out, has greater validity and credibility. The probability sampling is based on the concept of random selection, which is a controlled procedure that assures that each population element is known non-zero chance of selection.

In contrast, non-probability sampling is arbitrary or non-random and subjective. Each member does not have a known non-zero chance of being involved(Saunders, M Lewis and Lewis, 2009). Even though probability sampling has technical advantages, however, in some cases non-probability sampling might be chosen by researchers due to several factors. Firstly, non-probability sampling is quick, convenient and less expensive compared to probability sampling (Saunders, M Lewis and Lewis, 2009). Secondly, it is possible that non-probability sampling may be the only feasible alternative. Furthermore, the total population may not be available for study in some cases. Two types of non-probability sampling are convenience sampling and purposive sampling. The present study uses a convenience sampling where the sample is selected only in case the target population is available.

In relation to sample size, these studies recommended the following rules of thumb to determining the size of the sample:

1. Sample size larger than 30 and less than 150 are appropriate for most research.
2. In multivariate study, the sample size should be several times (preferably 10 times or more) as large as the number of variables in the study

The smaller the samples have more sampling error and lower reliability. Ordinarily, a sample of less than about 30 responses will provide too little certainty to be practical(Saunders, M Lewis and Lewis, 2009).

3.3.2 Data Collection Techniques

A questionnaire survey approach was adopted given the empirical nature of the investigation, the desire to reach a wide range of respondents located within a large geographic area and cost and time constraints. It is also the most common method of data collection in investigation studies. Questionnaire was the main and lone instrument for data collection because kind of population literate person; (2) Most of the population difficult to find opportunity and time for an interview, and (3) The increasingly expensive nature of alternative tools of data collection. The data is to be collected through questionnaire a survey alongside a personally administered approach and one method of questionnaire distribution was used namely: google forms. this method is believed to be the most convenient way to collect data in this type of research.

3.4 Sustainable Development of Green IT

A) Green IT Impact on the Environment (Environmental Sustainability)

Green practices and policies have a strong environmental impacts and controls economic growth and prevent from organizational crisis (Jänicke, 2012). Things like global warming (GWP), abiotic depletion (ADP), acidification (AP), and eutrophication are three main indicators for that can change environmental sustainability (Santoyo-Castelazo & Azapagic, 2014). Green IT enhanced process innovation in green products and reduce negative impact thereby increasing the competitive advantage (Sezen & Çankaya, 2013).

Table 1 *Questionnaire to Check Awareness on Environmental Impact due to Green IT*

Qs 1-5 Adapted from (Gholami, Sulaiman, Ramayah, & Molla, 2013)

No	Question
1	Usage of green IT devices reduces air pollution.
2	Implementation of green IT concepts helps reduce the e-waste (electronic waste).
3	IT devices contribute in causing global warming.
4	Green IT help recycle wastes.
5	Recycling and reusing help reducing the consumption of resources.

B) Green IT Impact on Social (Social Sustainability)

The green IT procedures impart great value in to the bio-physical nature of humans working in different industry to reach social sustainability (Mani et al., 2016). Social implications are very high while practicing green IT practices in the organization (Kuhlman & Farrington, 2010).

Table 2 *Questionnaire to Check Awareness on Green IT's Social Impact*

No	Question
1	Green IT increase the quality of social life. (Balram & Dragićević, 2005)
2	Implementing green IT is a social responsibility. (mayuri patel 2017)

3	Green IT A atmosphere improve social commitment.
	(Gholami et al., 2013)
4	Green IT is a priority.
	(Balram & Dragićević, 2005)
5	Green IT awareness can create sustainable development.
	(Chen, Watson, Boudreau, & Karahanna, 2011)

C) Green IT Impact on Economy (Economic Sustainability)

Economic sustainability can be achieved right from the product development stage (Kremer et al., 2016). Green IT growth can improve eco-efficiency and sustainable environment (D'Amato et al., 2017). Green sustainable assessment systems optimize resources and design to attain sustainable wellbeing (Reith & Orova, 2015) Economic sustainability increases the willingness sustainability and green innovation (Saunila, Ukko, & Rantala, 2018).

Table 3 *Questionnaire to Check Awareness on Green IT's Economic Impact*

No	Question
1	Green IT practices help in developing university economic efficiency.
	(Gholami et al., 2013)
2	Green IT reduces electricity bills.
	(Bose & Luo, 2011)
3	Green IT increase university's process efficiency.
	(Bose & Luo, 2011)
4	Green IT atmosphere have negative economic impact.
	(Aldieri & Vinci, 2018)
5	Green IT help in employment growth and Economic innovation.
	(Aldieri & Vinci, 2018)

3.5 Questionnaire design

The instrument that the researcher use in this research is structured survey questionnaire. The survey questionnaire was developed based on the research objectives and divided into specific part. Close ended question format is used in this research in which the respondents only need to choose their answer by choosing in the scale list provided. The reason of using this format of questionnaire is because it is easier for respondent to respond since options are provided and it is easy to understand. It is also useful for result analysis and hence statistical interpretation can be assessed. The development of questionnaire is based on literature review mainly in which related studies from other researchers are used as a guideline. From that, research objectives can be achieved through this method.

The questionnaire has been divided into four sections (A, B, C and D) with a total of 20 items. Section (A) asks about background information pertaining to the respondents, including gender, educational level and field of study. The objective of this section is to provide information about important characters of the students that facilitate in identifying similarities and differences between the sampled students. Such identification is an essential factor for successful analysis and interpretation / explanation of the analysis results. Section (B) addresses the scale items related to Green IT environmental sustainability. Section (C) addresses the scale items related to Green IT social sustainability. Section (D) addresses the scale items related to Green IT economic sustainability. The layout of the questionnaire is shown in Appendix **"A".**

3.6 Pre-Testing of The Questionnaire

The purpose of pretesting is to validate the data collection instruments and to ensure the appropriateness of the administration of the survey. The questionnaire has been validated by expert before being distribute to targeted respondents. It is to ensure that the questionnaire is suitable to be used for this study. The experts chosen are based on their expertise in the areas of study. Expert received the questionnaire and review each question in the list and gave comments about it. Researcher made improvement or changes according to experts' opinion.

3.7 Pilot Study

The purposes of conducting a pilot study are:

1) To warrant the potential respondents understand the survey questions well; and.
2) To warrant that the research instrument as a whole functions well.

A preliminary questionnaire was distributed firstly to 5 students from different background of study to ensure that the language used is easy to understand and the questionnaire is clear.

3.8 Data Analysis

Data analysis is a logical and analytical process in which data is being analyzed and examined. it involves inserting, classifying, coding, transforming, tabling and graphing information in order to provide useful results or outcomes. this information is crucial for the conclusion and supporting decision making.

Analyzing the questionnaire is done by using Microsoft Excel software. Microsoft excel is one of the most widely used software for analytical purpose, it used because of the ease of controlling the software which can generate accurate result for the research.

3.9 Summary

This chapter has covered on the mythology part, which explains research design and methods have been used in this study. In this study, the research process is also explained in the context as well as population and sampling method. The questionnaire design is further refined and explained in detail allowing a better understanding of the research method is also discussed towards the end. The results will then be shown in the next chapter.

CHAPTER 4

RESULTS AND DISCUSSION

4.1 Introduction

This chapter includes the result from surveys and the statistical analysis of the data has been obtained. The data analysis that was included the profile of respondents and graphical analysis of the responses, also included towards the end of the chapter the summary of the chapter.

4.2 Respondents' Profiles

The first section, section A was about demographic. This section consists of 5 questions which consists of gender, level of education and field of study. The sample consists of 110 respondents. **Table 4.1** shows the respondents profile.

Table 4 *Respondents' profile*

| Description	Category	Frequency	Percent
Gender	Male	55	50%
	Female	55	50%
Highest Level of Education	Degree	93	85%
	Master's Degree	7	6%
	PhD	10	9%
Field of Study	IT-related	86	78%
	Non-IT-related	24	22%

4.2.1 Gender

From Figure 4.1, it shows that there are 55 males (50%) and 55 females (50%). This shows that the questionnaire was equally distributed between males and females, taking into consideration that the number of females in the university is more than the number of males.
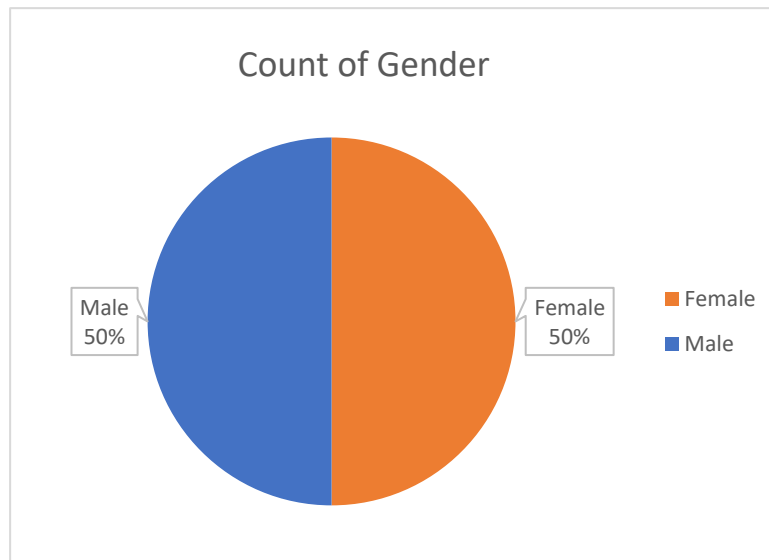
Figure 2 *Gender*

4.2.2 Level of Education

Figure 4.2 shows an overwhelming percentage of 85% that is equivalent to 93 respondents were degree students. 10 respondents (9%) were PhD students and only 7 respondents (6%) were master's degree students.
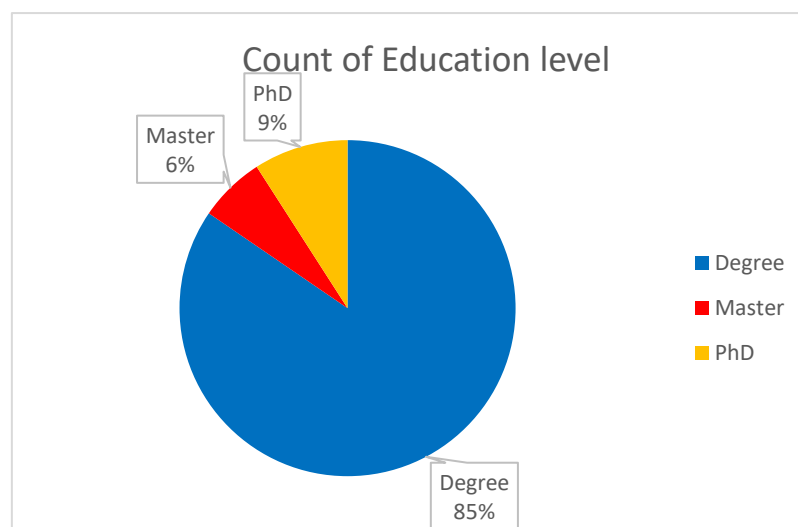
Figure 3 *Educational level*

4.2.3　Field of Study

As Figure 4.3 illustrates the respondent's majority were from IT-related field of study which is at 86 respondent (78%) and 24 were form non-IT-related field of study (22%).
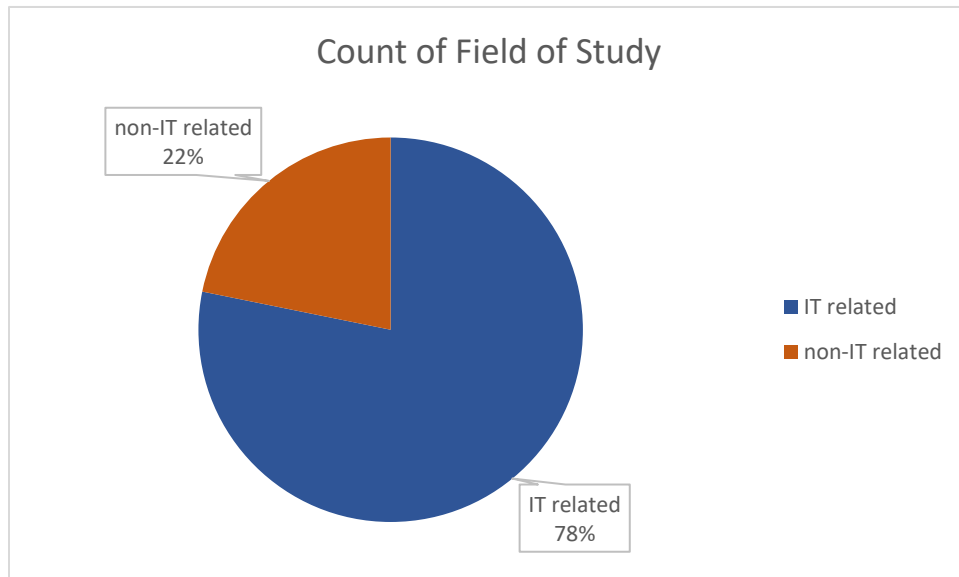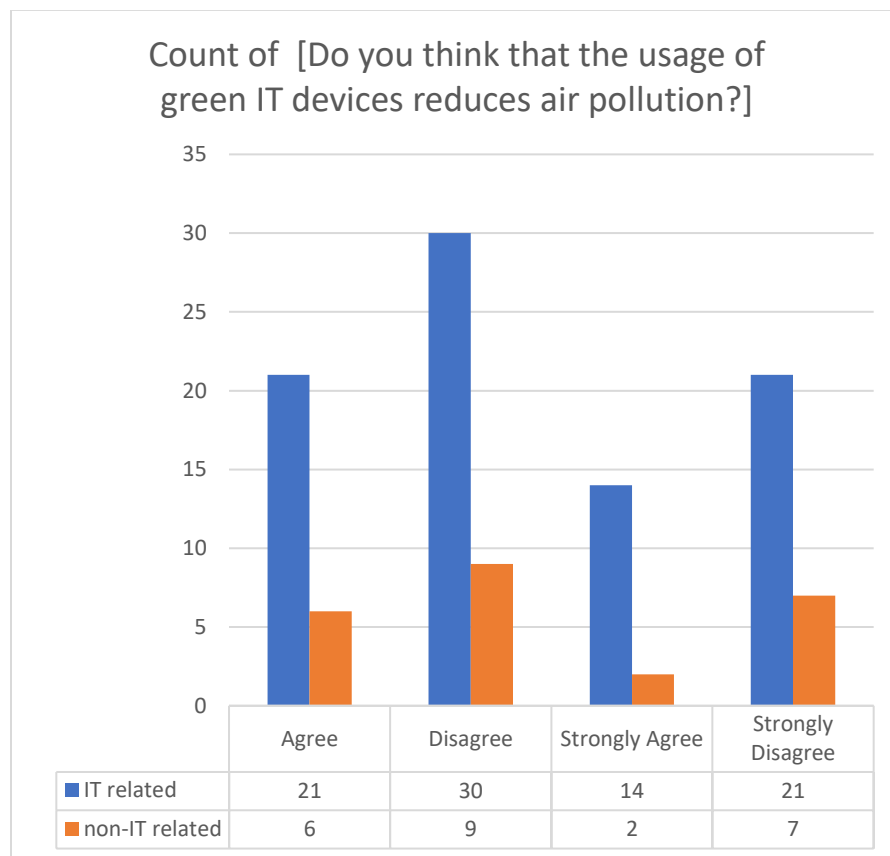

Figure 4 *Field of Study*

4.3 Green IT Impact on the Environment

The second section, section B contains 5 questions about the environmental damages that caused by IT devices and how Green IT contribute in reducing it.

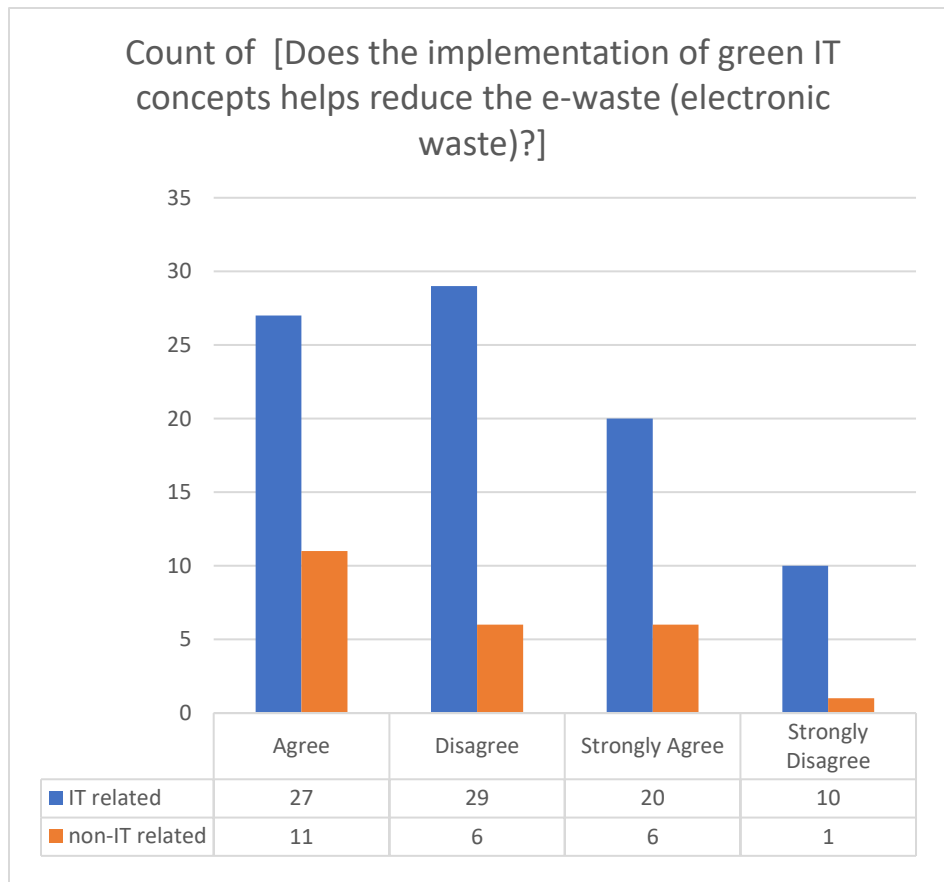### 4.3.1 Usage of green IT devices reduces air pollution

Based on the figure 4.4. In this statement there were 110 respondents responded to the questions. Out of that, 14 respondents were STRONGLY AGREE that using green IT devices reduces the air pollution from IT related field of study. While, 2 respondents only from non-IT related field of study. Meanwhile, 21 IT related respondents and 6 non-IT related were AGREE. The result also shows that 21 IT related, and 2 non-IT related respondents were STRONGLY DISAGREE. Lastly, there were 30 IT related, and 9 non-IT related respondent were DISAGREE that using green IT devices reduces the air pollution.

Count of [Do you think that the usage of green IT devices reduces air pollution?]

	Agree	Disagree	Strongly Agree	Strongly Disagree
IT related	21	30	14	21
non-IT related	6	9	2	7

Figure 5 *Air Pollution*

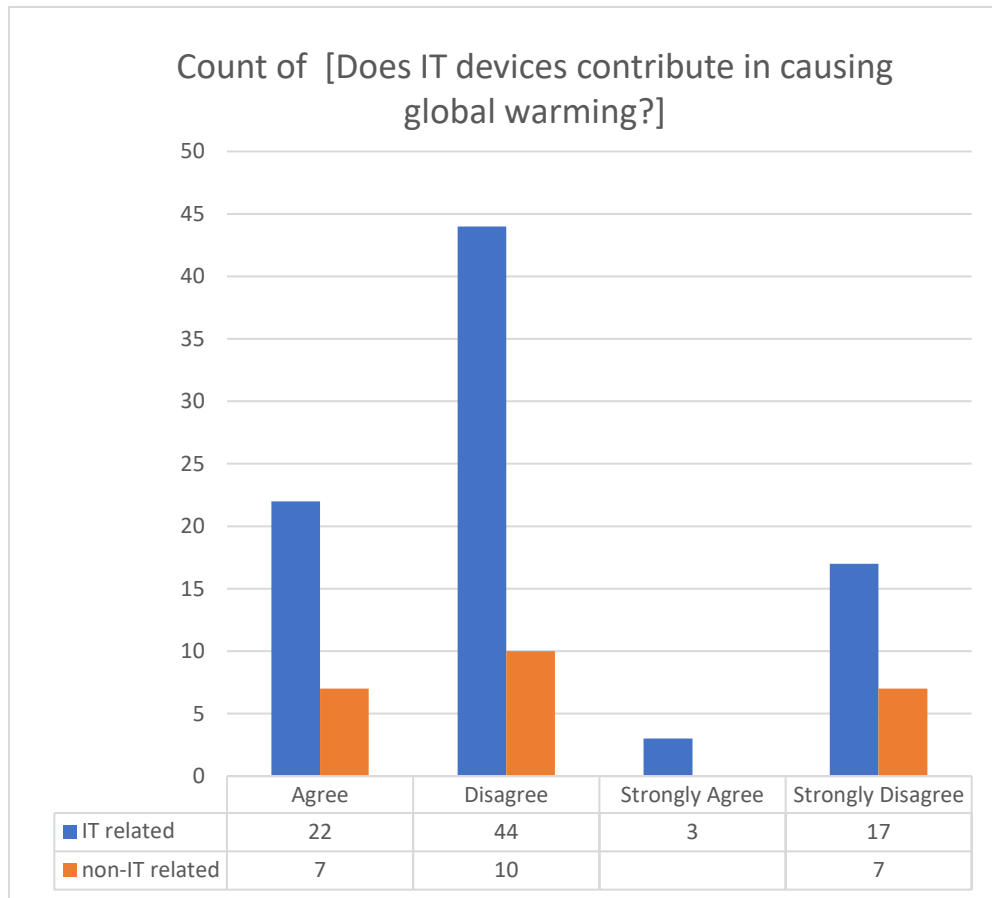### 4.3.2 Green IT contributes in e-waste reduction

There were 110 respondents to this question as Figure 4.5 shows. 20 IT related, and 6 non-IT related respondents were STRONGLY AGREE that green IT implementation helps reducing the e-waste. At the same time, 27 IT related while 11 non-IT related respondents were AGREE. The result also shows that 29 IT related, and 6 non-IT related respondents or were DISAGREE. Lastly, there were only 10 IT related while only one non-IT related respondent were STRONGLY DISAGREE that the implementation of green IT reduces e-waste.

Count of [Does the implementation of green IT concepts helps reduce the e-waste (electronic waste)?]

	Agree	Disagree	Strongly Agree	Strongly Disagree
IT related	27	29	20	10
non-IT related	11	6	6	1

Figure 6 *E-waste reduction*
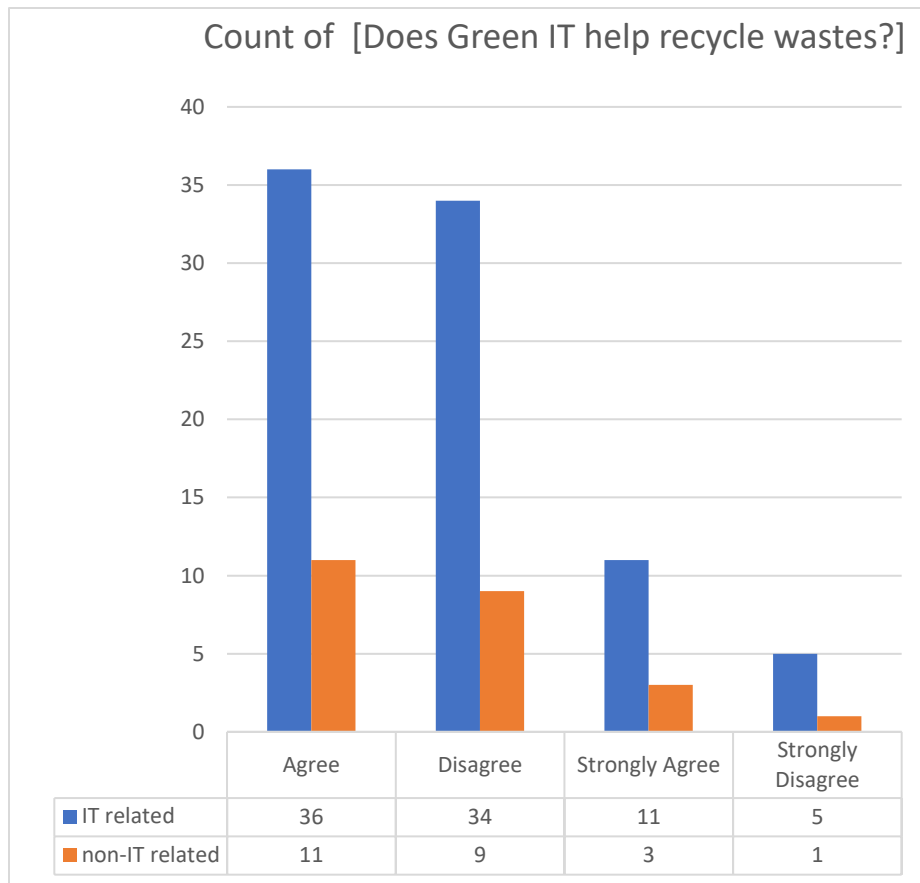
4.3.3 IT devices effect on global warming

As Figure 4.6 illustrate there were 110 respondents to the statement IT devices influences the global warming. The number of DISAGREE reached the pick of 44 IT related and 10 non-IT related respondents. At the same time the responses to STRONGLY DISAGREE were 17 IT related while non-IT related where only 7 responds. On the other hand, the number of respondents who AGREE that IT devices influences global warming in IT related were 22 responds, and non-IT related were7 responds. At last, only 3 IT related respondents were STRONGLY AGREE to this statement.

Count of [Does IT devices contribute in causing global warming?]

	Agree	Disagree	Strongly Agree	Strongly Disagree
■ IT related	22	44	3	17
■ non-IT related	7	10		7

Figure 7 *Global Warming*
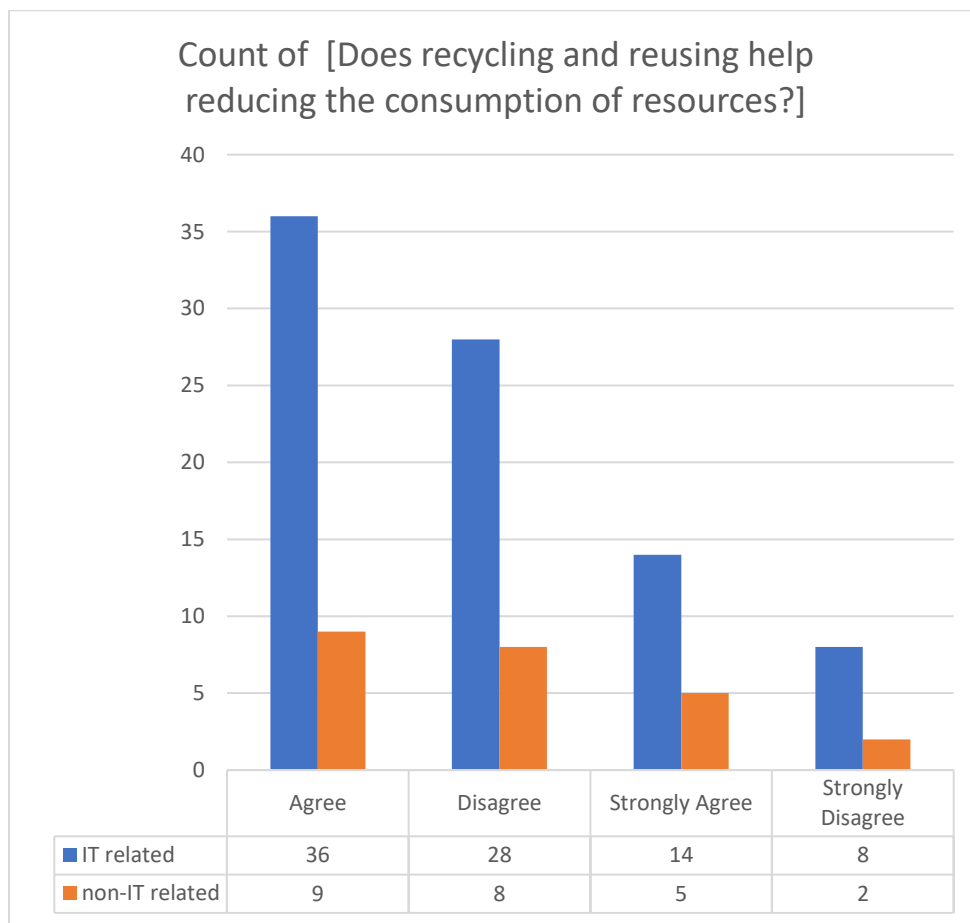
4.3.4 Green IT encourage waste recycling

Figure 4.7 below shows that in the statement green IT encourage recycling waste, 14 respondents were STRONGLY AGREE, 11 IT related and 3 non-IT related field of study. And 47 of them were AGREE, 36 IT related and 11 non-IT related field of study. While, 43 respondents 34 of them were IT related and 9 non-IT related field of study were DISAGREE that green IT encourages recycling. Lastly, there were only 5 IT related and one non-IT related respondents who STRONGLY DISAGREE to that statement.

Count of [Does Green IT help recycle wastes?]

	Agree	Disagree	Strongly Agree	Strongly Disagree
IT related	36	34	11	5
non-IT related	11	9	3	1

Figure 8 *Green IT encourage recycling*

4.3.5 Recycling reduces the consumption of resources

According to Figure 4.8. In this statement there were 110 respondents responded to the questions. Out of that, 19 respondents, 14 of them were IT related and 5 non-IT related field of study were STRONGLY AGREE that recycling reduces resources consumption. Meanwhile, 36 IT related and 9 non-IT related respondents were AGREE. The result also shows that 28 IT related and 8 non-IT related field of study respondents were DISAGREE. Lastly, there were only 10 respondents were STRONGLY DISAGREE 8 of them were IT related and only 2 were non-IT related field of study that recycling reduces resources consumption.

Count of [Does recycling and reusing help reducing the consumption of resources?]

|	Agree	Disagree	Strongly Agree	Strongly Disagree
IT related	36	28	14	8
non-IT related	9	8	5	2

Figure 9 *Resources Consumption*

4.4 Green IT Impact on Social life

The third section, section C consist of 5 questions about the green IT influence on the society and how people should deal with it.

### 4.4.1   Green IT increases the quality of social life

Looking to Figure 4.9 we can see that there were 110 respondents to this question. 47 of them were AGREE, 34 form IT related and 13 from non-IT related field of study, that green IT increases the Quality of social life. And only 10 were STRONGLY AGREE from IT related field of study. On the other hand, there were 47 of the respondents DISAGREE,38 from IT related and 9 from non-IT related field of study. And only 6 respondents, 4 IT related and 2 non-IT related field of study, were STRONGLY DISAGREE to that statement.

Count of [Does Green IT increase the quality of social life?]

	Agree	Disagree	Strongly Agree	Strongly Disagree
IT related	34	38	10	4
non-IT related	13	9		2
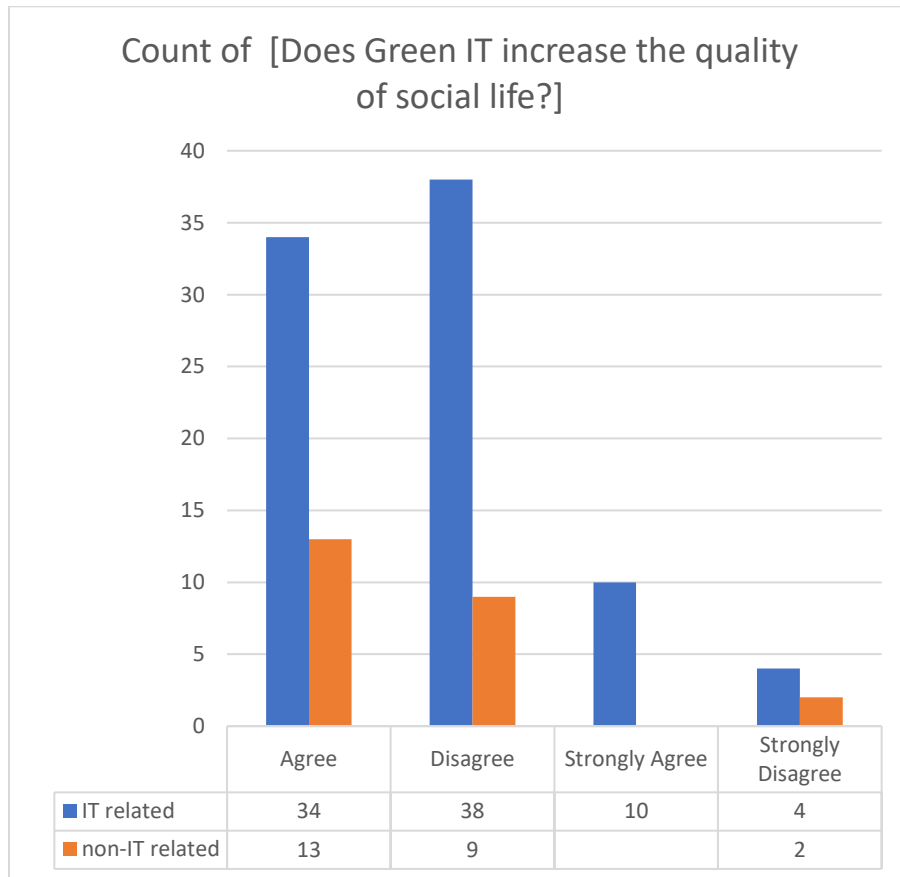
Figure 10 *Quality of Social Life*

### 4.4.2 The implementation of green IT is a social responsibility

Figure 4.10 clarifies that there were 110 responses to the statement green IT implementation is a social responsibility. 41 responds, 31 IT related and 10 non-IT related field of study were AGREE. Meanwhile, 16 respondents, 15 IT related and 1 non-IT related field of study were STRONGLY AGREE to the statement. Whilst, 42 respondents, 30 IT related and 12 non-IT related field of study were DISAGREE. Finally, 11 respondents, 10 IT related and 1 non-IT related field of study were STRONGLY DISAGREE.
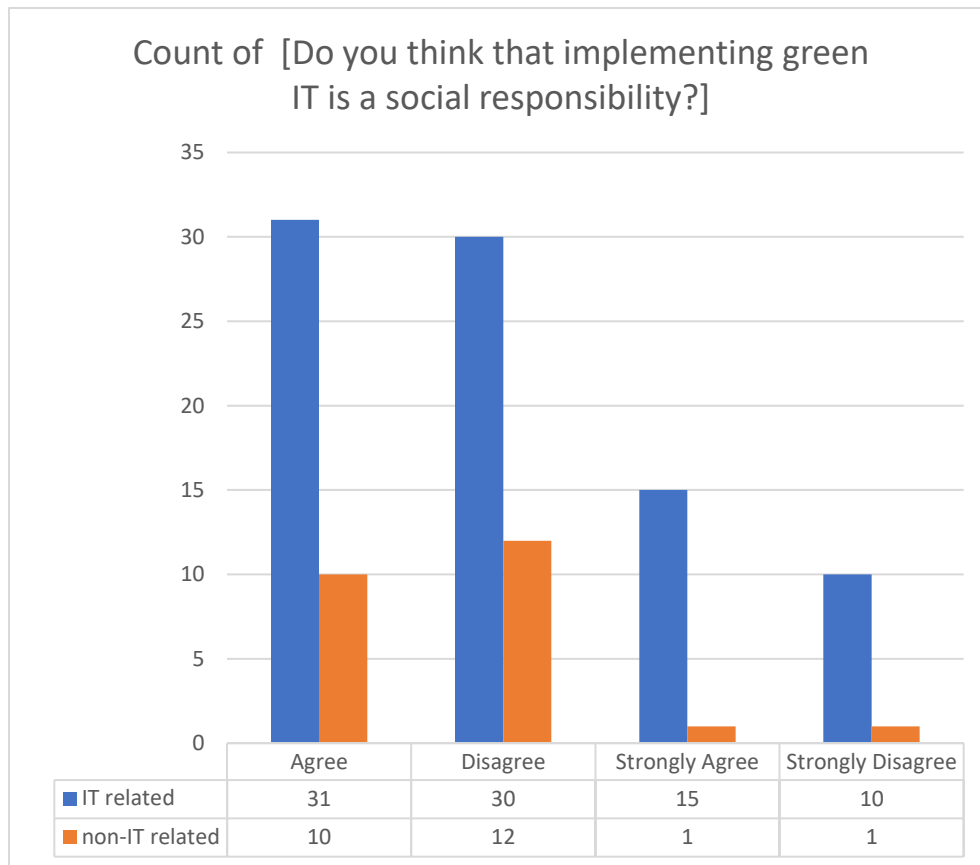
Figure 11 *Social Responsibility*

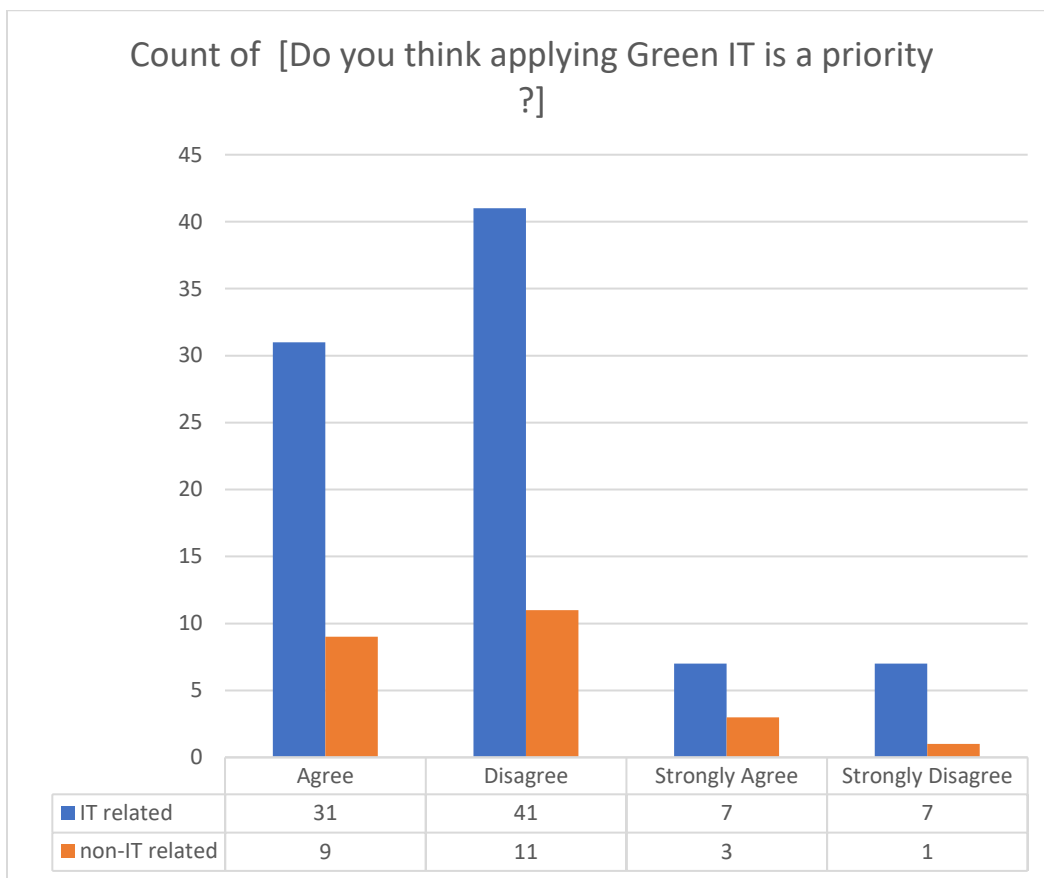### 4.4.3   Green IT atmosphere improve social commitment

There were 110 respondents to this question as Figure 4.11 shows. 10 respondents 9 of them from IT related and 1 from non-IT related field of study were STRONGLY AGREE that green IT atmosphere improves social commitment. At the same time, 47 respondents 35 from IT related and 12 from non-IT related field of study were AGREE. The result also shows that 41 respondents 31 from IT related and 10 from non-IT related field of study were DISAGREE. Lastly, there were only 12 respondent 11 from IT related and 1 from non-IT related field of study were STRONGLY DISAGREE that green IT atmosphere improves social commitment.

Count of [Does Green IT Atmosphere improve social commitment?]

	Agree	Disagree	Strongly Agree	Strongly Disagree
IT related	35	31	9	11
non-IT related	12	10	1	1
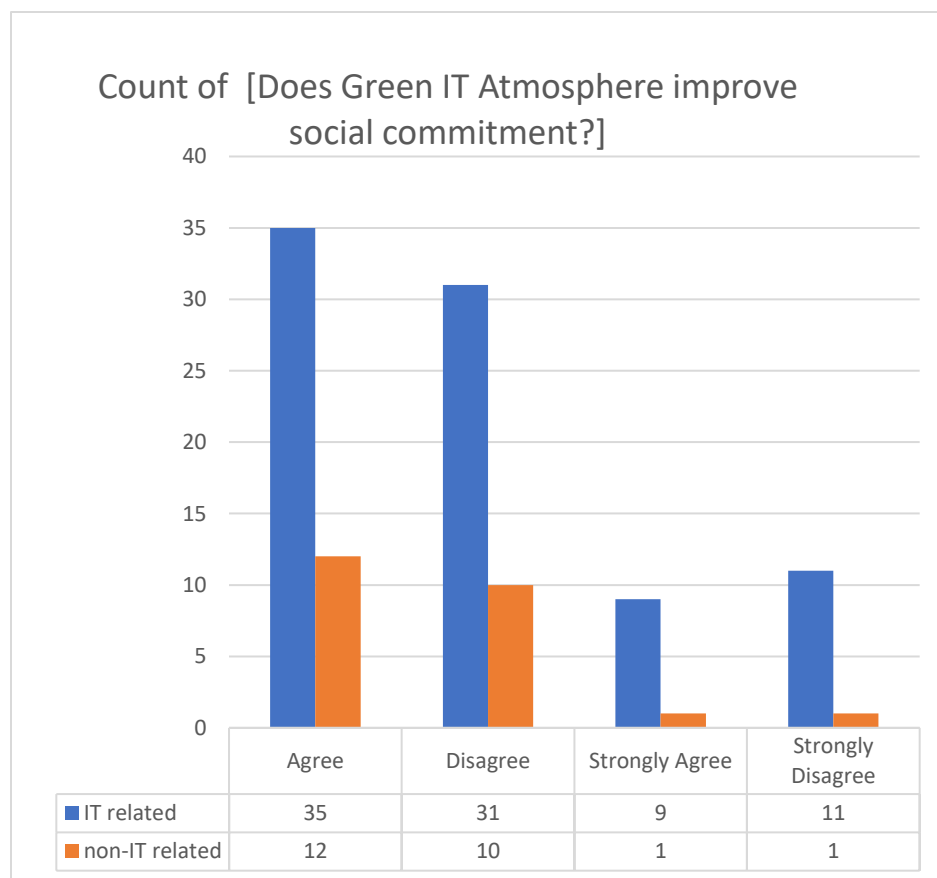
Figure 12 *Social Commitment*

### 4.4.4 Application of green IT is a priority

According to Figure 4.12. In this statement there were 110 respondents responded to the questions. 10 responds 7 from IT related and 3 from non-IT related field of study were STRONGLY AGREE that the application of green IT is a priority. Meanwhile, 40 respondents 31 from IT related and 9 from non-IT related field of study were AGREE. The result also shows that 52 respondents 41 from IT related and 11 from non-IT related field of study were DISAGREE. Lastly, there were only 8 respondent 7 from IT related and 1 from non-IT related field of study were STRONGLY DISAGREE that the application of green IT is a priority.

Count of [Do you think applying Green IT is a priority ?]

	Agree	Disagree	Strongly Agree	Strongly Disagree
IT related	31	41	7	7
non-IT related	9	11	3	1

Figure 13 *Green IT is a priority*

4.4.5 Awareness about green IT can create sustainable development

As Table 4.11 demonstrate there were 110 respondents to the statement Awareness about green IT can create sustainable development. The number of AGREE reached the pick of 45 responds 32 from IT related and 13 from non-IT related field of study. At the same time the responses to STRONGLY AGREE were 22 responds 18 from IT related and 4 from non-IT related field of study. On the other hand, the number of respondents who DISAGREE that green IT awareness can create sustainable development were 36 responds 30 from IT related and 6 from non-IT related field of study. At last, only 7 respondents 6 from IT related and 1 from non-IT related field of study were STRONGLY DISAGREE to this statement.

Count of [Does Green IT awareness can create sustainable development?]

|	Agree	Disagree	Strongly Agree	Strongly Disagree
IT related	32	30	18	6
non-IT related	13	6	4	1
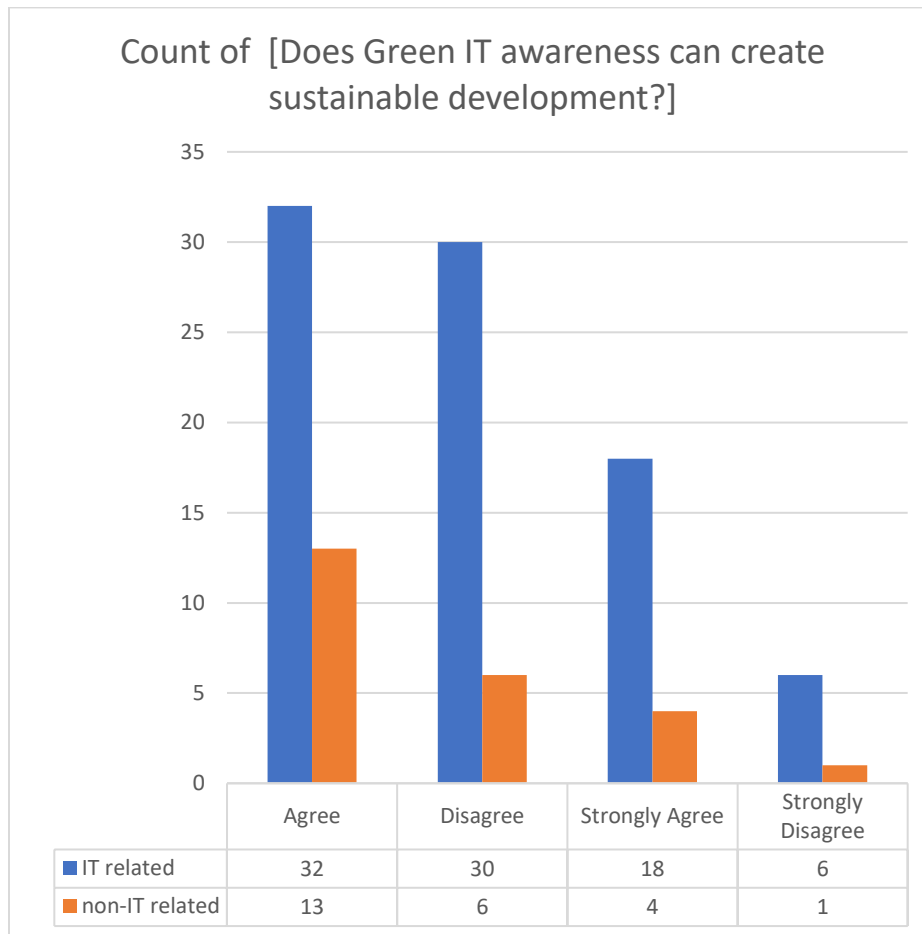
Figure 14 *Sustainable Development*

4.5 Green IT Impact on Economy

The fourth section, section D consisted of 5 questions about the green IT influence on economy, how its implementation can create economic efficiency and its contribution in reducing the cost.

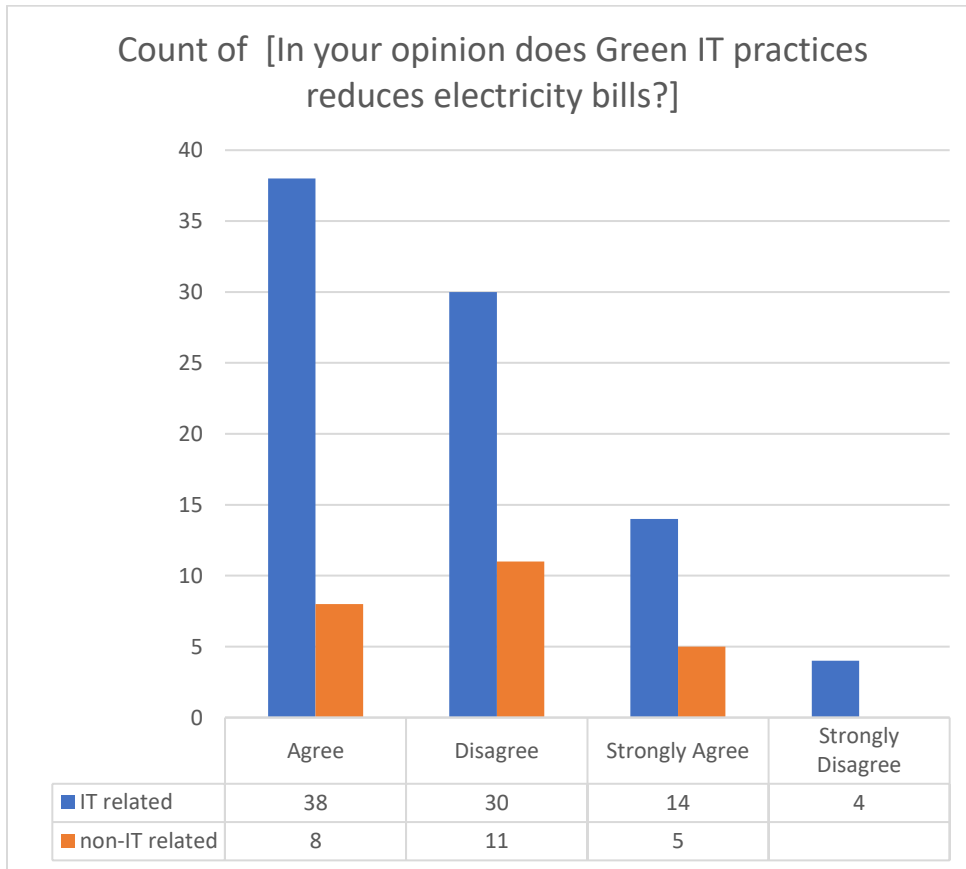### 4.5.1 Green IT help in developing university financial efficiency

Looking to Table 4.14 we can see that there were 110 respondents to this question. 43 of them, 28 from IT related and 15 from non-IT related field of study, were AGREE that green IT increases university financial efficiency. And 19 respondents, 17 from IT related and 2 from non-IT related field of study, were STRONGLY AGREE. On the other hand, there were 43 of the respondents 36 from IT related and 7 from non-IT related field of study, DISAGREE. And only 5 from IT related field of study were STRONGLY DISAGREE to that statement

Count of [does Green IT help in developing university financial efficiency?]

	Agree	Disagree	Strongly Agree	Strongly Disagree
IT related	28	36	17	5
non-IT related	15	7	2	
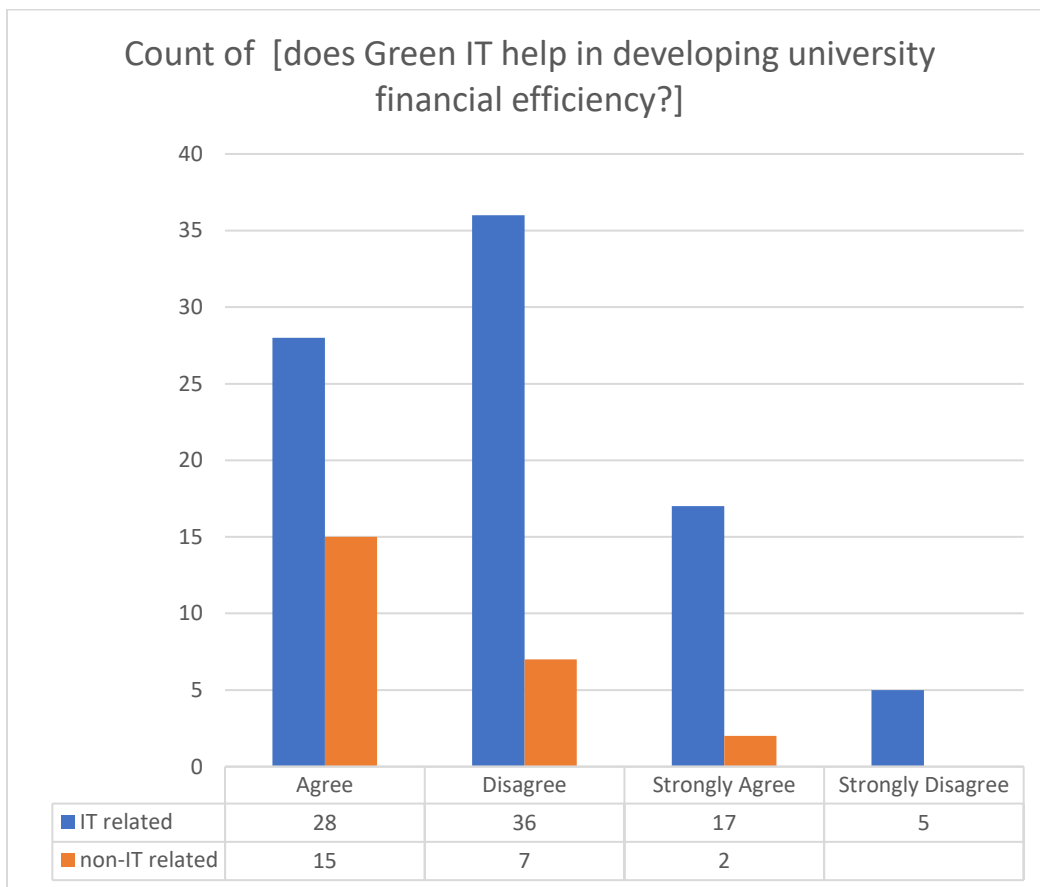
Figure 15 *Financial Efficiency*

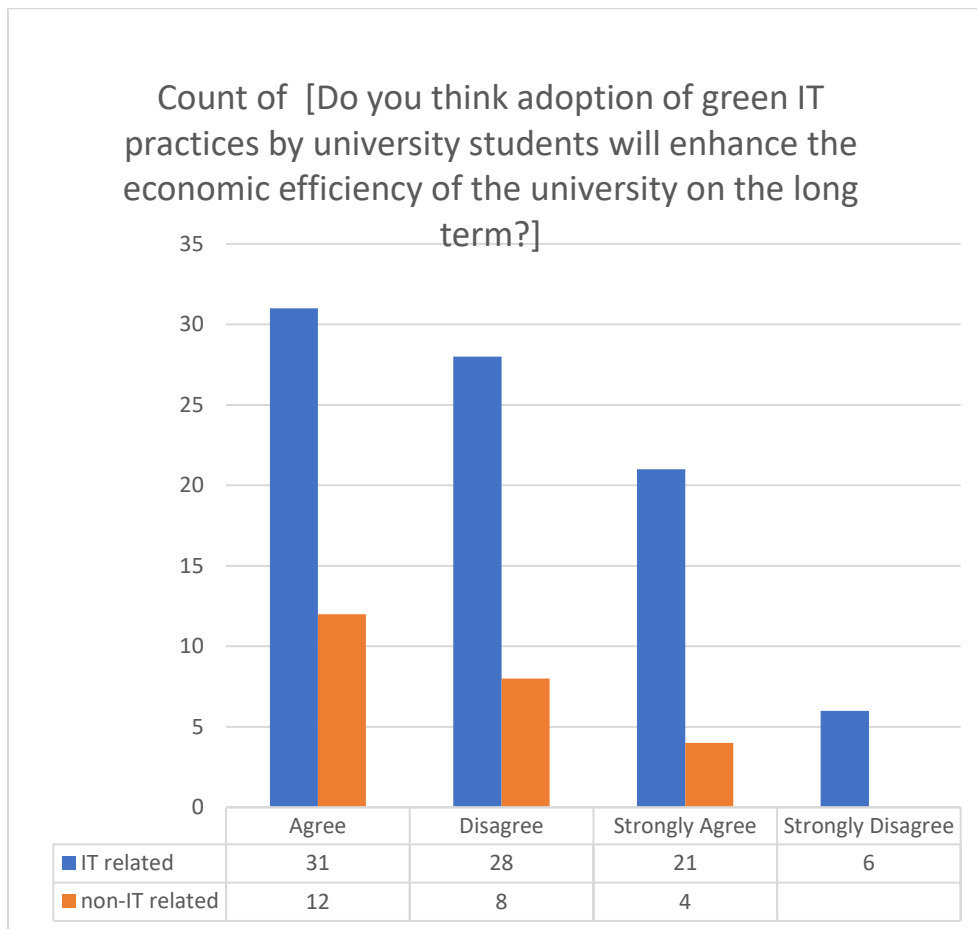### 4.5.2 Green IT practices reduces electricity bills

There were 110 respondents to this question as Figure 4.15 shows. 14 IT related, and 5 non-IT related respondents were STRONGLY AGREE that green IT practices can reduces electricity bills. At the same time, 38 IT related while 8 non-IT related respondents were AGREE. The result also shows that 30 IT related, and 11 non-IT related respondents or were DISAGREE. Lastly, there were only 4 IT related respondent were STRONGLY DISAGREE that green IT practices can reduces electricity bills.

Count of [In your opinion does Green IT practices reduces electricity bills?]	Agree	Disagree	Strongly Agree	Strongly Disagree
IT related	38	30	14	4
non-IT related	8	11	5	

Figure 16 *Green IT practices reduces electricity bills*

4.5.3   University student adoption of green IT practices enhances the economic efficiency

According to Figure 4.16. In this statement there were 110 respondents responded to the questions.25 respondents, 21 of them were IT related and 4 non-IT related field of study were STRONGLY AGREE that adoption of green IT practices by the students enhances the economic efficiency. Meanwhile, 31 IT related and 12 non-IT related respondents were AGREE. The result also shows that 28 IT related and 8 non-IT related field of study respondents were DISAGREE. Lastly, there were only 6 respondents from IT related field of study were STRONGLY DISAGREE the students' adoption of green IT practices enhances the economic efficiency.
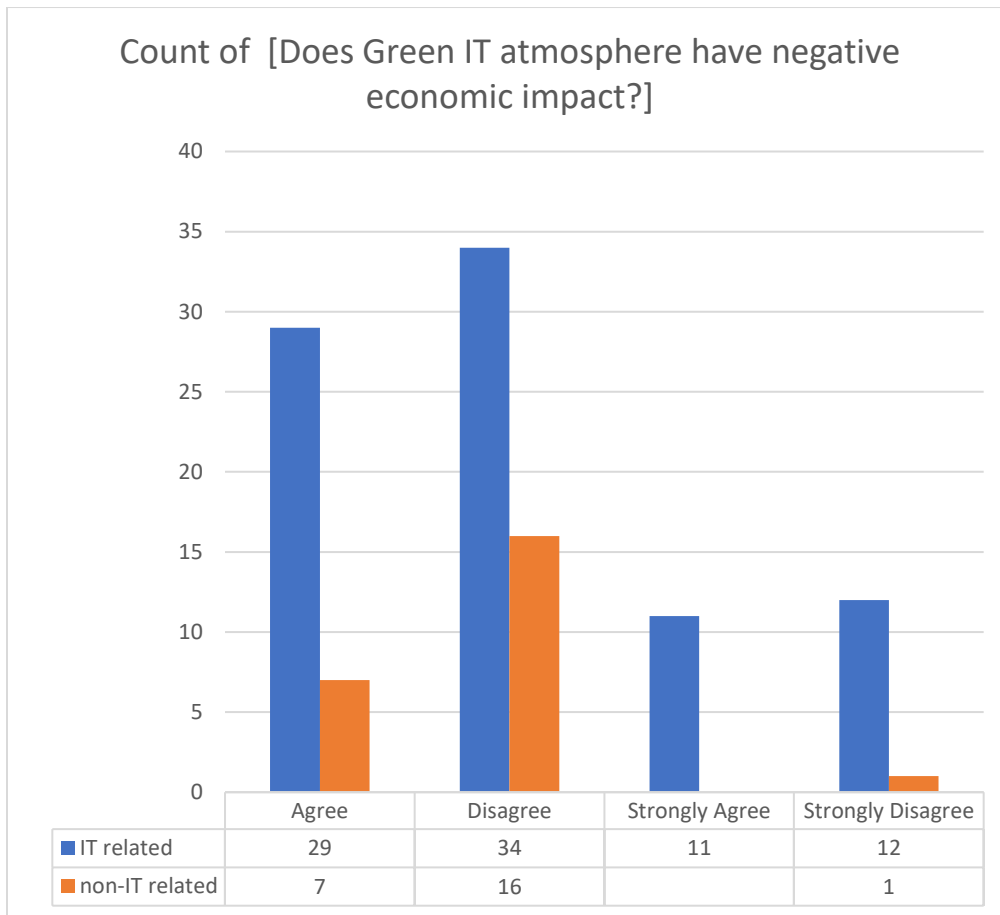
Count of [Do you think adoption of green IT practices by university students will enhance the economic efficiency of the university on the long term?]

	Agree	Disagree	Strongly Agree	Strongly Disagree
IT related	31	28	21	6
non-IT related	12	8	4	

Figure 17 *Green IT practices enhance economic efficiency*

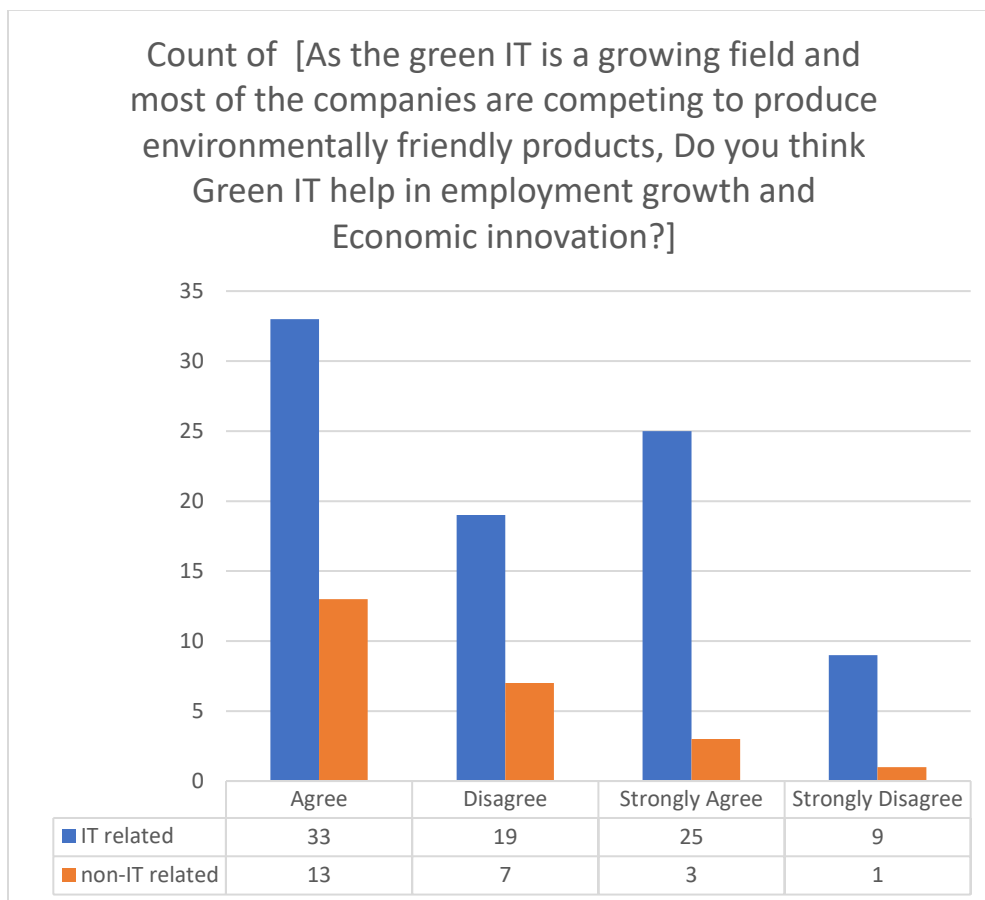### 4.5.4 Green IT has negative economic impact

Figure 4.17 below shows that in the statement green IT has negative impact on economy, 11 respondents from IT related field of study were STRONGLY AGREE. And 36 of them were AGREE, 29 IT related and 7 non-IT related field of study. While, 50 respondents 34 of them were IT related and 16 non-IT related field of study were DISAGREE that green IT encourages recycling. Lastly, there were 12 IT related and one non-IT related respondents who STRONGLY DISAGREE to that statement.

Count of [Does Green IT atmosphere have negative economic impact?]

	Agree	Disagree	Strongly Agree	Strongly Disagree
■ IT related	29	34	11	12
■ non-IT related	7	16		1

Figure 18 *Green IT has negative economic impact*

4.5.5 Green IT helps in employment growth and economic innovation

Based on the Figure 4.18. In this statement there were 110 respondents responded to the questions. 28 respondents, 25 from IT related and 3 from non-IT related field of study field of study, were STRONGLY AGREE that green IT helps in employment growth and economic innovation. Meanwhile, 33 IT related respondents and 13 non-IT related were AGREE. The result also shows that 9 IT related, and 1 non-IT related respondents were STRONGLY DISAGREE. Lastly, there were 19 IT related, and 7 non-IT related respondent were DISAGREE green IT helps in employment growth and economic innovation.

Count of [As the green IT is a growing field and most of the companies are competing to produce environmentally friendly products, Do you think Green IT help in employment growth and Economic innovation?]

	Agree	Disagree	Strongly Agree	Strongly Disagree
IT related	33	19	25	9
non-IT related	13	7	3	1

Figure 19 *Economic Innovation*

4.6 Result of Analysis

From the analysis above, the percentage of agreed answers to each question has been calculated to estimate the total awareness level. Also, to determine at which part they are lacking awareness. Table 5 shows the results of the analysis. questions with 50 percent agreed answers and above are classified as 'Knowing', while questions with less than 50 percent agreed answers are classified as 'Not knowing'. Which means that the respondents know and agree that the statement is true. The results show that the average of the awareness level is 0.53 (53%), which means around half of the respondents has enough knowledge about green IT. While the other half is under 50 percent level of awareness. This result has been obtained by calculating the mean of the questions responses percentage.

$$AM = \frac{1}{n} \sum_{i=0}^{n} a_i = \frac{1}{n} (a_1 + a_2 + \cdots + a_n)$$

Table 5 *Result*

No		Result	Percentage
1	Usage of green IT devices reduces air pollution	Not knowing	39%
2	Implementation of green IT concepts helps reduce the e-waste (electronic waste)	Knowing	58%
3	IT devices contribute in causing global warming	Not knowing	29%
4	Green IT help recycle wastes	Knowing	55%
5	Recycling and reusing help reducing the consumption of resources	Knowing	58%
6	Green IT increase the quality of social life	Knowing	52%
7	Implementing green IT is a social responsibility	Knowing	52%
8	Green IT Atmosphere improve social commitment	Knowing	52%
9	Applying Green IT is a priority	Not knowing	45%
10	Green IT awareness can create sustainable development	Knowing	61%
11	Green IT help in developing university financial efficiency	Knowing	56%
12	Green IT practices reduces electricity bills	Knowing	59%

13	Adoption of green IT practices by university students will enhance the economic efficiency of the university on the long term	Knowing	62%
14	Green IT atmosphere have negative economic impact	Knowing	43%
15	Green IT help in employment growth and Economic innovation	Knowing	67%

4.6.1 The Impact on Environment

Green IT impact on environment was the lowest in term of awareness level. The average of awareness level was 0.48 (48%). This elucidate that students are unconscious that IT life cycle has many environmental implications. As well that Green IT helps in reducing this implication.

4.6.2 The Social Impact

the average awareness level on the social implications is near to half by 0.52 (52%). A question was asked about the necessity of Green IT application by societies got 45% agreed responds. Some student thought that applying green IT practices by individuals is not a must, oblivious to the fact user phase in IT life cycle in the most dangerous phase to the environment.

4.6.3 The Impact on Economy

This section reached the highest level of awareness with the average 0.57 (57%). Most of the respondents were agree with the statements in this section, showing a higher level of awareness about the economic implications.

4.7 Decision Making

According to the results explained in the previous section, the students' level of awareness is quite low. Therefore, an informatic website has been developed to help the student to understand more about green IT, sustainability and the impact of IT products on environment and economy. It also contains some quizzes that assess the corporations and individuals' practices determining the level of greenness.

4.7.1 Screenshots
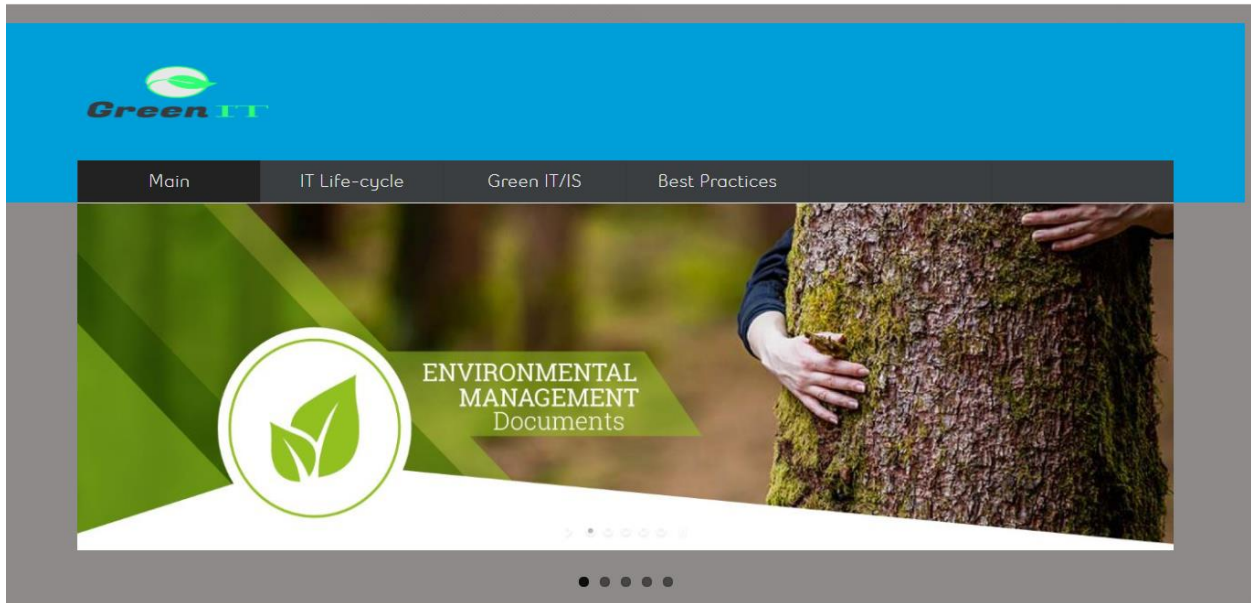
Figure 20 *Main Page*

Figure 21 *IT life-cycle*

Figure 22 *Green IT/IS*

Figure 23 *Best practices*

4.8 Summary

This chapter has covered on the responding profile part, which discuss the demographic analysis have been used in this study. In this study, each section is also discussed and analyzed. And the decision has been taken according to the result obtained. Some of the screenshots of the developed website is shown at the end of this chapter.

CHAPTER 5

CONCLUSION

5.1 Introduction

This chapter will further explain the replication of research as well as the implication of research the it will be ended with a conclusion.

5.2 Recapitulations of Research

The aim of this research is to investigate UMP students' awareness of green IT. The problem statements, research objectives and research scope were discussed in chapter 1 In Chapter 2, the overview of sustainability, green campus and green IT were explained where later in chapter 2 the awareness on green IT practices was discussed. Data analysis, result and decision making were conducted in chapter 4. This research answers the following objectives:

i) To study on the sustainability principle for the awareness questionnaire development.

A number of research papers and articles on sustainability, sustainable development and its principles and green IT and its relation to sustainability were reviewed. The reviewed papers were then used to develop a list of questionnaires to test the awareness level. The questionnaires were analyzed in the previous chapter.

ii) To assess the green IT awareness among UMP students through survey method.

The main objective of this research is to investigate the students' understanding about green IT and its relationship with environment, economy and society. The questionnaire was developed to serve this objective. It also was designed and tested to ensure that it is the suitable instrument to do the investigation.

iii) To develop a green IT website for rising the awareness of green IT concept and practice.

The green IT website works as an assistant that provide the user with the necessary information about green IT, sustainability and assess the user practices and which level of green they achieved.

5.3 Implication of Research

This study has previewed previous research that has been done on green sustainable campus. green buildings, recycling and waste management, reducing electricity and water consumption and green IT are the factors that create the green campus. in this research we focus on green IT and its contribution to make a green campus. creating awareness about green IT will generate an atmosphere of commitment towards the IT devices and the way it is being used. It important to determine the students' level of awareness as they are the majority of the consumers in the campus in order to achieve the green IT campus.

by understanding the level of awareness among the students and determining how much they are green, the top management can create awareness programs that provide the list of green practices to improve the campus sustainability. Lecturers and student council can take the result of this research and organize talks that talk about IT and its effect on the environment, economy and society and how these implications can be avoided by implementing green IT. Having aware and practicing students can create not only a green campus but also an organizational efficiency. However, the green campus and organizational efficiency cannot be achieved only by the students' practices. The organization itself need to follow the green way to manage its institutions.

5.4 Conclusion

To obtain the green IT campus in UMP, this study is very important to improve students' behavior towards the environment. UMP need to pay more attention on organizing green programs and events at the same time encouraging the students to follow the green IT practices. The simplest way to be green is by practicing it in the correct way, thus students' practices are very important.

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QUESTIONNAIRE

Investigation the Awareness of Green IT concept and Application

Green IT (Information Technology): Is IT services and devices that are designed, manufactured, used, disposed in an environmentally friendly way.
This survey is part of my thesis and your participation is highly appreciated.

*Required

1. **Email address** *

   _____

2. **Name** *

   _____

3. **Gender** *

   Mark only one oval.

   ◯ Female

   ◯ Male

4. **Education level** * *Mark only one oval.*

   ◯ Degree

   ◯ Master

   ◯ PhD

5. **Field of Study** * *Mark only one oval.*

   ◯ non- IT related

   ◯ ITrelated

6. Green IT impact on the Environment (Environmental Sustainability) *

Mark only one oval per row.

	Strongly Disagree	Disagree	Agree	Strongly Agree
Do you think that the usage of green IT devices reduces air pollution?	⬭	⬭	⬭	⬭
Does the implementation of green IT concepts helps reduce the e-waste (electronic waste)?	⬭	⬭	⬭	⬭
Does IT devices contribute in causing global warming?	⬭	⬭	⬭	⬭
Does Green IT help recycle wastes?	⬭	⬭	⬭	⬭
Does recycling and reusing help reducing the consumption of resources?	⬭	⬭	⬭	⬭

7. Green IT Impact on Social (Social Sustainability) *

Mark only one oval per row.

	Strongly Disagree	Disagree	Agree	Strongly Agree
Does Green IT increase the quality of social life?	⬭	⬭	⬭	⬭
Do you think that implementing green IT is a social responsibility?	⬭	⬭	⬭	⬭
Does Green IT Atmosphere improve social commitment?	⬭	⬭	⬭	⬭
Do you think applying Green IT is a priority ?	⬭	⬭	⬭	⬭
Does Green IT awareness can create sustainable development?	⬭	⬭	⬭	⬭

8. Green IT Impact on Economy (Economic Sustainability) *

Mark only one oval per row.

	Strongly Disagree	Disagree	Agree	Strongly Agree
does Green IT help in developing university financial efficiency?	⬭	⬭	⬭	⬭
In your opinion does Green IT practices reduces electricity bills?	⬭	⬭	⬭	⬭
Do you think adoption of green IT practices by university students will enhance the economic efficiency of the university on the long term?	⬭	⬭	⬭	⬭
Does Green IT atmosphere have negative economic impact?	⬭	⬭	⬭	⬭
As the green IT is a growing field and most of the companies are competing to produce environmentally friendly products, Do you think Green IT help in employment growth and Economic innovation?	⬭	⬭	⬭	⬭