DEVELOPMENT OF FRAMEWORK ON GREEN INFORMATION AND COMMUNICATION TECHNOLOGY (GICT) AWARENESS IN MALAYSIA'S EDUCATION SECTOR

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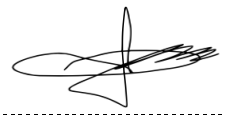
Pemeriksa Dalam *(Internal Examiner)*	:	**PROF. TPr. DR. DANI SALLEH**	Tandatangan *(Signature)*	

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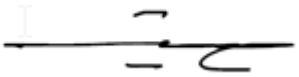
Penyelia Pertama (*First Supervisor*)	:	**PROF. MADYA DR. ZAINAL MD ZAN** Tandatangan *(Signature)* 

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ABSTRACT

ICT has been accepted as the major tool in developing knowledgeable societies and noted to be the technological mechanism that could provide ways to think and design education system and processes. The ubiquity of ICT leads to increased energy consumption and carbon dioxide emission with considerable negative impacts on the environment. This ubiquity also leads to an increase volume of e-waste. Since the education world is well noted to have a substantial amount of ICT users, its imminent to for all users to be aware of GICT and its importance. Awareness on Green ICT (GICT) describes the cultivation of knowledge about managing ICT infrastructures in order to minimise the effects on humans and the environment. Studies show that there is no official legislation that enforces GICT practices in Malaysia and most Malaysians are not aware of how to dispose their obsolete ICT devices. This research was designed to determine the level of GICT awareness among teachers in Malaysia, to identify the issues related to GICT practices among teachers in Malaysia and to construct a framework to improve awareness on GICT practices among teachers in Malaysia's education sector. The approach used in this study is a quantitative method whereby a number of 1260 emails were sent to schools, both primary and secondary from each state to get respondents for the online questionnaire but only 1008 teachers responded due to the closure of schools because of the covid-19 pandemic. From the findings, it can be concluded that the awareness of GICT practices among the teachers who responded in this survey is moderate (54.95%). Findings using the Pearson Coefficient for independent variable, X, in this study (knowledge on ICT usage) and dependent variable, Y, (awareness of GICT practices) shows a relationship with high connection. Conclusively these outcomes have proven all the hypothesis constructed in this study to be true and the model fit using multiple standard linear regression and awareness has 69.27% of chance being influenced by knowledge. Framework was constructed while issues in implementing GICT practices were discussed and suggestions were given in hope that further action can be taken by the responsible parties in advocating and upholding the green practices in ICT.

Key words: GICT, carbon emission, energy consumption, knowledge on ICT usage, awareness on GICT practices

ABSTRAK

Teknologi maklumat dan komunikasi (ICT) adalah istilah umum yang merangkumi pelbagai jenis peranti dari perkakasan komputer, program perisian dan komunikasi yang berlaku antara lebih dari satu peranti komputer. Walaupun ICT telah diterima sebagai alat utama dalam membangun masyarakat yang berpengetahuan dan terkenal sebagai mekanisme teknologi yang dapat menyediakan cara untuk berfikir dan merancang sistem dan proses pendidikan, penggunaan ICT turut membawa impak negatif yang besar seperti peningkatan dalam penggunaan tenaga dan pelepasan karbon dioksida ke persekitaran. Keadaan ini juga membawa kepada peningkatan jumlah 'e-waste'. Memang tidak dapat dinafikan bahawa dunia pendidikan mempunyai pengguna ICT yang luas. Objektif penyelidikan ini bertujuan untuk menentukan tahap kesedaran ICT hijau di kalangan guru di Malaysia, untuk mengenal pasti isu-isu yang berkaitan dengan amalan ICT hijau di kalangan guru di Malaysia dan untuk merekabentuk satu kerangka kerja untuk meningkatkan kesedaran mengenai amalan ICT hijau di kalangan guru di Malaysia. Sebanyak 1260 e-mel telah dihantar ke sekolah rendah dan menengah dari setiap negeri untuk mendapatkan responden untuk soal selidik atas talian tetapi hanya 1008 guru sahaja yang memberi respon mungkin disebabkan penutupan sekolah sewaktu wabak covid-19. Dari hasil kajian, dapat disimpulkan bahawa kesedaran mengenai amalan ICT hijau di kalangan guru yang menjawab borang soal selidik dalam tinjauan ini adalah sederhana iaitu sebanyak 54.95%. Dapatan menggunakan Pekali Pearson untuk pemboleh ubah bebas, X, dalam kajian ini (pengetahuan mengenai penggunaan ICT) dan pemboleh ubah bersandar, Y, (kesedaran mengenai amalan ICT hijau) menunjukkan hubungan yang jelas iaitu kesedaran mempunyai 69.27% peluang dipengaruhi oleh pengetahuan. Kesimpulannya didapati, semua hipotesis yang dibina dalam kajian ini adalah benar. Kerangka kesedaran ICT hijau telah dibentuk dan isu-isu dalam melaksanakan amalan ICT hijau telah dibincangkan dengan memberi cadangan dengan harapan agar tindakan selanjutnya dapat diambil oleh pihak yang bertanggungjawab dalam menganjurkan dan menegakkan amalan hijau dalam ICT.

Kata kunci: *ICT hijau, pelepasan karbon, penggunaan tenaga, pengetahuan mengenai penggunaan ICT, kesedaran mengenai amalan ICT hijau*

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LIST OF ABBREVIATIONS

CO_2	-	Carbon Dioxide
CRT	-	Cathode Ray Tube
DDI	-	Domestic Direct Investment
E-PEAT	-	Electronic Product Environmental Assessment Tool
FDI	-	Foreign Direct Investment
GDP	-	Gross Domestic Product
GHG	-	Green House Gases
ICT	-	Information and Communication technology
IoT	-	Internet of Things
KASA	-	Knowledge, Attitude, Skills and Aspiration
KeTTHA	-	Ministry of Energy, Green Technology and water
KPI	-	Key Performance Index
LED	-	Light Emitting Diode
MCMC	-	Malaysian Communication and Multimedia Commission
Mt	-	Mega tonnes
PCs	-	Personal computers
QR code	-	Quick Response code
SMEs	-	Small and Medium Entrepreneurs
SMIs	-	Small and Medium Industries
TFT LCD	-	Thin film-transistor liquid-crystal display
TOP	-	Targeting Outcomes of Programs
URL	-	Uniform Resource Locator
VOIP	-	Voice Over Internet Protocol

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CHAPTER ONE

INTRODUCTION

1.1 Introduction

Information and communication technology (ICT) is an umbrella term used to cover a wide range of devices from computer hardware, the software programs and the communication that occurs between more than one computer devices. It includes all infrastructures of communication tools and the integration of telecommunication such as computers, fax machines, phones and telephone lines, wired and wireless network, printers, video cameras, robotics, and even software's and hardware's.

The purposes of these ICT tools are to enable humans' access information by communication between one or more devices. Wael Sh. Basri et al., (2018) stated that Information and Communication Technology (ICT) is a critical essence in bringing forth astounding development in education sector. In fact, Hilbert and Lopez, (2011) stresses that ICT is capable of creating opportunities and be a tool for knowledge acquisition beyond measures. Meanwhile, Information technology (IT) is also referred to an industry that involves computers, software, networking and other infrastructures that is being used to manage and relay information.

Therefore, the future and wellbeing of any nation vitally depends on how they pioneer and secure ICT in all aspects of growth and development. Indeed, ICT provides the core enabling technologies for harnessing all other field of sciences. This comes to show that a coordinated and well-funded strategy is needed to prepare the citizenry to understand and ameliorate barriers of distance, scale and complexity of this technology. Failing which, we deter our ability to understand and control systems that is empowering our lives and societies.

Another profound dimension of ICT is that it enables the generation of vast amount of data through simulations and sensors that gives a deeper insight into the behaviour of systems that may only exist theoretically. Investments on ICT will elucidate the abstractness of the scientific universes. Moreover, the modern society not only depends on ICT for its survival but also turns to ICT for its convenience and pleasure.

So as to say, Information and Communications Technology (ICT) has gone through an astounding evolvement from a simple information sharing devices to a smarter pragmatic device which could manoeuvre all intelligence at greater degree. In fact, Luis, N. and Joan, K. (2012) stated in their work that ICT devices are capable of making work smarter in 2020 for it provides intelligence and even lessen the impact of the most imminent threat to our earth: the climate change.

According to Shadiya et al., (2016), the importance of ICT in advancing socio-economic development have been recognized by many nations. Hence, efforts were taken by their government to venture immensely in developing the ICT sector.

Globally, initiatives have been taken by governments to seriously venture and invest in the ICT sector to enable them to be at par with the developed nations around the globe. ICT is not only seen as a part of the education but also in all aspects of human capital. Eventually everyone wants to be well verse digitally to keep up with the tremendous change the technology is bringing forth.

Dawning of this new digital era though embraced by nations worldwide, has infused the fear and anxiety of whether it is sustainably healthy for the environment. Alkali et al. (2017) stated that with the unprecedented growth of the ICT sector, the world is likely to encounter environmental problems. Mismanagement of ICT equipment's have been noted to contribute to carbon dioxide emission and global warming (Gartner, 2008). This statement has been supported by many researchers such as Goasduff and Forsling (2007), Weiss (2007), Elliot and Binney (2008), Ruth (2009), Berthon and Donnellan (2011), Thongmak (2012) and many more. With more reports pouring in on the impacts of being digitally advance, researchers are diverting their interest to adopting sustainable practices.

Awareness of sustainable development practices among the society in a country has become the key to prosperity that all policy makers and administrators, must adhere to prosper and develop in the world. The realization of creating this society is crucial to sustaining the environment for the future generation. Many initiatives and collective efforts have been taken by researchers to uphold green concepts in all aspects of development in the world. And these efforts have brought about the awareness on green concepts among people in general. Therefore, living in the time

zone of digital revolution, world bodies have become concern about adopting green information and communication technology (GICT).

Green Information and Communication Technology (GICT) is elaborated as an effort to manage ICT infrastructures while giving great consideration to the environmental problems if these infrastructures are mismanaged. Internationally, request was put forward by G8 countries to take sterner action towards implementing cleaner energy and sustainable development (Kavita and Sameer, 2013). Hence, GICT practices is a necessary measure that need to be taken in addressing environmental degradation. Malaysian Administrative Modernisation and Management Planning Unit (MAMPU, 2010) has defined GICT as to adhere to strict green ways in the production, use and disposal of computers, servers and other ICT devices such as monitors, mice, printers and networking equipment. Therefore, GICT holds substantial promises in tackling environment issues in general.

Meanwhile, awareness is a term that well emphasizes the need to practice an idea or an issue and in many studies the technology (Selyamani and Norasnita, 2015). Therefore, awareness on GICT describes the cultivation of knowlegde about managing ICT infrastructures in order to minimise the effects on humans and the environment (Rabiatul Adawiah and Mohd Shukri (2018), Laura-Diana Radu (2016); Sulaiman Ainin et al (2017); David Lautenschutz (2018); Mosharrof and Noreha (2015); Tunku Badariah Tunku Ahmad et al (2013)).

Level of awareness is measurable according to Timmermans and Cleeremans (2015). According to them, awareness can only be assessed via reporting one's experience. In another words, awareness can be deduced from a well answered questionnaire. They also stressed that there is substantial progress in measuring the level of awareness and researchers have made steadfast progress in measuring it while noted that this task creates several interesting issues. According to Azmi et al., (2017) awareness on green practices can be measured by determining the organizational training programs, government regulations and policy on environment and knowledge of an individual.

In order for the awareness of GICT to penetrate among people in general, initiatives should be taken to educate the young. Administering a proper curriculum which educates the future generation on sustainability and GICT is vital in ensuring the nation's future and wellbeing. Inevitably, teachers play a crucial part in the education system as one of the stakeholders (Bullah, Nadiah and Yunus Melor, 2018). Therefore, the knowledge of GICT and sustainability practices among teachers is indispensable to ensure a proper knowledge on handling ICT is passed on.

Researches show that there is a need to explore the knowledge on GICT since it is still below par in Malaysia (Ahmad et al, 2013), though tremendous efforts have been paved to map Malaysia in the digital stream. In the education sector for instance, the policy on ICT education was developed and implemented in 2010 to solidify the integration of ICT in education. This move was to ensure the outcome of students who are digitally equipped to enter the workforce of an industrialized nation

of Vision 2020. Many initiatives were taken since then to intensify the integration of ICT in education (Abdul Rahman Daud, 2003). Vast number of allocations were dispensed through the Malaysia Plans to ensure schools were being equipped with computer labs and ICT equipment. But Ahmad et al (2013) stated that there are limited researches done about GICT awareness among ICT users in Malaysia. As in the case of teachers, knowledge and awareness on GICT is not well documented.

1.2 Statement of the Problem

The education world which comprises of teachers and students is well noted to have a substantial amount of ICT users (Noor Fadzilah Rahman et al., 2022). He also added that undeniably, computers and laptops are heavily used in all facets of one's education life. ICT has been accepted as the major tool in developing knowledgeable societies and noted to be the technological mechanism that could provide ways to think and design education system and processes in order to have a quality education as aspired by the nation.

But a nation that only emphasizes on developing ICT knowledge and usage without implanting the green ways will eventually face environmental problems such as accumulation of e-waste and extensive carbon dioxide emission (Alkali et al, 2017). Laura- Diana Radu (2017, pg.1) stated in her research that "the ubiquity of ICTs leads to increased energy consumption and carbon dioxide emission with considerable negative impacts on the environment. This ubiquity also leads to an increase in the volume of e-waste." Subsequently, studies show that two percent of the global carbon dioxide emission is attributed to computer usage (Thongmak,

2012). According to Boccaletti et al., (2008), the usage of ICT equipment especially computers are the main contributors of global carbon dioxide. Gartner (2008) also reported that ICT sector is responsible for the 2 percent carbon dioxide emission in the overall carbon footprint. Specifically, he reported that the 2 percent which is equivalent to 0.86 billion tons and subsequently is expected to increase to 4 percent in the year 2020, especially in the developed nations.

Oxidized form of carbon is carbon dioxide and carbon which is present in the atmosphere with its equivalents in the greenhouse gas emission defines carbon footprint. These facts about the rate the carbon footprint is expanding have brought about serious fear among scientist all over the globe. Carbon dioxide emission from power stations, vehicles and electronic devices are getting larger by day and causing polluting to the environment. These pollutants have an injurious effect on human health and the environment. Though the number looks small, immense development and colossal growth in the ICT sector will give a staggering effect to the carbon footprint.

Meanwhile Alkali et al., (2017) stressed that the e-waste from the ICT sector is becoming a serious issue that need immediate attention. To conquer the environmental problems resulting from the extensive ICT integration, rigorous move to adopt GICT is vital.

Though there are many intensive researches done to show the importance of ICT literacy and being digitally advance but little is known on the awareness of green

practices in relation to ICT usage (Jones et al., 2005). Nizam and Vilhi (2018) have stressed in their research that there are only scanty researches done on awareness of GICT practices in Malaysia. Meanwhile a study by Rabiatul Adawiah and Mohd Shukri in 2018 showed that most teachers lack knowledge of GICT as shown in Table 1.1 They also reported that there is no difference on knowledge on GICT based on teacher's level of education.

Table 1.1: ***Teachers Knowledge on GICT***

Topic	Mean Score	Level
The needs on GICT	1.00	Low
Characteristics of GICT	1.40	Low
Applications on GICT	1.70	Low
Source of carbon emission	3.00	Medium
Global warming and climate change	3.48	Medium
Overall Mean Score	2.17	Low

Source: Rabiatul Adawiah and Mohd Shukri, 2018

Studies also show that the level of awareness on GICT is fairly low, even among student in the higher institutions. In fact, this statement was also supported by Mosharrof and Noreha (2015), who found in their research that students in the higher institutions are not aware of and concern about GICT. While there is a greater need to enrich knowledge on effectively use the ICT, Tyler (2005) also stated that students need to empower sufficient knowledge on using ICT in an accountable and eco-friendly way.

In addition, the study also stated that topics on green elements in ICT should be taught in schools, colleges or universities since the term green energy and technology is new to them. These studies come to show that the GICT knowledge should be

given attention in the education sector and inevitably GICT knowledge among teachers is vital in order to create a sustainable society who are aware of implementing green ways to combat environmental issues related to technology. Ahmad et al., (2013) stated that there are limited researches done about GICT awareness among ICT users in Malaysia. As in the case of teachers, knowledge and awareness on GICT is still not addressed comprehensively.

Ironically, Irfan and Amat (2015) found that even the teachers' level of ICT integration in the teaching process is at a low level though the Malaysian government has taken tremendous efforts in mapping the ICT literacy and digital progress across the nation especially in the education sector. Initiatives of the National ICT Policy has brought about tremendous changes in the education sector such as SchoolNet, Computer Labs, EduWebTV, Teaching Mathematics and Science in English (PPSMI) and Access Centres (Ninth Malaysia Plan, 2006-2010).

Researchers have also stated that despite all the attention given to integrating ICT in teaching and learning processes in schools, the aspect of cultivating knowledge on sustainably managing ICT or GICT has been left unattended (Rabiatul Adawiah and Mohd Shukri (2018). Moreover, in the Malaysian context, there is a lack of collaboration between the initiatives of National ICT Policy and the National Green Technology Policy. The National Green Technology Policy was initiated by Ministry of Energy, Green Technology and Water (KeTTHA) in 2009. Though this policy outlined the guidelines to the management pertaining to acquisition, use and disposal

of ICT equipment's in order to minimize the effect toward the environment, the extend of these initiatives in schools have not been recorded properly.

It is apparent that with the rate the ICT devices are being obsolete and reversal of the PPSMI policy, all the outdated ICT infrastructures are bound to be pilling up in some places or mismanaged. From the fieldwork, it has been discovered that these old and obsolete ICT devices have been heaped up in cupboards in schools awaiting disposal. Figure 1.1a and 1.1b shows the outdated and obsolete laptops and projectors in one of the schools which was distributed during the PPSMI policy being harboured in school cupboards awaiting disposal.

Little are the awareness of the administrators that these equipment's poses great danger to the environment. PPSMI programme was bulldozed in the year 2003 under the supervision of the then Prime Minister, Mahathir Bin Mohamad but halted in 2012 by the later government.

These obsolete and unused devices will only heap up as e-waste. Kogelman (2014) reported that lack of awareness and implementation resulted in the failure of GICT practices in the country will eventually heap up the e-waste three times more than the global municipal solid waste as estimated by Samarakoon, M.B. (2014).

In another study by Rafiza Kasbun (2016), it was stressed that there is no official legislation that enforces GICT practices in Malaysia and most Malaysians are not aware of how to dispose their obsolete ICT devices. Many are just not aware about

what happens to these outdated devices. Murugesan (2013) reported that efforts have been taken in United States, Hong Kong, India, parts of Europe and United Kingdom to educate the younger generation on green computing through practices in their educational programmes in schools and higher learning institutions.

Figure 1.1a: *PPSMI Outdated and obsolete laptops and projectors which still awaits disposal*
Source: Field work, 2021

Figure 1.1b: *PPSMI ICT infrastructures which still awaits disposal*
Source: Field work, 2021

But researches done by Raj (2008), Rafiza Kasbun (2016), Erfan et al. (2013), Abdullahi Bello et al. (2013) and Mosharroff H M and Noreha (2015) show that GICT is not being incorporated comprehensively in Malaysia. A well embellish policy have been configured though this study showed that GICT practices have been painted well in frameworks and documents but not fully practiced in daily work transaction.

Noor Fadzilah Rahman et al. (2022) in their studies added that constraints of GICT implementation in the education sector is due to lack of support, awareness, concern and involvement of students and staffs. Besides the situation is aggravated by lack of strict government regulation, good procurement practices and inadequate research and development in GICT practices.

Therefore, this study is an attempt to fill the gap in the literature by identifying the awareness of GICT practices and issues on GICT practices among teachers in Malaysia and will be a reference to subsequent studies.

1.3 Research Question

It is inevitable that with the progress of the nation towards a digitally advance country, without proper administration and enforcement, ICT usage in Malaysia can bring detrimental effects. The knowledge about GICT is essential in moving the nation towards sustainable development. Moreover, awareness about the effects of technology towards the environment should be seriously propagated to everyone for

a better understanding on going green technologically. Thus, this brings to the questions that mooted the idea for this research, which are as follows:

1. What is the level of GICT awareness among teachers in Malaysia's education sector?
2. What are the issues faced by teachers in implementing green practices in ICT?
3. How to improve GICT awareness among teachers in Malaysia's education sector?

1.4 Research Objectives and Approach

With the ever increasing need to upgrade the e-government sector, many initiatives were taken to enhance the ICT facilities and knowledge among the people generally. This research has been galvanized by the studies on the unmanaged ICT equipment that has become obsolete and dumped in separate rooms in schools which awaits disposal by government. The objectives of this study are as below:

i) To determine the level of GICT awareness among teachers in Malaysia's education sector.

ii) To identify the issues related to GICT practices among teachers in Malaysia's education sector.

iii) To design a framework to improve awareness on GICT practices among teachers in Malaysia's education sector.

1.5 Scope of the research

This study will be focussing on awareness on GICT practices among teachers in Malaysia's education sector. As of Mei, 2019, there are a total number of 420106 teachers in Malaysia (Ministry of Education, 2019) with 236797 of them teaching in 7779 primary schools and 183309 teachers in 2439 secondary schools. Since teachers play a significant role as moderators of knowledge by shaping young minds to the needs of a country, therefore awareness of GICT is vital among teachers in order to cultivate the knowledge of managing ICT infrastructures in sustainable ways to deter environmental problems.

Though the digital revolution began somewhere in the late 1950s to the late of 1970s throughout the globe, digital proliferation in Malaysia has been notable only with the inauguration of Multimedia Super Corridor (MSC) in 1996. Since then, Malaysia has taken many initiatives to promote and employ ICT in e-government, telemedicine, smart schools, multipurpose cards, worldwide manufacturing webs and borderless marketing. The government has invested millions in developing the ICT infrastructures in the country (Eleventh Malaysia Plan, 2016-2020)

Meanwhile, the statistic from Malaysian Communication and Multimedia Commission (MCMC, 2019) shows a prominent usage of internet, mobile-cellular, television and radio access and Broadband penetration. As seen in Table 1.2 the proliferation of ICT in Malaysia is notably high. In other words, ICT is being used abundantly in all endeavours by all walks of life in Malaysia. Table 1.2 shows the Broadband Penetration Rate per 100 Inhabitants by States which was documented in

the second quarter and third quarter of year 2019. The percentage is prominently high in all states of Malaysia.

Obviously, magnanimous importance has been given to integrating ICT in teaching and learning process (Simin Ghavifekr, 2015).

Table 1.2: ***Broadband Penetration Rate per 100 Inhabitants by States***

States	**Broadband Penetratration Rate per 100 Inhabitants (%)**	
	2nd Quarter of 2019	**3rd Quarter of 2019**
Perlis	111.2	115.9
Kedah	102.6	103.2
Pulau Pinang	154.2	151.5
Perak	122.5	120.9
Selangor	139.8	140.8
Federal Territory Kuala Lumpur	260.7	265.0
Federal Territory Putrajaya	107.2	100.0
Negeri Sembilan	144.2	142.5
Melaka	126.3	125.7
Johor	148.0	148.7
Kelantan	92.3	93.1
Terengganu	94.5	97.4
Pahang	103.6	104.8
Sabah	81.0	82.0
Sarawak	109.6	108.6
Federal Territory Labuan	96.7	95.9

Source: MCMC, 2019

For instance, the Malaysian Ministry of education has taken tremendous efforts to integrate ICT in the education sector by providing laptops, LCD projectors, up grading all computer labs in schools and in 2016, teachers were given the YES Altitude Smartphone to modulate the teaching and learning process in classrooms.

Hence, knowledge of ICT among teachers is well researched but with all the integration and usage comes the adverse effects of ICT which have not been looked into seriously. This prompted this research to be carried out among the teachers in Malaysia.

1.6 Significance of the study

The importance of this study is to make teachers aware of the importance of GICT and perhaps change the mind set of teachers to adopt GICT in their daily life. The outcome of this study could spur the implementations of GICT initiatives in a larger scope especially in the education sector. In the longer run, administrators will have to fully realize and anchor policies while monitor the way ICT is being used in each sector to safeguard our environmental sustainability.

Initiatives to introduce ICT usage in all sectors was planned carefully since the Eighth Malaysia Plan till now. In order to be cognisant about the challenging global landscape, Malaysia has perceived the importance of ICT in the growth momentum to ensure the citizens prosper in line with the global changes. Since then, the education sector has seen multifaceted and rapid transformation which focuses on ICT usage in teaching and learning process (Eleventh Malaysian Plan, 2016-2020).

Though, Malaysia has long undergone policy reforms towards sustainable development where the planning started as early as 1970s with the introduction of regulations to manage pollution from palm oil industry. In July, 2009, the National Green Technology Policy was only launched as a driver to hasten the national economy and promote sustainable growth in development.

The concept of GICT became significant only after Gartner's report was published in 2008. The report purported that approximately 2 percent of the global carbon dioxide (CO_2) is caused by the ICT industry due to energy usage (Figure 1.2). Another study by the Boston Consulting Group (2012), stated that ICT's own footprint is projected to rise to 1.27 GtCO2e by 2020. Since then, researchers have been seriously concerned about the relationship between ICT and environment. Though there are bouts of discussion on the related matter, only few real-world implementations are recorded (Laura- Diana Radu, 2016).

Existing literatures show that limited attention is given on awareness of GICT practices. Most studies focused on GICT awareness among students in the higher learning institutions (Dookthiram et al., 2012, Batlegang, 2012, Ramachandiran, 2012, Ahmad et al., 2013, Abdullah Bello et al., 2013, Selyamani.S and Norasnita Ahmad, 2015). Moreover, despite the enormous importance showed in the importance of going green in the sector of business, industries and among universities students, studies that addressed the awareness or GICT practices among teachers in Malaysia is not well researched.

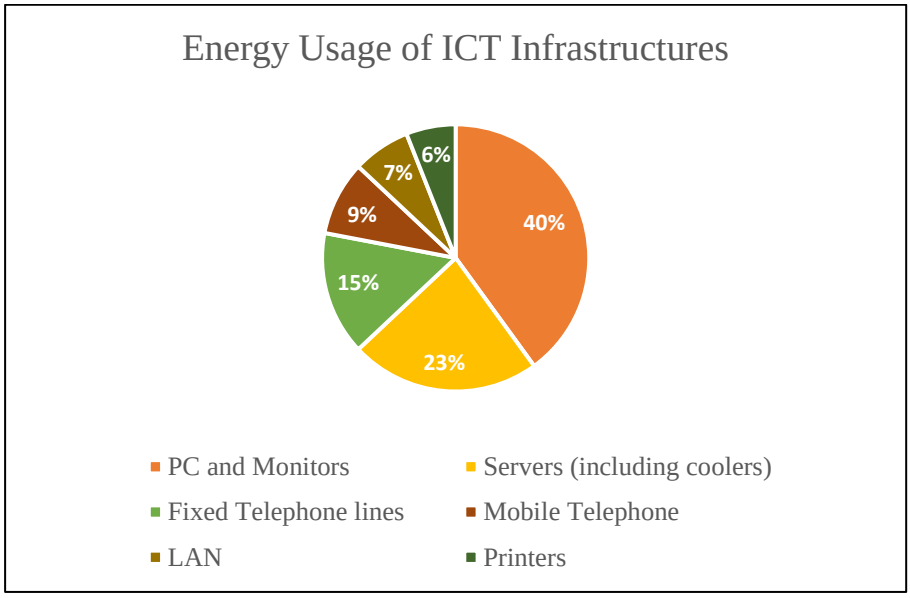

Figure 1.2: *Energy Usage of ICT Infrastructures*

Source: Gartner,2007

This study could show the insight on how teachers are aware of and adopt GICT practices in their daily activities. It will shed some information to the administrators on the extent of the GICT practices among teachers in the education sectors and how to improve the green practices among teachers and the public for a well-planned sustainable development of the country in the longer run.

1.7 Chapter Organization

This research consists of five chapters as shown in Figure 1.3. Chapter One gives a brief inside to GICT, problem statement, research questions, research objectives scope of research, and the significance of this research. Chapter Two is about Green Information and Communication Technology (GICT). Previous findings, operational definitions, aspects of GICT and various models in technology awareness are

discussed in this chapter. In addition, each concept is defined by looking into previous researches and their contribution. A conceptual framework is also formulated to show the connection between variables. Chapter Three discusses on the governments ICT initiatives, Green Technology Policy and GICT frameworks. The methodology of this study is elaborated in Chapter Four, followed by Chapter Five which is all on the findings. Mode, Median and Mean of results from the survey are shown in tables in this chapter. Moreover, T-Test, Pearson Coefficient and Standard Multiple Regression have been conducted and tabulated for better understanding of the findings. Chapter Six shows how the awareness of GICT practices is assessed meanwhile Chapter Seven discusses on the issues in GICT practices and ways of tackling the issues. Finally, Chapter Eight is the conclusion of this study

CHAPTER ONE
Introduction
This chapter gives a brief insight to GICT,the problem statement, research questions and research objectives.

CHAPTER TWO
Green Information and Communication Technology (GICT)
Previous findings, operational definitions, aspects of GICT and various models in technology awareness are discussed in this chapter

CHAPTER THREE
Malaysia's GICT Initiatives
The governments ICT initiatives, Green Technology Policy and GICT frameworks are discussed in this chapter

CHAPTER FOUR
Methodology
Detailed explanation on research design and method is given here

CHAPTER FIVE
Findings
Mode, Median and Mean of results from the survey are shown in tables in this chapter. Moreover, T-Test, Pearson Coefficient and Standard Multiple Regression have been conducted and tabulated for better understanding of the findings

CHAPTER SIX
Assessing GICT Awareness
The mean results from chapter five were modulated into radar chart for a clear picture of the respondent's knowledge, attitude, skill and aspiration. Furthermore, the awareness was calculated based on the area of the radar chart

CHAPTER SEVEN
Issues In Implementation of GICT
Barriers in implementing GICT and ways to tackle the issues are discussed in this chapter

CHAPTER EIGHT
Improving GICT Awareness and Conclusion
This chapter concludes the study. The limitation of the study and possible GICT researches in the future have been discussed in this section

Figure 1.3: ***Chapter Organization***

1.8 Summary of the Chapter

This study is hoped to draw a clearer line in addressing the need to develop the GICT in education and extend teachers' participation in GICT practices. In harbouring development and mapping Malaysia in the global digital race, sustainable practices should be given priority. The future of the country not only lies in the degree it has developed digitally and economically but also in planning to maintain the wealth of environment that has been granted to us. Much need to be apprehended in the field of GICT. The knowledge of GICT should be delivered to all ICT users in the country to overcome the predicted devastation and destructive force associated to our warming planet. In the next chapter, the dawn of GICT is explained with reference to the literatures. Each term, concepts and policies have been depicted to give a better understanding about GICT.

CHAPTER TWO

GREEN INFORMATION AND COMMUNICATION TECHNOLOGY (GICT)

2.1 Introduction

The idea of sustainability came into action after the publication of the Brundtland Report in 1987 by World Commission on Environment and Development (United Nation, 2012). This report advocates on stringent measures that need to be taken by all developers with consideration of the devastation of climate that the future generation will have to encounter. The rationale of this report was to inform the leaders of the world that it is vital to conserve the energy and resources to ensure that the future generations could live without decreasing the quality of life. There should be an equilibrium in development and environmental protection to preserving life of humans in the natural system. Earth's ecosystem should continue to function in order for the biotic living beings are able to live and survive. This report though not seriously taken at the time of its publishment, later became a tool of research for scientist around the globe.

This chapter discusses the literature review of this study in detail. Previous findings have been quoted to give a promising insight to what is GICT all about and the importance of thinking green and applying green practices in all human endeavours.

2.2 Concept Definition

Defining each concept in GICT is important to give the insight to what GICT is all about. In order to understand GICT, the role of ICT is defined first and followed by other concepts such as carbon footprint and e-waste and finally one can deduce the dawn of GICT.

2.2.1 Information and Communication Technology (ICT)

Information and Communication Technology or better known as ICT denotes all electronic devices which is capable to capture, transmit and display data and information. According to Bokolo and Mazlina (2016), ICT comprises of all facilities which are equipped with computer network, data handling and telecommunication. Being widely employed in the field of education, research, administration and others, as an effective tool to bring about revolution of this modern era, whereby ICT, is capable of creating numerous benefits to sustainable development and enhance virtual communication and administration. However, ICT also creates a large environmental footprint over the world (Masud and Noreha, 2014).

2.2.2 Carbon Footprint

Carbon footprint is an important concept which measures greenhouse gases GHG emission. Many definitions have been given by researchers worldwide in the pursuit to understand the term, carbon footprint. This term is associated to carbon emission by all electronic devices, vehicles and power generating stations and it has been a great concern of many nations across the globe to overcome the adverse effects to humans and the environment. According to Abeydeera et al (2019), greenhouse gases

comprise of gases such as sulphur dioxide, nitrogen dioxide, chlorofluorocarbons (CFC) and carbon dioxide. Among these gases carbon dioxide is a prominent one that has been recognized to cause global climate change or global warming.

Thomas and Jan (2008) stated that the carbon footprint can be defined as the whole amount of carbon dioxide produced unilaterally by an activity or the total amount produced in the life stages of the product. They added that all activities conducted by humans either directly or indirectly have to be taken into account. Meanwhile, Wiedmann, and Minx (2008) defines carbon footprint as the amount of carbon dioxide vented from the humans' daily activities. In addition, Patel (2006) said that, by quantifying the amount of carbon dioxide, from all its sources the carbon footprint can be computed.

According to Carbon Trust (2007, pg. 10), carbon footprint is defined as the total amount of greenhouse gases such as carbon dioxide and methane that are being generated by the activities of the human population. They also purported that there is a way for discovering and determining the individual greenhouse gas emissions from each and every activity in the process of demand and supply scheme of work. Global Footprint Network (2007) on the other hand said that carbon footprint is the demand on bio capacity required to sequester (through photosynthesis) the carbon dioxide (CO2) emissions from fossil fuel combustion.

In fact, carbon footprint is and extension of an older idea of ecological footprint. An ecological footprint was a term used to define the water and land use for production to sustain the activity of a population (Grub & Ellis ,2007).

All these definitions were then concluded and suggested the carbon footprint could actually be calculated because ‘carbon footprint’ is the “total amount of carbon dioxide” and other greenhouse gases, which is effused over the full life cycle from process or product. This emission can be indicated as grams of carbon dioxide equivalent per kilowatt hour of generation (gCO2eq/kWh)." (Baldwin, 2006)

It is with this definition, Gartner (2007) reckoned that the Information and Communication Technology (ICT) sector, gauged 2 percent of the overall carbon footprint. Though the number looks insignificant, it is bound to expand with the immense growth in the electronic and digital ballooning.

2.2.3 Electronic waste (E-waste)

Department of Environment Malaysia (2018) defines “E-wastes” as electronic appliances which are broken, old or obsolete and non-working. Ram Krishna and Sampasaha (2015) said e-waste is defined as discarded electrical and electronic equipment which are considered as waste, either as a whole or separate part or rejects from their manufacturing and repair process. During production and its disposal ICT hardware’s creates serious problems to the environment. Elliot, Steve & Binney and Derek, 2008, stated that, though ICT can accelerate progress tremendously, it can also be a tool of immense environmental pollution in all stages in its lifecycle. While

designing and manufacturing ICT equipment's can be a source of greenhouse gas emission, its operation has been noted to be a major contributor of carbon dioxide and drains all the energy from our energy grid. Moreover, ICT structures which consist of harmful and toxic elements such as lead, chromium and mercury poses greater danger as e-waste upon disposal.

The toxic components in these electronic wastes when dumped in landfill, contaminates the surrounding and diffuses into water and enters the waterways. Mallard (2010) stressed that old computer hardware's especially with the CRT monitor which consist lead in glass portion of the cathode ray tube can explode when deposited in a landfill. The significant amount of lead that it contains can react with other chemical elements and cause serious contamination of soil, air and the underground water. Eventually this becomes hazardous to all living being in the environment. Another research shows ICT is the second largest portion of e-waste produced in the Western Europe after household appliances. (Fatihah et.al, 2014). Undeniably, Murugesan (2008) said ICT has become a crucial part of the environmental problems the world is currently facing. Figure 2.1 shows the disposals of e-waste in Malaysian households.

Inevitably, changes and development in the digital world which involves ICT is bound to be a major challenge and drawback to the environment due to the rate these devices are being obsolete and disused. In 2012, the total e-waste generated in Malaysia was about 10 to 15 percent of the total waste generated nationwide. This

value is bound to increase with the blooming of housing and industries in the urban area, not to mention about penetrance of waste collection in the rural areas.

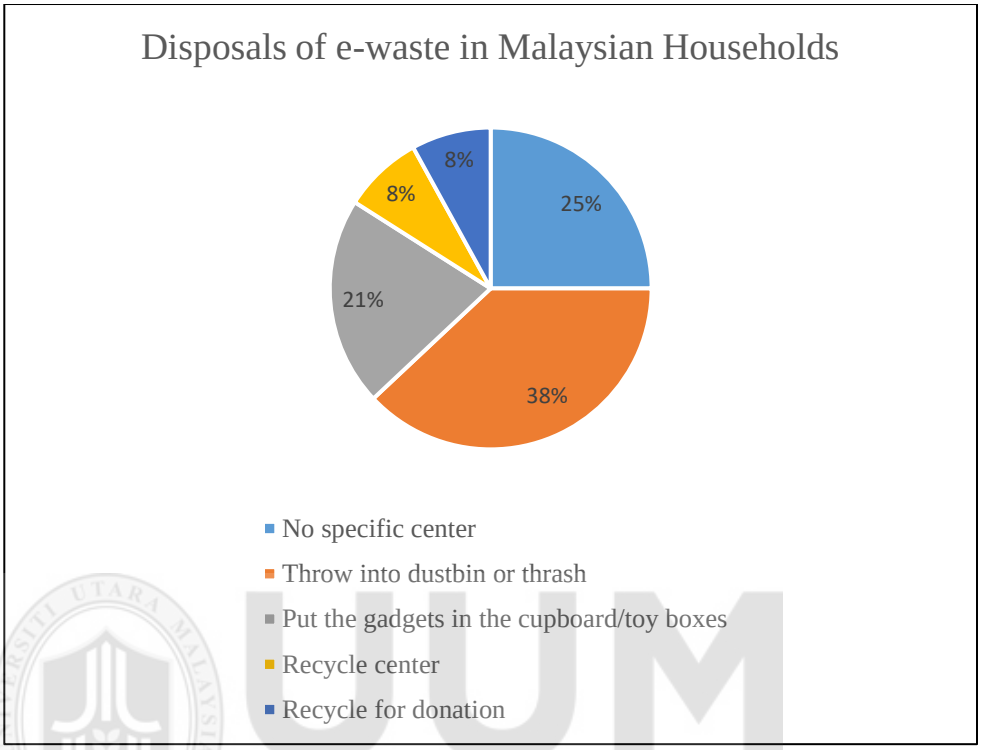

Figure 2.1: *Disposals of e-waste in Malaysian Households*
Source: Rafiza Kasbun (2016)

Researchers have found that the obsolescence rate of the electronic devices in the digital world are the crucial reason for accumulation of e-waste in landfills. A short life span of these electronic devices which requires replacement in every two years seems to have aggravated the discarding or exportation of these devices as second-hand merchandise. (Fatihah Suja et al, 2014)

Amit Kumar and Maria Holuszko (2016) stated that an amount of 41.8 million tons of e-waste was generated around the globe in 2014 which is about 5.9 kg per person,

and the seriously notable portion is being generated by developed nations. They projected that the whole quantity of e-waste will be 50 million in 2018. Meanwhile Balde et al., (2015) added that in 2014, the overall-waste generated in Canada per person was 725kg, among which the e-waste was 20.4 kg.

Cucchiella et al., (2015) and Golev et al., (2016) pointed out that about 3 to 6 percent of the e-waste is made up of printed circuit boards. These circuit boards consist more than 20 metals such as gold, platinum, silver, aluminium and copper at different ranges and is estimated to bring a gross income value of USD 23,568 per ton.

Excavating the soil in the landfill and concealing the waste by covering with plastic sheets or clay has become a common practice in many countries. This method of disposing the e-wastes is called landfilling. However, the major disadvantage of this method is the percolating of liquid toxic materials into the soil and contaminants which ooze into the ground water and eventually enters the food chain of living organisms. To overcome this problem Heacock et al. (2015) suggested that these electronic wastes should be recycled and the different metals need to be extracted before sending to the landfills. Nevertheless, extraction of these metals and recycling them in the market could decrease the burden of finding new metals for production, as well as reduce greenhouse gas emissions.

2.2.4 GICT

Laura-Diana Radu (2016) has defined GICT as “ways to reduce the negative effects of ICT usage on the environment.” After Gartner published a report in 2007 on the

detrimental effects of ICT, the term "GICT" and "Green IT" became an eminent part in the field of sustainable technology. Bokolo (2016) reported that GICT "can make a significant contribution in reducing carbon dioxide emissions and mitigating the effects of global climate change and other environmental problems."

According to Calero and Piattini (2015), concepts such as "green by IT" and "green in IT", "green by software" and "green in software", "green by hardware" and "green in hardware" are referred to the different domain of involvement in protecting the environment. Table 2.1 below show the definition and description of each of these terminologies.

Table 2.1: ***Definition of Green in IT and Green by IT***

Concept	Definition	Concept	Description
"Green by IT"	.. …the impact of IT on the environmental productivity of other sectors"	"Green by hardware"	Equipment's fitted to monitor to protect the environment. Hardware's used are environment friendly and can be disposed without posing danger to the environment.
		"Green by software"	Applications that are exclusively created to provide efficient resources management to protect the environment.
"Green in IT"	"…. the IT sectors own activity and its impact on environmental efficiency"	"Green in hardware"	Initiatives in the ICT sector to minimize the utilization of depleting resources, pollution and managing waste efficiently.
		"Green in software"	Reducing potentially harmful software's and enforcing sustainable practices in software engineering.

Source: Sustainability, 2016

These terminologies were later joined by "Green Computing", "Green Software", "Green IS", and Green Software Engineering. (Hilty and Aebischer, 2015). All these concepts were coined up when researchers found that all stages electronic devices became a genesis of environmental pollution. The devices lifecycle that poses danger to the environment are during manufacture, operation and disposal. (Friedman, 2007;

GAO, 2005; Gartner, 2007; Greenpeace, 2010; McKinsey, 2004; UNEP, 2005). These devices pose great threat to the environment upon disposal due to the toxic substances that are used in manufacturing. To address the problems, initiatives were taken by means of programming and ways to recycle and to sustain these devices in order to avoid environmental contamination.

GICT then became a more appropriate and general term which could decipher sustainable practices in the lifecycle of these electronic devices to secure a promising environment. Moreover, GICT defines clearly the involvement of the information technology with the social benefits (Sulaiman Ainin, et al ,2017).

2.3 Dawn of GICT

Since ICT promotes advancing knowledge and human capital, it also must foster closer ties with sustainable development. The Climate Group, (2008), stated that ICT plays an indispensable role in the global economy as a major operator of growth and development. The role of ICT in people's life is estimated to encompass 8.7 percent of global gross domestic product (GDP) by 2020.

While ICT keeps expanding its market place and penetrates every niche and corner of the human life, not many are aware that though ICT infrastructures pose as a great source of pollution and places a heavy burden on our electric grids while accelerate the contribution of greenhouse gases, ICT is also the solution in potentially reducing GHG emission and creating jobs for millions of people.

All ICT related equipment and infrastructures run on electricity and generation of this vast amount of electricity produces harmful substances like carbon dioxide (CO_2) into the atmosphere. Due to the growing awareness on carbon emission, researchers began to quantify the amount of carbon emission for a better understanding on the effects (Abeydeera et al (2019). In another research, Jonathan and Mark, (2014), stated that the energy consumption of ICT is increasing rapidly towards substantial figures. They quoted that data centres are responsible for more than 1.5 percent of the world's total consumption of energy.

According to Zaineb.et.al., (2016), Internet of Things (IoT) application, which has a large scale of connected devices as estimated to be in the range of 50 billion to 100 billion active devices creates a large draw from electrical power stations globally. In fact, Murugesan in 2008 stated that "every year a personal computer in use generates about a ton of CO_2." Study by Mallard (2010) stressed that it is essential to go green due the consumption of energy that is needed to light up the computer monitors whereby an amount of 60 to 500 watts of electricity is needed. Moreover, to light up LCD or CRT monitors an extra addition of 35 to 150 watts of electricity is required. With that being the case, a single computer uses about 95 to 650 watts of electricity in consumption and the amount of time the computer is being used is of essence too.

Moreover, a study conducted by Schneider Electric in 2008 showed that, an average desktop requires 85 watts of electricity just to stay inert even when the monitor is turned off. The same study showed that a staggering amount of electricity and money could be saved if users leave the computers idle everyday all over the world. One

computer left on for 24 hours a day can consume between USD $115 and USD$160 of electricity per year, and could dump 1500 pounds of CO_2 into the atmosphere. (Schneider Electrics 2008). Generally, a tree can absorb 3 to 5 pounds of CO_2 each year. Conclusively, to offset the amount of CO_2 emitted by one computer that is left on annually, 500 trees are needed. Abdullahi Bello et al. (2010) added that to offset the CO_2 produced in a university library in the Malaysia would require a billion trees even when the computers are left in hibernate or sleep mode.

Another study by Chakraborty et al. (2009) pointed out that from the estimated USD$250billion of electricity which needed to power computers worldwide annually, only 15 percent of that electricity is spent on real computing. The balance of 85 percent of power is wasted by leaving the computers in an idle state during working hours or throughout a day or over weekends. Hence, green computing knowledge is important to prevent the tonnes of energy wastage throughout the world.

Reducing carbon dioxide gas from the atmosphere is the main concern of sustainable development. Greenhouse gases which consist of carbon dioxide, sulphur dioxide, nitrogen dioxide, methane, chlorofluorocarbon and others are known to be the major culprits of global warming. According to a report by Australian Computer Society (2010), a significant amount of carbon emission is caused by ICT usage in the country, given that Australia is known to be one of the largest carbon emitters in the world with 13.248 million kilowatt per hour of electricity used by ICT engagers. This amount is reported to have emitted 14.365 Mega tonnes of CO_2.

In 2008, Schneider Electrics reported that data centres are the biggest component of carbon emitters in ICT infrastructures (18.8%). Meanwhile personal computers have a portion of 15.8%, followed by printing and imaging devices as much as 15.7% and finally servers emit an amount of 14.7%. Any addition to the ICT infrastructures such as game insoles will enhance the carbon emission to a bigger portion. Bokolo and Mazlina (2016) stated in their study that in Asia, a substantial amount of energy is used by servers and ICT cooling and power equipment.

It can be concluded that ICT and its infrastructures are faced with issues of carbon emission due to the consumption of electricity in its operation and environmental problems upon disposal since the obsolescence of these devices are rather rapid.

Studies also show that many ICT users do not have the knowledge on how the ICT usage can be detrimental to the environment. Pearce (2001) and Creighton (2002) found in their research that a staggering number of university students in America does not shut down their computers after use. This report was also supported by Dookhitram et al. (2012) and Batlegang (2012). In fact, study by Dookhitram et al. (2012) and Batlegang (2012) showed that students in the higher institutions are unaware of the impacts of ICT to the environment. Most of the students are found to have minimal or zero knowledge on energy saving techniques.

According to Bokolo and Mazlina (2016) though ICT is a major part of carbon dioxide contributors, it can impede and be the solution to resolve high energy usage

and reduce environmental impacts. This is referred to as GICT. ICT can be used to facilitate CO2 footprint analysis, monitoring and reporting to reduce their environmental footprint and increase energy efficiencies. They added that many countries have applied green strategies and initiatives to reduce carbon dioxide emissions. According to Mohammad et al., (2015) and Jan et al. (2013), GICT offers a promise to ICT scholars and researchers to make a consequential and remarkable contribution in reducing emission of carbon dioxide and mitigating the repercussions of global climate change and other environmental problems.

2.4 Components of GICT Practices

With the overwhelming rise of awareness on the effects of ICT to the environment, scholars have started to call for environmental sustainability measures that should be taken to reduce CO2 emission and reduce the energy cost of powering ICT devices. Greening the ICT would mean greening the infrastructure or equipment's and the process of ICT usage. The following are ways of greening the ICT in our daily lives as suggested by researchers.

a. ICT Equipment Recycling

According to Arijit Samajdar (2018), proper disposal of ICT waste is vital in order to eliminate the dangerous effects of the toxic components in ICT infrastructures. Hence appropriate methods of equipment recycling and disposal is important to reduce carbon footprint. Moreover, toxic components from ICT products such as Mercury, Lead, Cadmium, Barium and Lithium contaminate the environment and moves through the food chain via root plant translocation system.

b. Printer Consolidation & Reduction

This method can be used to reduce the usage of papers in printing or rather a paperless effort to ensure that the components of printers such as ink toner and cartridges and other hazardous material does not become pollutants to the environment. Other green practices are having online communication and minimize printing hard copies or print only when it is really necessary. Bokolo and Mazlina (2016) also reported that telecommunication companies such as Maxis, Celcom and Digi have paperless practices for top up and subscriptions.

c. End-User PC Power Management:

The conventional way to reduce power usage would be to off the PCs, Router and other ICT infrastructures when not in use but other methods that can be useful in power reduction is substituting desktops to laptops which uses TFT's LCD (Thin film-transistor liquid-crystal display) instead of CRT Monitors. Not to be forgotten, the recent generation of ICT infrastructures are already equipped with energy efficient components which only requires the knowledge on behalf of the end-users.

d. Improved Telecommuting Capabilities:

Telecommuting is another GICT approach which offers ways to reduce carbon footprint. Rather than commuting for international seminars, webinars reduce travel and can be deployed to tackle the environmental footprints. On the other hand, traffic congestion and pollution can also be addressed by conducting webinars and google meets.

e. Purchasing energy certified equipment

To meet the demand of the eco-friendly needs of the ICT industry a series of labels were created for the devices to be green by hardware. Table 2.2 shows the series of labels established in greening ICT on various stages such as consumers' usage, manufacturing and recycling.

f. Greening Data Centres

The rapid rise of web applications and internet has led to the blooming of data centres. Enterprises are installing more servers and expanding the capacity so that the servers can draw far more electricity than the former ones. These data centres other than being expensive, are having power shortage issues due to the large draw of electricity by the servers.

Presumptuously, these strategies can minimize the greenhouse effect of using computer systems and operating data centres.

Table 2.2: *Series of eco- labels*

Logo	Label	Definition
	Blue-Angel	… a German ecolabel which was established in 1978. This label shows that the product has an environmentally friendly design and involves broad criteria such as reduction in pollution in all of its life stages such as manufacturing, usage and end of life of the computer equipment, reducing energy consumption and recycling from product design.
	E-PEAT	E-PEAT which is the abbreviation for 'Electronic Product Environmental Assessment Tool' registered products
	TCO	…this is a Swedish ecolabel PCs, servers, mobile phones and printers. Initially this ecolabel was given to distinguish good quality and environment friendly screens. TCO ecolabel is world's most comprehensive sustainability certification for IT products. This ecolabel started with TCO'92 which includes an energy saving sleep mode for computers. Eventually TCO certification has included hazardous materials, ergonomics and socially responsible manufacturing.
	Eco-Label	…is a Europe eco-label which is used for all consumer products including computers.
	Energy Star	….is now in version 5, is the energy efficiency label for hardware
	80plus	… is a label to emphasize the energy efficiency of power supply hardware. Computers, servers and data centres needs power supply to function. These power supply devices convert the alternating current (AC) to direct current (DC) which are used in most electronic devices.

Source: Green IT, Monaco (2017)

2.5 GICT in Sustainable Development Goals (SDG)

According to the Brundtland Commission Report (1987), to develop sustainably is to make sure that the future generation is presented with the same uncompromised environment as the one we are enjoying.

Meanwhile Funk (2003) defines a sustainable organization as one which has a focused motive of addressing energy efficiency and other environmental issues for all stakeholders in the longer run. On the other end, Gray and Milne (2002) stressed that sustainability requires both. In any nation, developments are focused on economic advantages. Resources are utilized for rapid growth, the betterment of the people and a sound economy. Many times, sustainability is overlooked. Hart (1997) added that sustainability comes with the capacity of the planet to support itself. Even though, permeation of ICT in all sectors of economy around the world has bring forth many challenges to personnel who are managing them. According to Franklin Wabwoba et al., (2013), ICT can also be used to employ methods of green practices to minimize the impact on the environment.

In 2015, the United Nations adopted the Sustainable Development Goals (SDGs) which was also known as Global Goals as a measure to protect the planet and end poverty, to ensure that peace and prosperity is enjoyed by all walks of life by the year 2030. Seventeen goals were integrated which are interrelated and an affect in one area is bound to affect the outcomes in others. Moreover, development should balance social, economic and environmental sustainability.

GICT plays a salient and interrelated role in SDG 11 and SDG 13. SDG11 is all about making human settlements and cities more resilient and sustainable by making them inclusive and safe. With more than 4 billion people living in urban areas, GICT can offer better deal in making smart green buildings with an intelligent transport system. Moreover, a well-designed unit in the smart cities which deploys GICT are essential in offering opportunities in economic, social and environmental benefits. While making cities more eco-friendly, GICTs role in making the cities sustainable is equally vital for the well-being of all urban inhabitants and the planet in general.

Meanwhile SDG 13 requires every nation to take distinguished measures to combat changes in climate and its repercussions. Reducing carbon dioxide gas from the atmosphere is the main concern of sustainable development. Greenhouse gases which consist of carbon dioxide, sulphur dioxide, nitrogen dioxide, methane, chlorofluorocarbon and others are known to be the major culprits of global warming. Since all ICT related equipment and infrastructures run on electricity and generation of this vast amount of electricity produces harmful substances like carbon dioxide (CO_2) into the atmosphere. Smart cities as in SDG 11 must consolidate and green the ICT infrastructure used in achieving SDG 13. In other words, a sustainable green smart city can only be attained by adhering to greening the ICT used or adopting GICT.

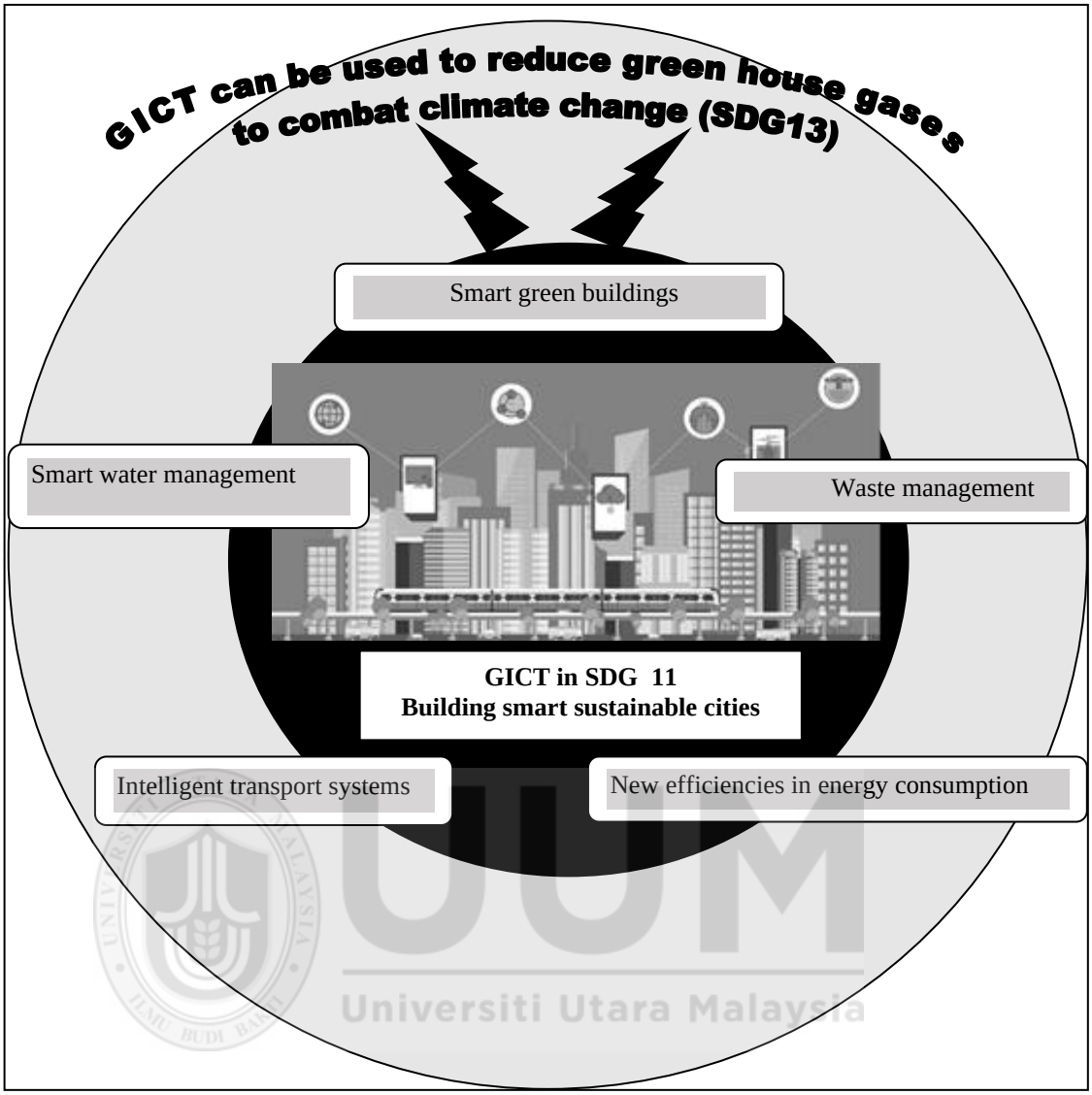

Figure 2.2: GICT in SDG 11 and SDG 13

Source: Authors Construct,2021

Building smart cities would mean usage of IoT (Internet of Things), as have been discussed in section 2.3 is an application, which has a large scale of connected devices as estimated to be in the range of 50 billion to 100 billion active devices which would draw a large amount of electrical power stations. Figure 2.2 clearly shows that to overcome this problem GICT products, equipment's and system could be used to minimize the degradation of the environment because it has zero or low

greenhouse gas emissivity which is safe for use in the smart cities and promotes a healthy and improved environment for all life forms. Moreover, GICT can mitigate the use of energy and natural resources. GICT is also the enabler to stimulate the use of renewable resources as required in SDG 13.

Therefore, GICT could be an answer to overcome problems in SDG 11 and SDG 13 to achieve sustainable development.

2.6 The GICT challenges

Awareness of ICT personnel in any organization is an important factor that decides the green practices in deployment and implementation of ICT (Mariani and Imam, 2012). According to Kaneko and Tomonaga (2011), knowledge is the understanding of all the facts on a particular subject; to perceive the issue or ability and be conscious of the situation and this leads to awareness. Abdullahi Bello et al., (2013) added that in GICT, understanding of all the fact that the user knows about the energy efficient techniques to lessen the adverse effects of the computing activities is knowledge. Most users are not aware of this knowledge which led to abundant usage of electricity and carbon dioxide emission. It is quite common for users to leave the computers on perpetually even after working hours in offices, libraries, hostels, staff rooms and laboratories."

Moreover, people generally commit themselves on any matters which they are aware of. Murugesan and Laplante (2011) stated that educating the public is an essential component in advocating pro-environmental attitudes. Educating the young minds

can promote and boost positive attitudes in them to adhere to GICT approaches. In fact, Hamid, Ghafoor and Shah (2012) stated that when people are made aware of the adverse effects of ICT and educate them on GICT approaches, they tend to apply these methods in their daily lives. This is parallel to what Apulu & Latham (2009) and Ogunyemi and Johnston (2012) said in their researches that is absence of technology awareness is most likely to emanate failure to seek opportunities in organisations. Technology awareness can enroute an organisation towards better opportunities. These studies come to show that lack of knowledge and awareness is the biggest barrier in awareness of green practices in an organization. Only when the benefits of the GICT is known to the people, there will be an attitudinal change in ways the ICT is being handled."

Another study by Olson (2008) and Gonzales (2005) stressed that "the awareness of green technologies is different in comparison to other technologies. Green technologies mainly consist of elements that need to be applied in reducing the harm on environment. Compliances for sustaining environment is perceived as costly and managers fear that business competitiveness may be affected with such expenses. (Mathur and Mathur, (2000)."

On the other end, Herman, Shalaby and Bundgen (2010) added that everything that has benefit has an adverse effect too and so GICT also has its unfavourable circumstances. As been quoted by Mathur and Mathur (2000) the tariffs needed to implement GICT such as training personnel, purchasing of new hardware and software is an added burden to organisations. Implementing GICT policies in this

case may hinder an organisation's strategic initiatives. Moreover, employing new methods can introduce newer security risks.

One such fear according to Mosharrof Hussain et al., (2014) and Murugesan and Laplante (2011) is virtualisation and cloud computing in GICTs. Malicious programs or contents that passes through the traffic between virtual hardware's are not detectable by conventional security programs. Appliances for GICT approaches are not only costly but has its limitations.

In conclusion, enterprising strategies need to be taken to enhance and implement GICT approaches for a better environment for everyone and also in business values.

2.7 GICT Policies

Colin (2017) stated that at global level, governments are beginning to realize the need to act more responsibly and have signed protocols and other agreements in reducing carbon emission. Government policies are essential to chart directions for any development. Policies clearly states vision to be attained and plan of action which outlines the strategy, responsibilities and measurements for evaluation. According to Molla and Cooper (2010), policy in GICT involves the framework of an organisation which has environmental sustainability criteria's and is used as a guidance in all stages of the ICTs life cycle such as sourcing, operation, services and end-life management. They added that the policy also defines the administration initiatives of GICT, budget allocation and other resources including the metrics to evaluate its impact on environment.

Philipson (2010), said that any policy framework should include a proper establishment which includes how to enforce, measure the effectiveness, monitoring of the strategies and mitigation of unwanted alleviation. A good GICT policy should consider the attitude, responsibilities and role of the users and committed in achieving the target of reducing carbon emission and enhance environmental quality.

Policies are vital for they indicate an organisations commitment to the technology is taking place. Moreover, Molla Coopers and Pittayachawan (2009) added green technology policy involves the framework which contains the criteria in handling GICT initiatives and operations. A well-illustrated framework is able to determine how an organization have administered green initiatives in their sustainable practices. Molla, Coopers and Pittayachawan (2009) also stated that GICT readiness policies are all about hindering activities that has a negative impact on environment such as production methods that use extensive energy, poor recycling practices, heavy use of hazardous materials and wasteful packaging practices.

Any policy on green technology must support the issue of sustainability. The operation and service policy in Green IT/ICT are inclusive of computer power management and computer usage policies for the staff in organisations meanwhile IT end of life policy have regulations and guide on disposal and settlement of ICT infrastructure. Normally precise guide is given on how to recycle the ICT products to avoid the environmental impact of their e-waste. Therefore, it is vital that an organisation has its well-groomed National Plan or ICT policy because in doing so

they will have a set of their goals to employ in GICT from manufacturing to end of ICT life. Having the National ICT policy will enhance human personnel especially officers in the ICT section to prepare themselves and their subordinates to utilize GICT.

2.8 Operational Definition

In this section the operational terms are defined to give a better understanding on the dependent, independent and mediating variables used in this research to assess the awareness of GICT among teachers in Malaysia.

2.8.1 Awareness on GICT Practices

Awareness plays a predominant role in determining the prevalent of a technology. One of the preliminary researchers, Lionberger proposed in 1968 that "awareness is one of the best-known acts for utilizing an innovation. Moreover, Islam and Gronlund (2011) stated that influence plays a predominant role in creating awareness which is a magnitude of attention a person is heedful in what they belief is right.

According to Laura- Diana Radu (2016) there are some factors that involuntarily influences the level of awareness among people such as the social responsibility towards the global and regional environmental problems. This is also supported by the study by Azmi et al. (2017) which stressed that creating awareness on green practices can eventually reduce the negative impacts of these technology has on the environment. Meanwhile Colin (2017) stated that "effects of ICT can be divided into two which are as a source of environmental problems and as an opportunity to

minimize the negative effects of ICT." Awareness on these effects can contribute immensely towards GICT awareness among users. Hence, awareness of teachers on the related matter can create a cascading effect in the nation in establishing sustainable goals.

Study by Apulu and Latham (2009) showed that application of any technology will be hindered if there is a lack in awareness about the technology. Hence, awareness on the part of teachers allows the knowledge of green practices to be propagated to students and eventually bring about the necessary changes among all users towards the stewardship of taking care of the environment in the longer run. There are some prominent researches done in assessing the level of awareness of people pertaining to green practices but few on teachers in Malaysia. Awareness of teachers on GICT will influence their mind-set on ICT usage and influence the intention to go green.

According to Azmi et al., (2017) awareness on green practices is influenced by organizational training programs, government regulations and policy on environment and knowledge of an individual. This is shown in Figure 2.3.

The importance of awareness has been stated and researched by many such as Din (2018), Harder (2009), Rabiatul Adawiah and Mohd Shukri (2018), Laura- Diana Radu, (2016), Dookthiram et al., (2012), Batlegang, (2012), Ramachandiran, (2012), Ahmad et al., (2013), Abdullah Bello et al., (2013), Selyamani.S and Norasnita Ahmad, 2015) and Murugesan (2008).

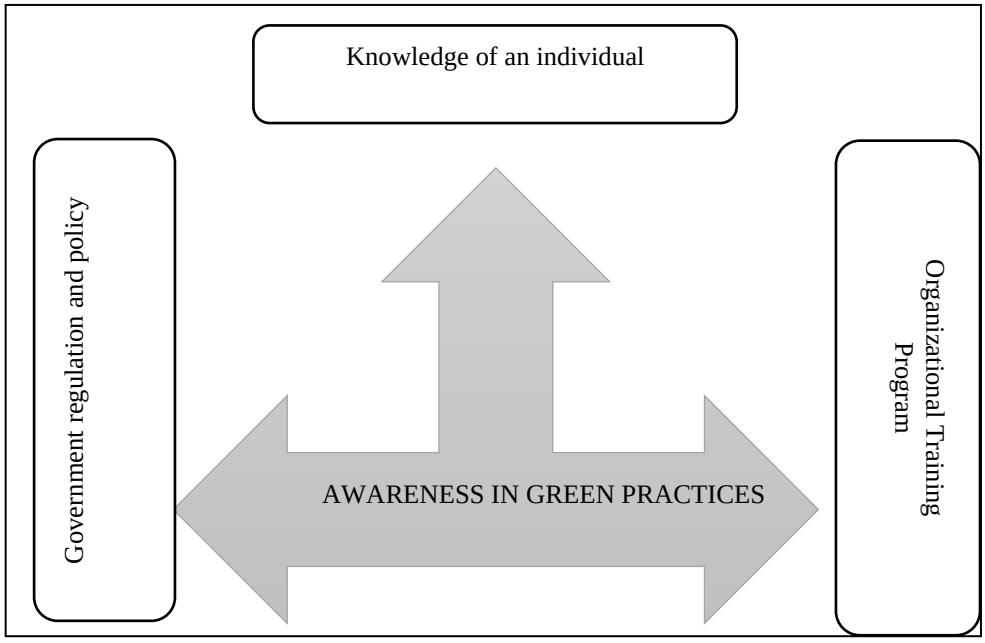

Figure 2.3: ***Influencing factors of awareness on green practices***
Source: Adapted from Azmi et al., (2013)

Awareness of a participant has been noted to be to be one of the key factors in determining the performance of individuals in a program. Bennet and Rockwell (1995), introduced the TOP model (Targeting Outcomes of Programs) (Fig 2.4) for evaluating outcome and suggested that policy makers or program planners should adhere to these models for assessing outcome of their planned programs.

Harder (2009) defined each step of this model and stressed that it is applicable in assessing planning or performance since the levels of both planning and assessing performance are mirror images of each other. In this model, awareness on the part of the participant is acronymed as KASA which denotes knowledge, attitude, skills and aspiration. This acronym KASA was first proposed by Bennet (1975). According to Harder (2009) the level of awareness in for any program can be investigated by evaluating an individual's knowledge on the particular program, the attitude one has

in the application, their skills and their aspiration towards the program. Hence this theory on awareness is also applicable in assessing the level of awareness in GICT among teachers. By evaluating the knowledge of teachers in GICT, their attitude in handling the ICT infrastructures, their skills and aspiration towards going green, the level of awareness on GICT among teachers in Malaysia can be explored.

In a study by Kite et al., (2018), awareness was related to behaviour in a hierarchical model, which denotes that the probability of achieving an outcome decrease as the process moves in the hierarchy (Figure 2.4). Henceforth, the population of people who actually engage in a desired behaviour will actually be smaller. Moreover, Kite et al. (2018) posits that awareness which is a proximal variable are affected by series of intermediate measures such as understanding and knowledge, attitude and social norms, self-efficacy and intention (Figure 2.5). This model which was used in the public health campaign is another alteration to the KASA concepts in the TOP model.

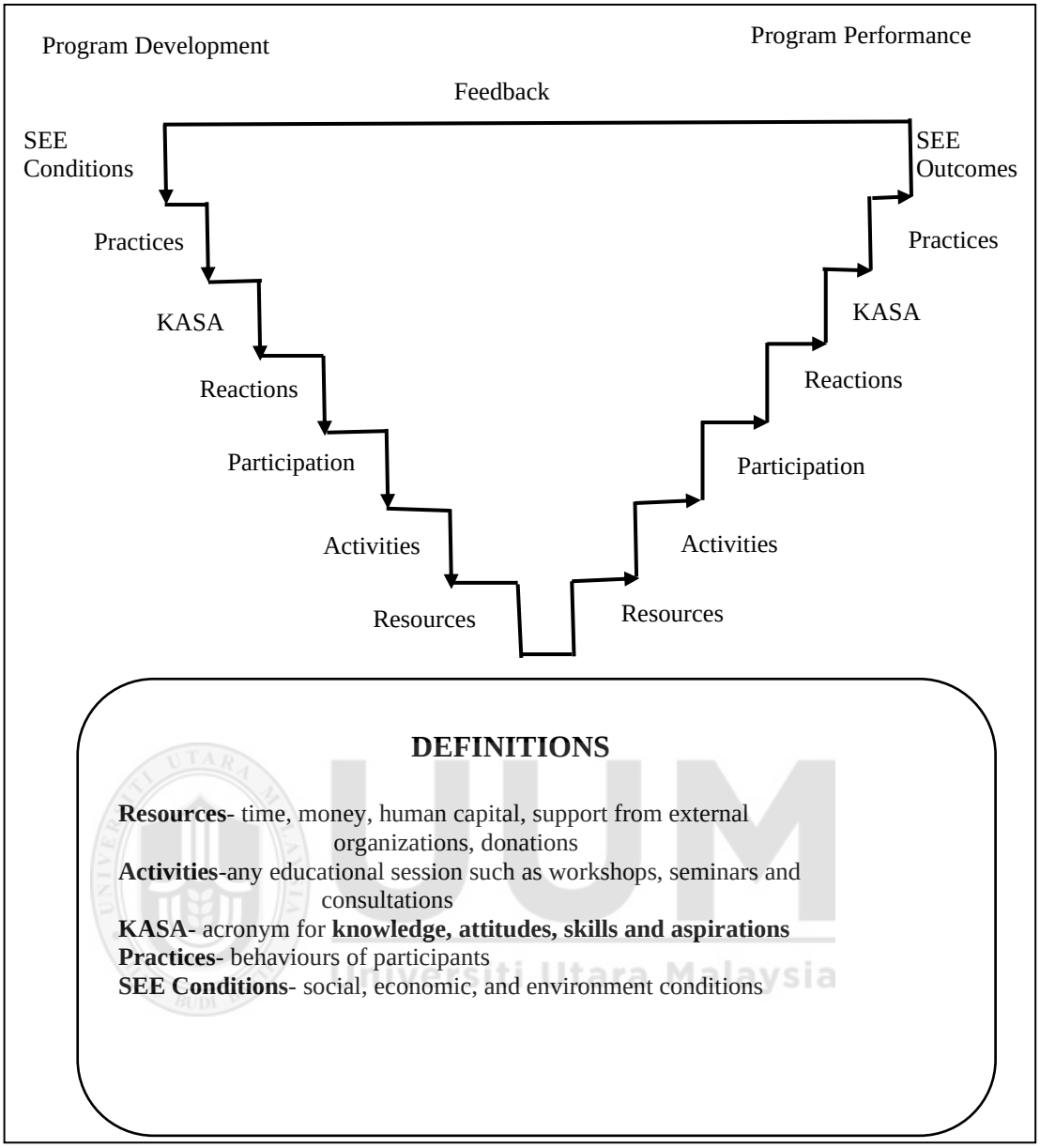

Figure 2.4: ***The Targeting Outcomes of Program (TOP) Model and concept definitions***

Source: Adapted from Bennet and Rockwell, 1995

People's beliefs on their capabilities are defined as self-efficacy. Inevitably, capabilities come with skills one possesses. Whilst self-efficacy and intention has been noted to have a positive effect to perform a specific behaviour.

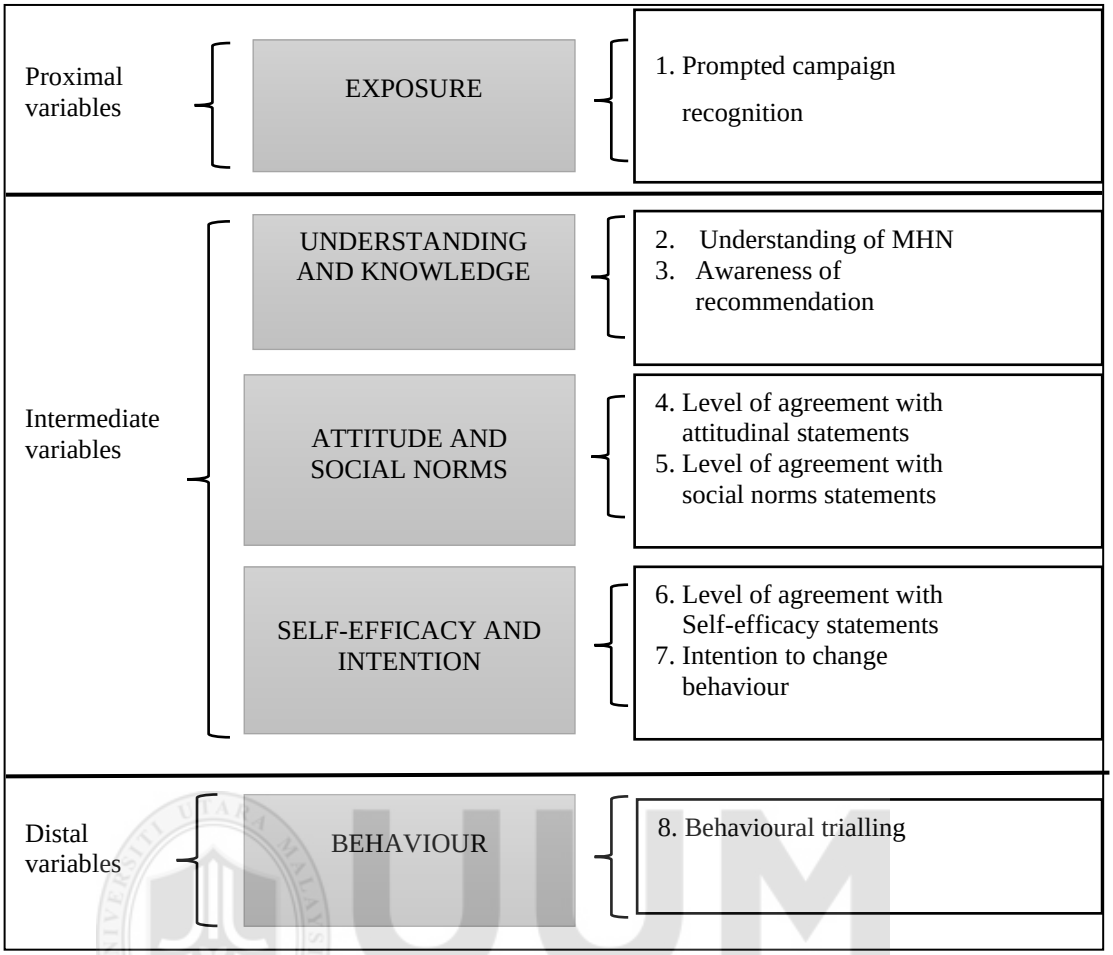

Figure 2.5: ***Make Healthy Normal theorized hierarchy of effects model (with evaluation, right hand side)***

Source: Kite et al., (2018)

Hence, it can be concluded that the level of teachers' awareness on GICT practices can be assessed by harbouring on their knowledge, attitude, skills and aspiration. These four aspects if investigated comprehensively can give an inside to how GICT is being practiced.

2.8.2 Knowledge in relation to GICT

Blackwell et al., (2001), defines knowledge as "the amount of information held in the memory" which in return influences the individual's reaction to the stimulus around

them. Brucks (1985) on the other hand, divided knowledge to objective and subjective types. An individual's perception or self-assessed knowledge on a particular subject is known as subjective knowledge. Meanwhile the actual accurate knowledge stored in the memory is objective knowledge. In other words, perceived or subjective knowledge is what individuals think they know about a subject concurrently objective knowledge measures what they actually know on the related matter. Radecki and Jaccard (1995) stressed that what individuals actually know functions as the matter of believe in them. Some studies even show empirical correlation between the two knowledges (Brucks, 1985; Carlson et al., 2009). Evidently, it is sensible to presume that by measuring objective knowledge, one can positively correlated to perceptions of subjective knowledge. According to Boccaletti and Moro (2000), the association between the two knowledges are vital to estimate an individual's acceptance of a new idea such as GICT.

Based on the statistical results of their research, Azmi et al., (2017) advocated that knowledge is the most influencing factors that bring awareness of green practices in an organization. Meanwhile Drejer (2004) mentioned that knowledge is an eminent tool to the implementations of technology innovation in any organization. Another study by Shi et al., (2013), stipulated that, the lack of green technology knowledge and the durability of green materials are the main cause of not implementing green technology in organizations. Hence the managers of any organization must ensure that the knowledge of GICT is well delivered to all employees. According to Rabiatul Adawiah and Mohd Shukri (2018), the individual knowledge is the basis of one's attitude and practice on GICT. They stressed that change in an individual's

attitude is very much inclined to the amount of knowledge one has about GICT. When there is an increase of knowledge, there will be a change in the attitude.

2.8.3 Attitude in GICT

Philipson G. (2010) stresses that attitude describes how we think, rather than how we act. Fishbien and Ajzen (1975) are engaging the term attitude to refer to a person's effective dimension with respect to some object, action or event. According to Molla and Cooper (2010), "attitude in GICT context is the expansion to which individuals and managements are attentive towards the climate change and the environmental impact of ICT usage and operation." In the study of Franklin Wabwoba et al., (2013), attitude is the weight of an organisation's values, sentiment and norms toward the ICT's role in climate change and eco-sustainability. Philipson G., (2010) said that a "positive attitude towards GICT is vital and precedes everything else." If the attitude comes from managerial human infrastructure especially in organisations and business this attitude is most efficacious. Human personnel support and managing is an essential part of any GICT program.

Obviously, acceptance and willingness to implement has been noted to be the major elements in becoming the attitude of a person in use of a newly acquired knowledge of technologies. (Molla and Cooper, 2010). According to Molla (2009), Weng and Lin (2011), Wabwoba et al., (2012), Mosharoff Hussain et al., (2014) and Thongmak (2016), the awareness or attentiveness on the quality of environment and its degradation due to carbon footprint is depicted in one's attitude. Whether the professionals have sufficient knowledge and skills to practice GICT. In 1975

Fishbein and Ajzen, proposed “The Theory of Reasonable Action” which is one of the most simplified theories introduced to study behavioural intention of any individual is shown in Figure 2.6. Fishbien and Ajzen (1975 pg.216) defined “the individual’s evaluation of an object as attitude” meanwhile “a link between an object and some attribute was defined as a belief”. Behaviour on the other hand is a result of an intention. Conclusively, attitude is a settled way of thinking or feeling that one puts into action. Another factor that influences the behavioural intention of a person in this model is “subjective norms of what they perceive their immediate community’s attitude to certain behaviour which denotes ones status in a community.”

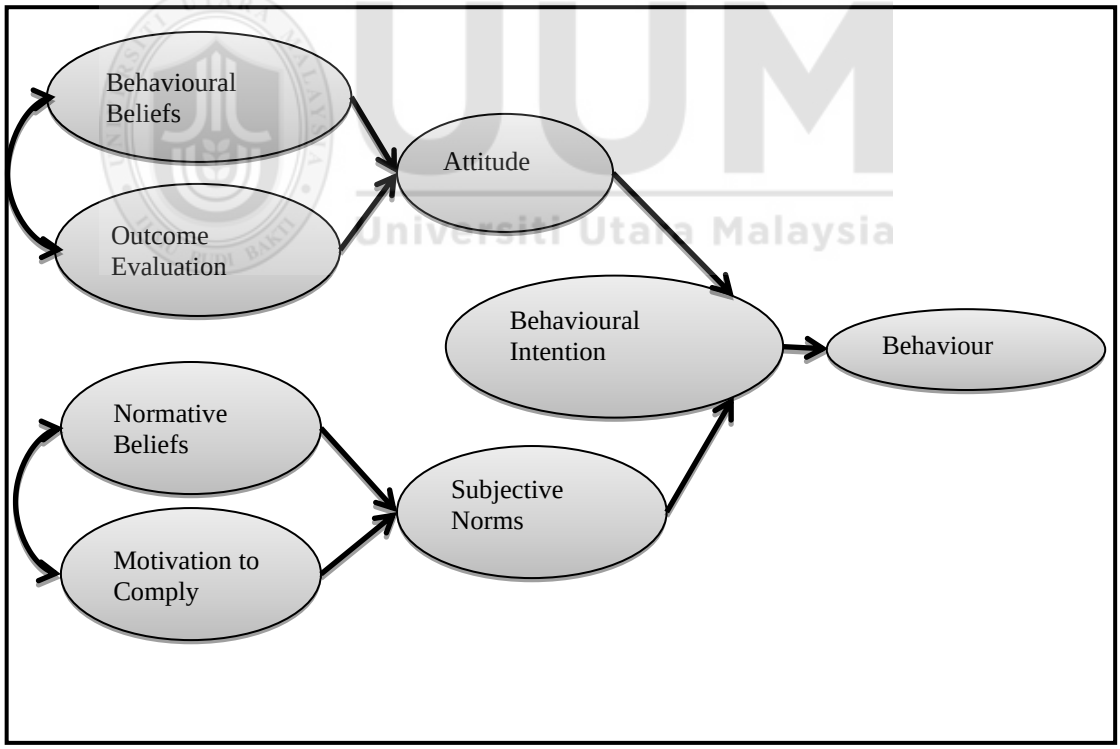

Figure 2.6. ***The Theory of Reasonable Action***
Source: Fishbein and Ajzen, 1975

Theory of Planned Behaviour (Figure 2.7) which was developed by Ajzen (1991) on the other hand has the same component of attitude and subjective norms which determines one's behaviour in many social studies and also on technology. According to this theory, a person's intention to act upon is determined by the person's attitude. This was also supported by Thongmak (2016)'s research which revealed that a positive attitude is vital in successfully adopting and constantly using GICT. The other factor added by Aizen (1991) was the perceived behaviour control which is a subjective behavioural attribute which stems out from attitude.

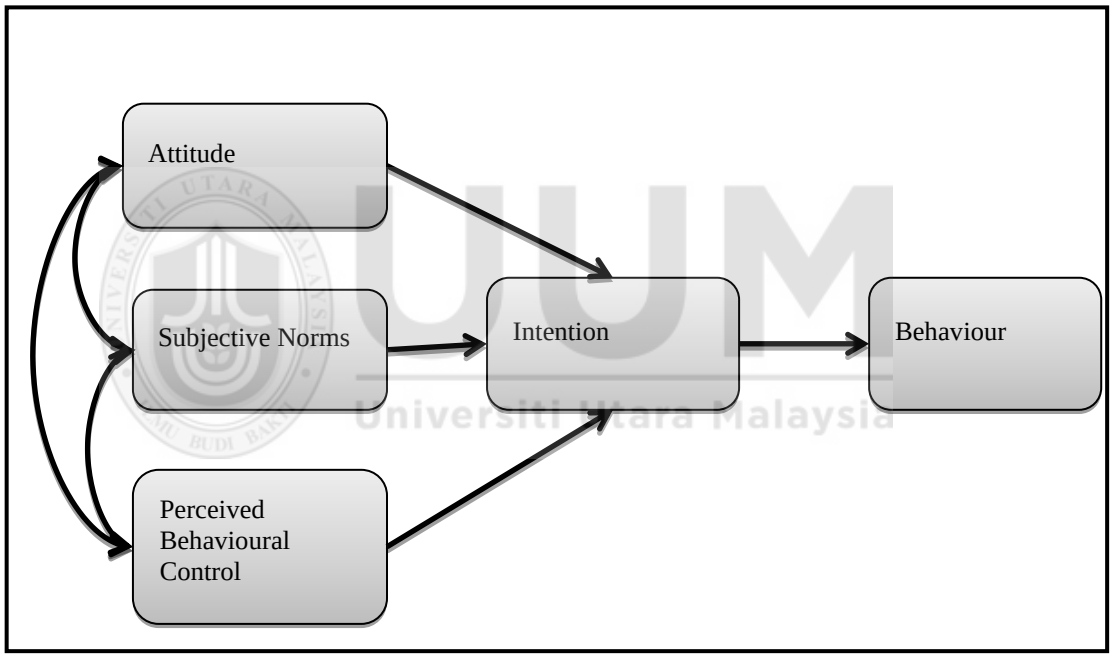

Figure 2.7. ***The Theory of Planned Behaviour***
Source: Ajzen, 1991

"Decomposed Theory of Planned Behaviour (Decomposed TPB)" was introduced by Taylor and Todd (1995). There are three factors upholded here that influences the behaviour of a person in technology acceptance which are attitude, subjective norms and perceived behaviour control.

Attitude has also been denoted to have a significant positive impact in the study of GICT adoption by Nizam and Vilhi (2018). They advocated that a positive attitude towards GICT should comprise of concern on climate change, energy saving tactics, attempts to reduce carbon emissions, responsibility shown in the use of printing materials.

Therefore, it is evident that attitude is an important attribute to finding the level of awareness among teachers on GICT practices.

2.8.4 Skill in relation to GICT

Skills that are required in handling ICT infrastructures are generally known as generic green skills (Mohd Zolkifli et al., 2018). With the revolution of green technology and pervasiveness of GICT, academicians and researchers have emphasized the importance of acquiring generic green skills among ICT users. Though the exact meaning of this term is still considered as ambiguous among researchers, it is commonly used to describe the non-technical or soft skills which are significant in environment sustainability and energy saving initiatives. Mohd et al. (2016) stressed that generic green skills are soft green skills which are non-technical and encompasses the attitude and ability needed to act upon in conserving the environment. Green skills are defined by Arasinah Kamis, Ridzwan Che Rus, Mohd Bekri Rahim, Faizal Amin Nur Yunus, Normah Zakaria & Haryanti Mohd Affandi (2017) as the ability or prowess in technology which in return helps to expand social, economic and environmental sustainability. Their stand is supported by Mohd Zolkifli et al., (2018) in Figure 2.8 which shows the three pillars of the generic green

skills that are considered important from the researchers' perspective of environmental sustainability.

Mohd Zolkifli et al.(2018) stated that besides soft skills such as, generic green skills are inevitable criteria in the present employment eligibility. This statement was also supported by Faizah et al. (2017). According to them, trained workers with generic green skills are valuable assets to an organization and an individual with these skills are less likely to be unemployed.

Hence generic green skills are an essential essence in practicing GICT especially in the academic sector for a vast proliferation. Mohd Zolkifli et al., (2018, p.2743) added that the knowledge of green generic skills is peremptory for academicians and administrators for they are the one who administer the curriculum and making sure that the skills are induced in workforce across the nation. This notion is further supported by Zaki Kamsah (2014), Nik Safiah Nik Ismail (2010), and Wentling (1987). They stressed that generic skills can be taught, learned and implanted among students. According to Dayue Fan (2016, pg.1) there are many ways to induce generic green skills among students through various methods of teaching and learning activities.Nevertheless, its imperative that teachers and academicians in general know and understand clearly the foremost importance of acquiring generic green skills in the longer run. In conclusion, Dayue Fan (2016) and Pavlova (2015) also emphasized that generic green skills are an important ingredient in raising the awareness of green practices.

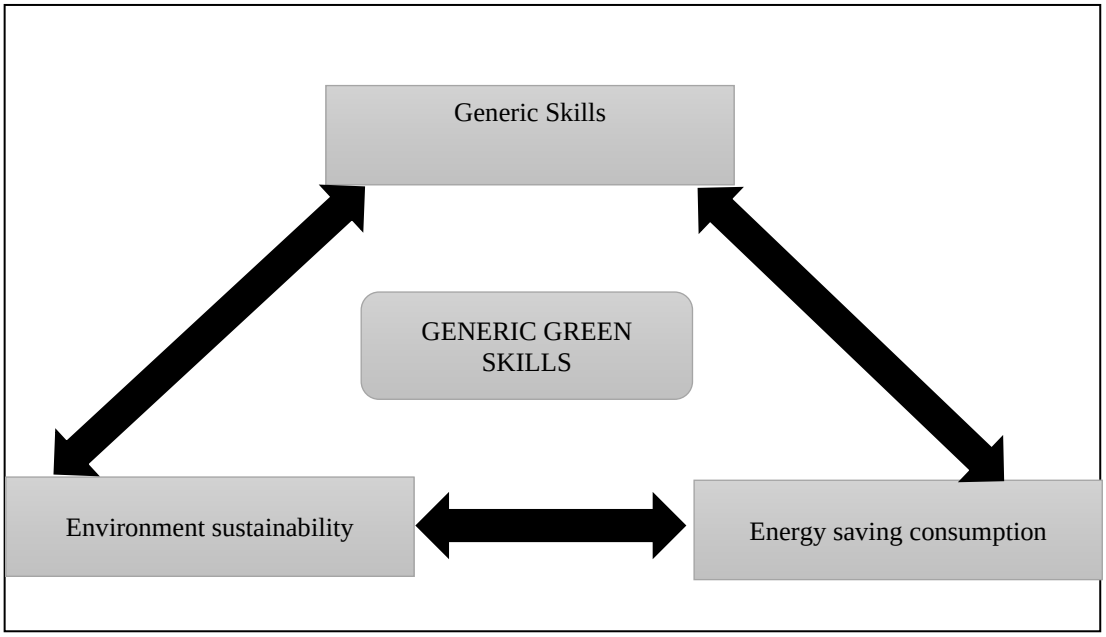

Figure 2.8: ***The three pillars of Generic Green Skills from academician's perspective.***

Source: Adapted from Zolkifli et al., (2018)

Moreover, a study by Wabwowa et al., (2012) have shown that lack of skill related to GICT is one of the significant factors that effects the implementation of GICT. Hence, teachers should have a good understanding and be skilful before GICT can be immensely practiced.

2.8.5 Aspiration in relation to GICT

According to the Oxford English Dictionary, aspiration is defined as an ambition or hope of achieving something. In the context of awareness of GICT practices, aspiration then can be referred to what an individual hopes to do in supporting the theme. Meanwhile, Lawson et al., (2003) has defines aspiration as "what we would like to do" in learning designs. This is shown in Figure 2.9 where aspiration is an important component of the model used in learning architectural designs.

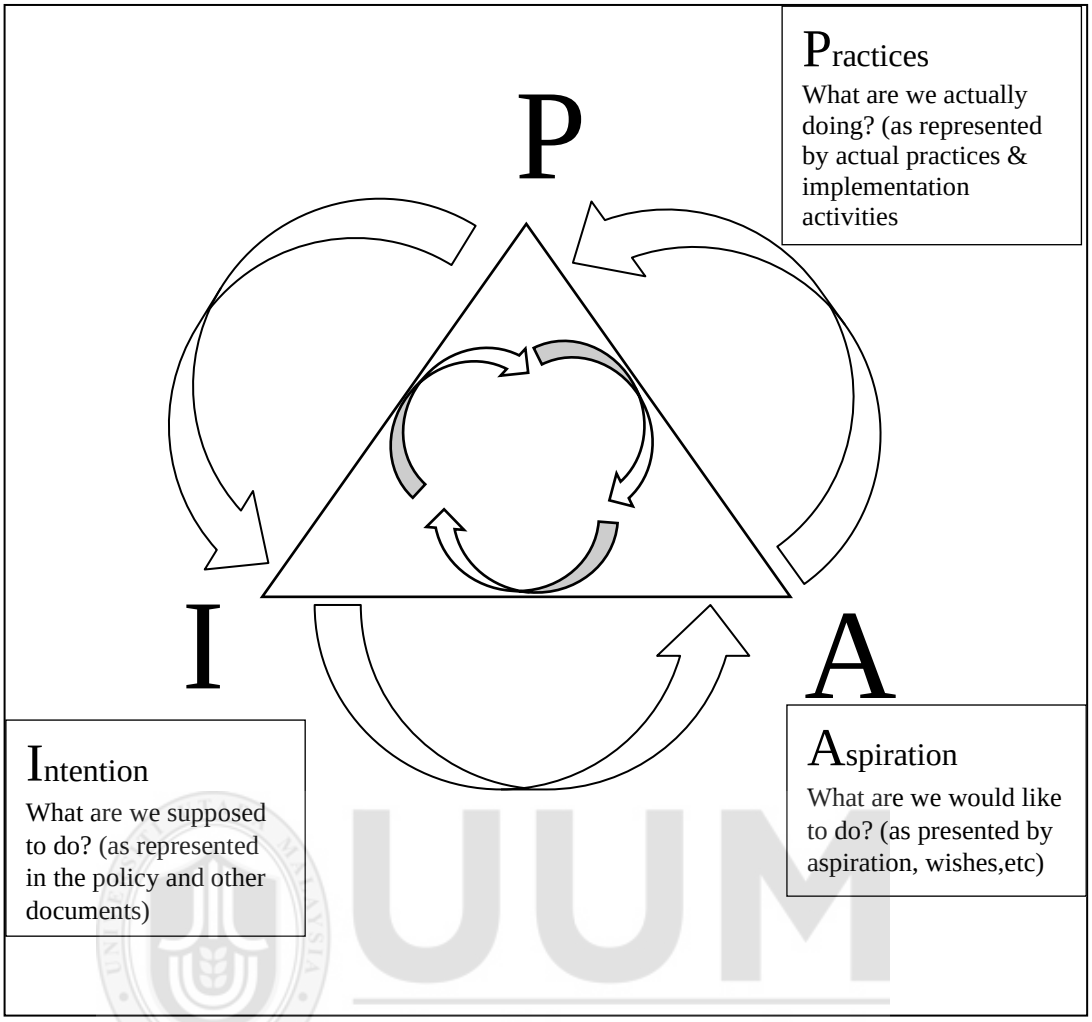

Figure 2.9: ***The IPA learning from experience Model***

Source: Adapted from Lawson et al., (2003)

Jayaratne (2010) defines aspiration as the utmost important internal motivation of any individual for a domineering behaviour or practice with full cognizance of its content, value, and application for achieving craved benefits. An individual's level of aspiration has a positive correlation towards an intention to change of an individual. Fishbein and Ajzen (1975) also described predictors of behaviours as intentions. An individual's aspiration can be considered as the beginning of the change process that leads to subsequent behaviours or practices of that person as seen in Figure 2.10.

Figure 2.10: ***Aspiration leads to change in behaviour*****.**

Source: Jayaratne (2010)

According to Jayaratne (2010, pg.4), "if effective programs are planned and administered on training individuals on GICT practices for instance, then participants of the program will leave as aspired individuals and take charge of what they have actually learnt. Putting into practice, what they have learnt will show in their behaviour or practice but real-life changes rests on the various socioeconomic and environmental factors. However, if any individual is not convinced of the greater good of a particular trait, then he or she will not aspire to improve to bring in the necessary changes. But in spite of everything, if the socioeconomic and environmental factors are favourable to the individual then there will a great change in the individual. That individual may be aspired to bring about the changes. This scenario is relevant in an application of a new piece of technology, as in this case GICT.

Jayaratne (2010) concluded that the level of aspiration can be determined by ascertaining an individual's intention in practicing what has been learnt. Therefore, the level of aspiration among teachers on practicing GICT can be determined by finding out their intention they have to practice what they have learnt about GICT from this study.

2.9 Maturity Models in GICT

Fowler (2015) defines maturity models as the tool that is used to help people assess the effectiveness of a program on a group in order to improve their performances. Fowler (2015) added that working with maturity models begins with assessment, that is to determine the level the subject is currently performing. Once the level is determined the researcher can use the level above to prioritize what capabilities the subjects need to learn next. Figure 2.11 shows an example of how a maturity model is constructed

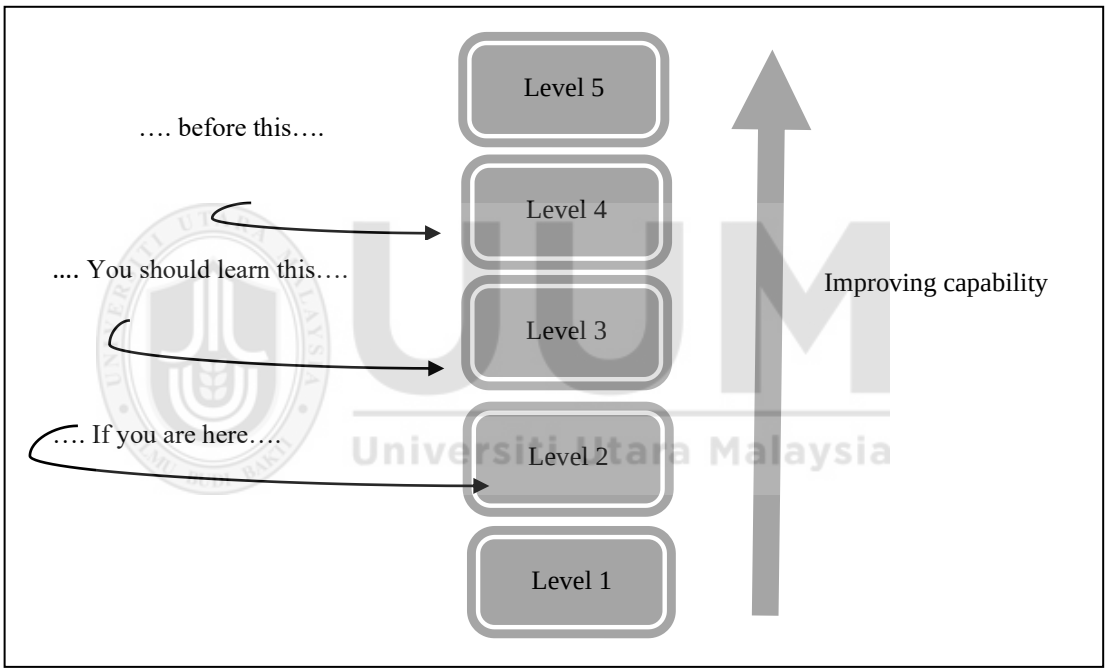

Figure 2.11: How maturity models are built

Source: Fowler,M. (2015)

In the context of ICT, Hankel et al., (2019) has proposed a model for green ICT adoption. According to Hankel et al., (2019), a G-Readiness model has to constructed first in order to determine the GICT adoption. Figure 2.12 shows the G-Readiness model constructed by Hankel et al., (2019) in order to find the GICT

adoption model. They tested on the variable governance, technology, practice, policy and attitude in order to determine the level of G-readiness among workers in three organisations. Each variable is also explained in the diagram as to why it is an important factor in determining the G-readiness.

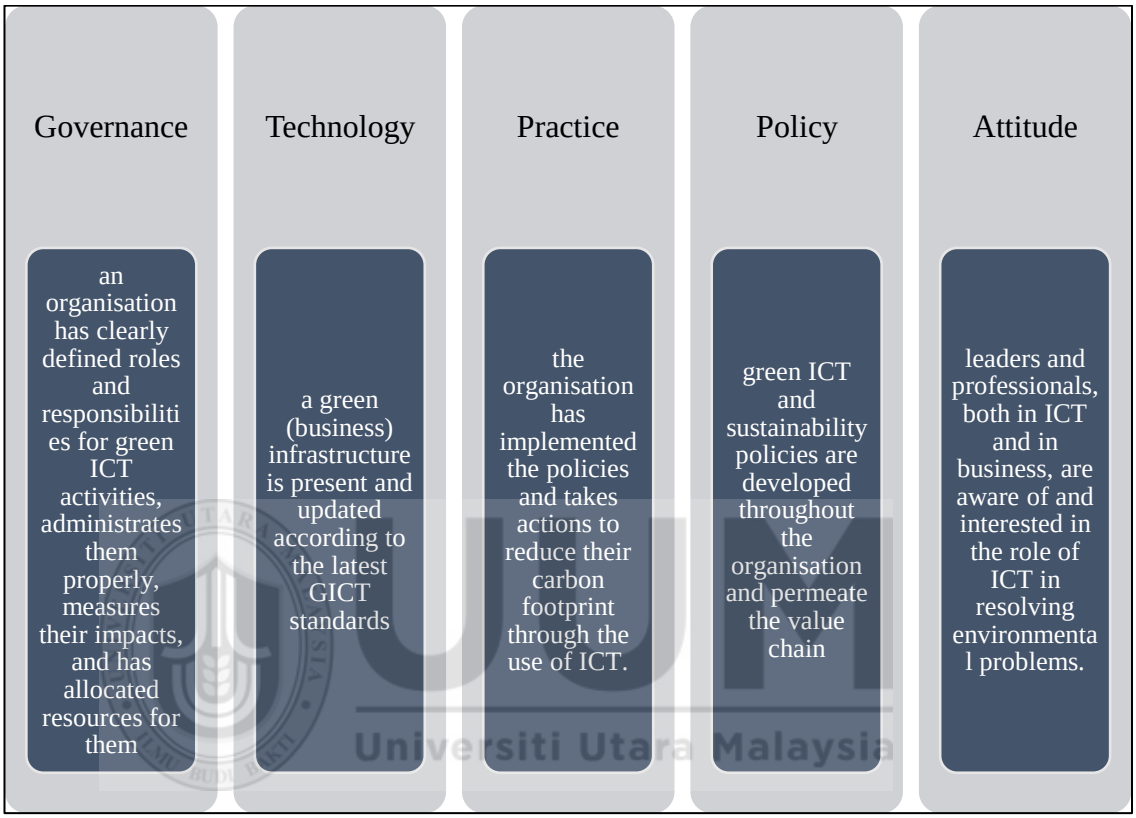

Figure 2.12: *G-Readiness model constructed by Hankel et al. in 2019*

Source: Hankel et al., (2019)

Based on the findings from the G-readiness Model, Hankel et al., (2019) concluded the GICT adoption model which is shown in Figure 2.13 below.

Figure 2.13: Hankel et al.'s GICT adoption model

Source: Source: Hankel et al., (2019)

Conclusively, they found that strategic alignment, culture and leadership, ownership, knowledge and experience and technical infrastructures influence the adoption of GICT in organisations. The model suggests the factors that an organisation should delve into for adopting GICT. These models were actually inspired by Molla (2008) who proposed the Green IT Adoption Model (GITAM). According to Molla(2008),

the general argument of this model is the combination of the static Green IT contextual variables, dynamic Green IT readiness dimensions and the strong order of IT drivers can be used to determine the Green IT adoption. Molla's GITAM model is shown in Figure 2.14 below.

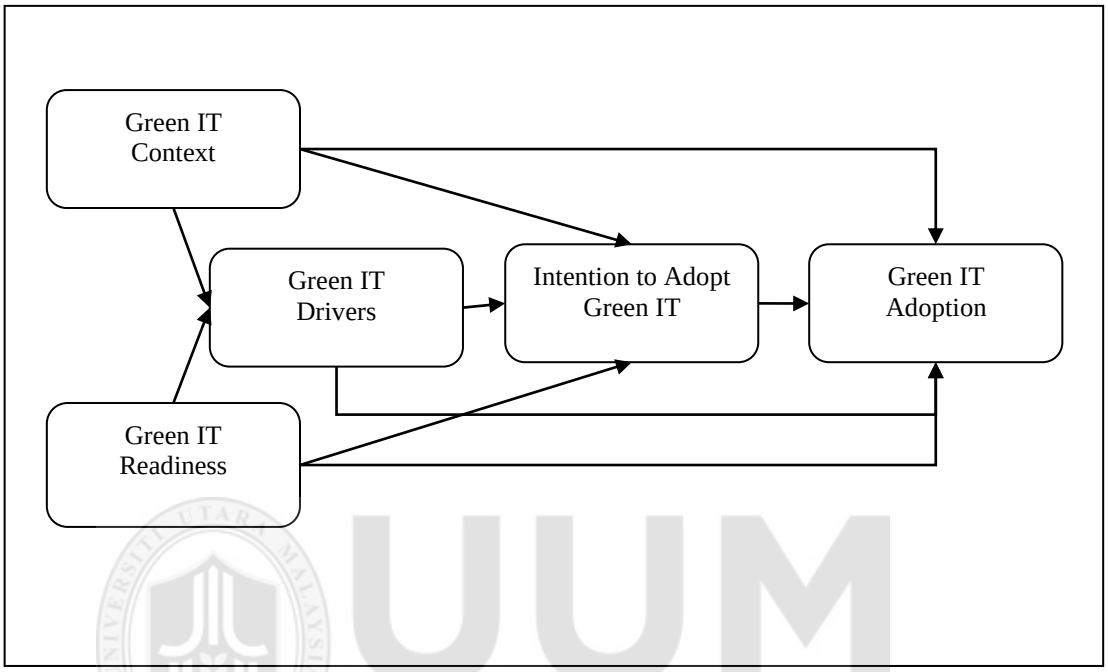

Figure 2.14: The GITAM: Basic Model

Source: Molla (2008)

In 2011, SaniaKhan et al., proposed the Green IT Multi-criterion Hierarchy Model that is practiced by the IT industry in India. SaniaKhan et al., (2011) estimated the various criterion and their appropriate weightages in association with GICT using the method called Analytical Hierarchy process (AHP) in their research. Each criterion was numbered in the model to show the priority or weightage it carries (Figure 2.15). The key findings in their study showed that Green IT practices are not known by many employees and considering the need to practice Green IT, the government can

take stricter measures by following the model and imposing stricter regulations towards adopting Green IT.

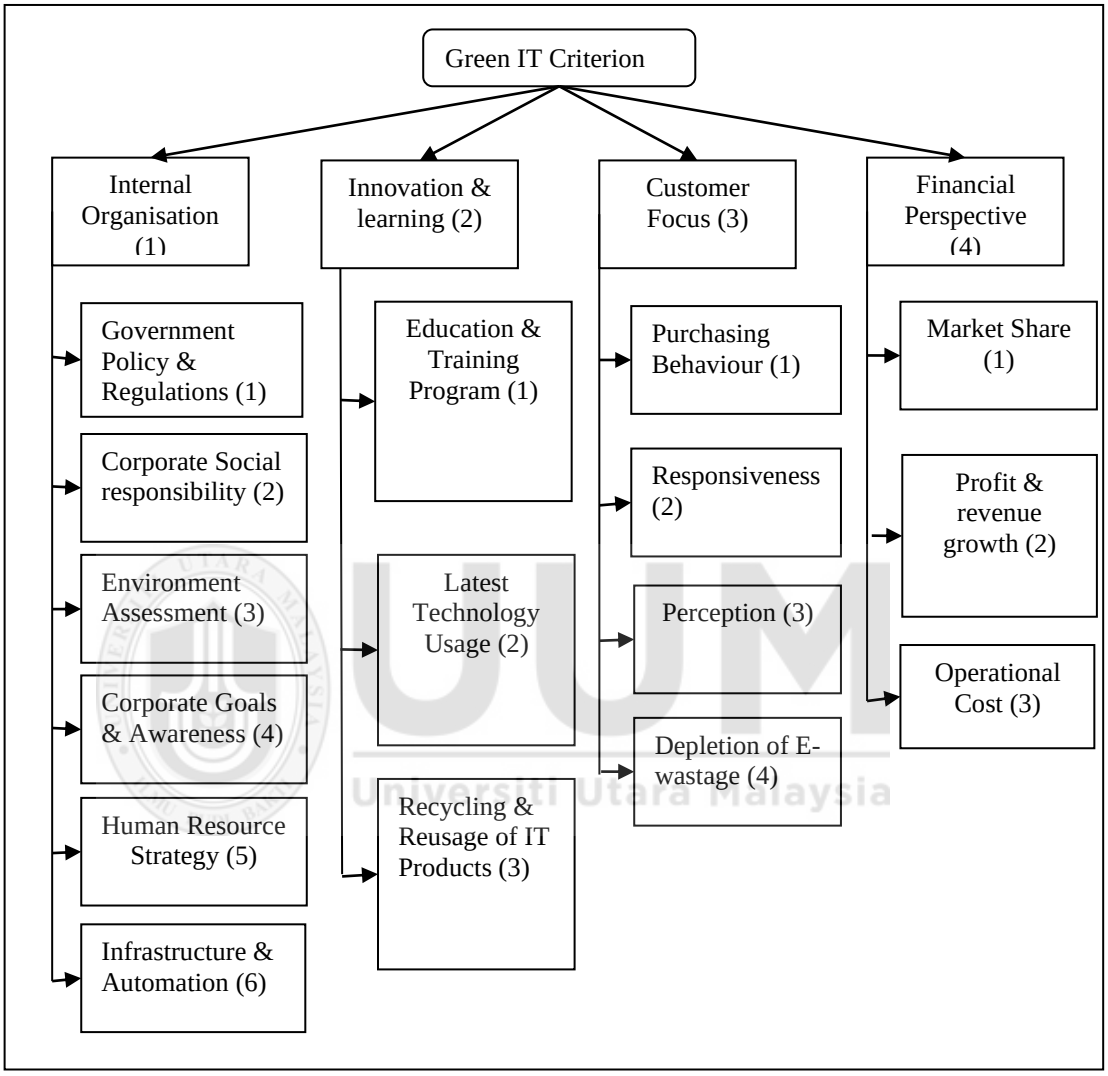

Figure 2.15: Green IT Multi-criterion Hierarchy Model

Source: SaniaKhan et al. (2011)

Later Bokolo and Mazlina (2016) came up with the model as in Figure 2.16. All their hypothesis was tested and proven. Bokolo and Mazlina (2016) concluded that institutional forces are positively related to adoption of a sustainable enterprise

strategy and IT personnel with higher motivation are highly to adopt sustainable strategies. Moreover, criterion such as ability, expectancy and organisational forces play a vital part in adoption of sustainable strategies. Interaction between sourcing, usage, disposal practices does affect the sustainable strategies of an organisation and the organisations timing, sector and size is also vital in sustainable applications.

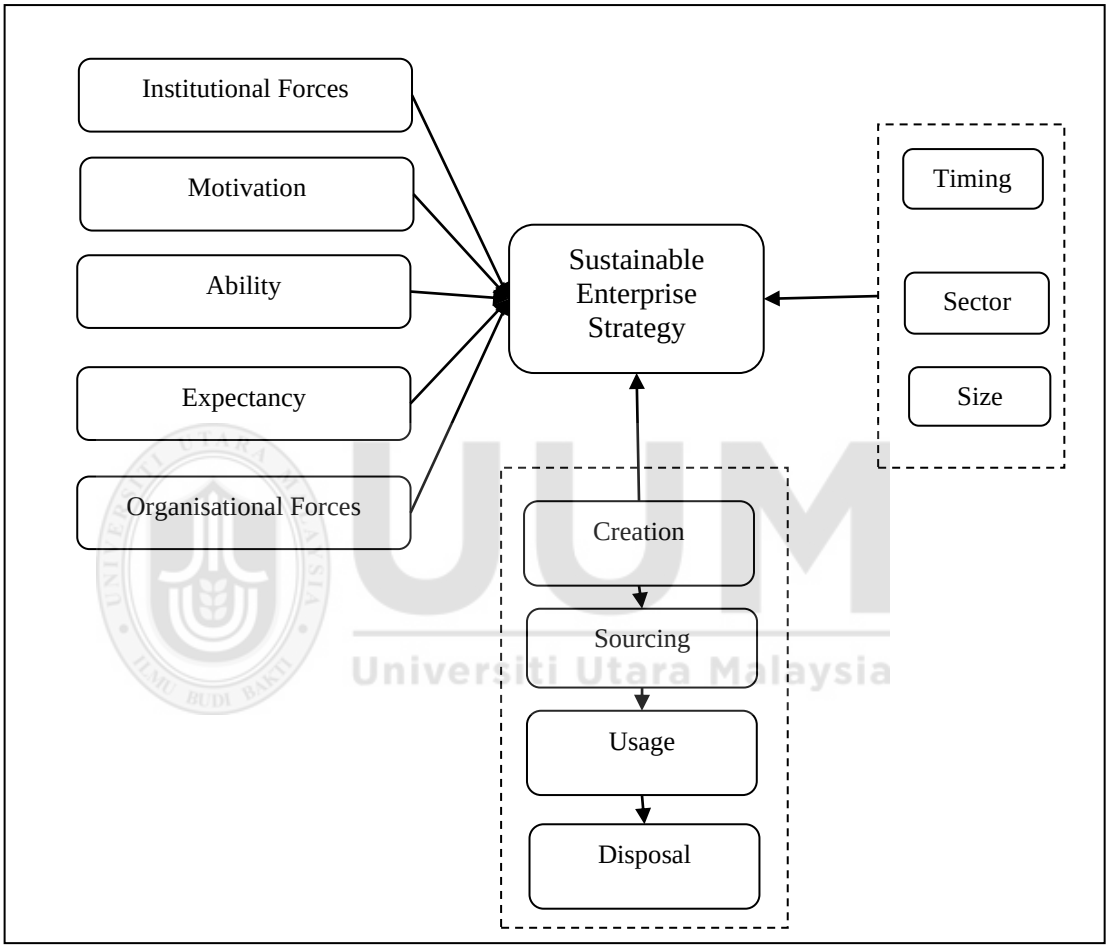

Figure 2.16: GICT Model as suggested by Bokolo and Mazlina

Source: Bokolo and Mazlina (2016)

According to Sarita et al. (2018), their green IT governance model was developed based on their exploratory and confirmatory factor analysis. Four main aspects that the model depicts is IT Governance Mechanisms, IT Decision Accountabilities, IT

Governance Influencers and Green IT Mechanisms (Figure 2.17). Furthermore, IT Governance Mechanisms depend on structures, processes and relational mechanism. Meanwhile, IT Decision Accountabilities depend on decision types and accountabilities. IT Governance Influencers are further divided to Green IT drivers, IT Governance Drivers and incentives and support. And finally, the Green IT Mechanisms is influenced by attitude, policy, practice and the technology.

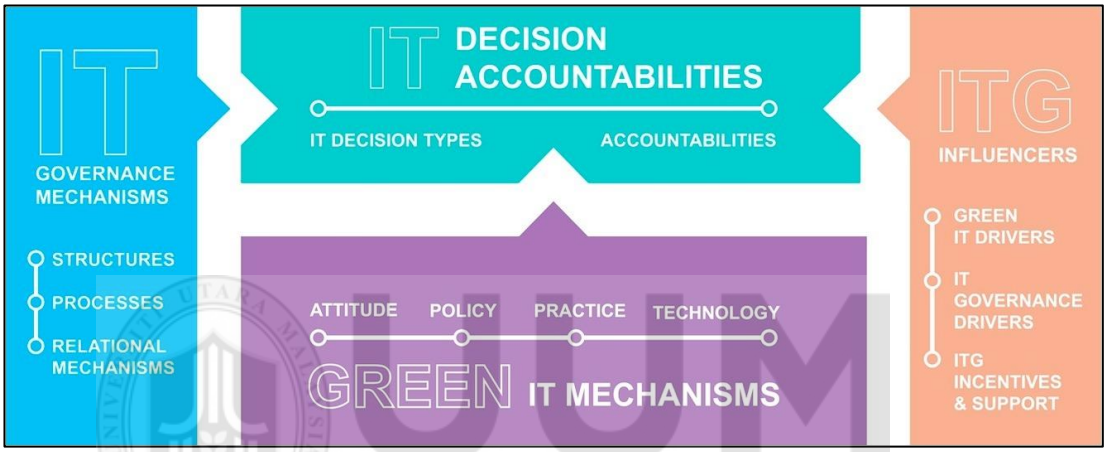

Figure 2.17: Green IT Governance Model

Source: Sarita et al (2018)

Conclusively, analysing the various models have shown that the Government policy and regulations, knowledge about the technology, skills and the attitude of the players in the ICT field are the essential components in studying awareness of GICT.

2.10 Theoretical Framework

According to Dickson Adom et al. (2019), the theoretical framework is one of the mandatory ingredients in a study since it stimulates the research and gives a guide for the researcher. Grant and Osanloo (2014) stated that "the theoretical framework is

the foundation upon which a research is constructed." They also stressed "the theoretical framework consists of theoretical principles, constructs, concepts, and tenants of a theory." Figure 2.18 shows the theoretical framework of this study. The independent variable of this study is the knowledge on ICT usage meanwhile the dependent variable is the awareness of GICT practices among teachers. Factors such as attitude, skill and aspiration of the teachers in handling the ICT are the mediating variables that determines the level of awareness among teachers in GICT practices.

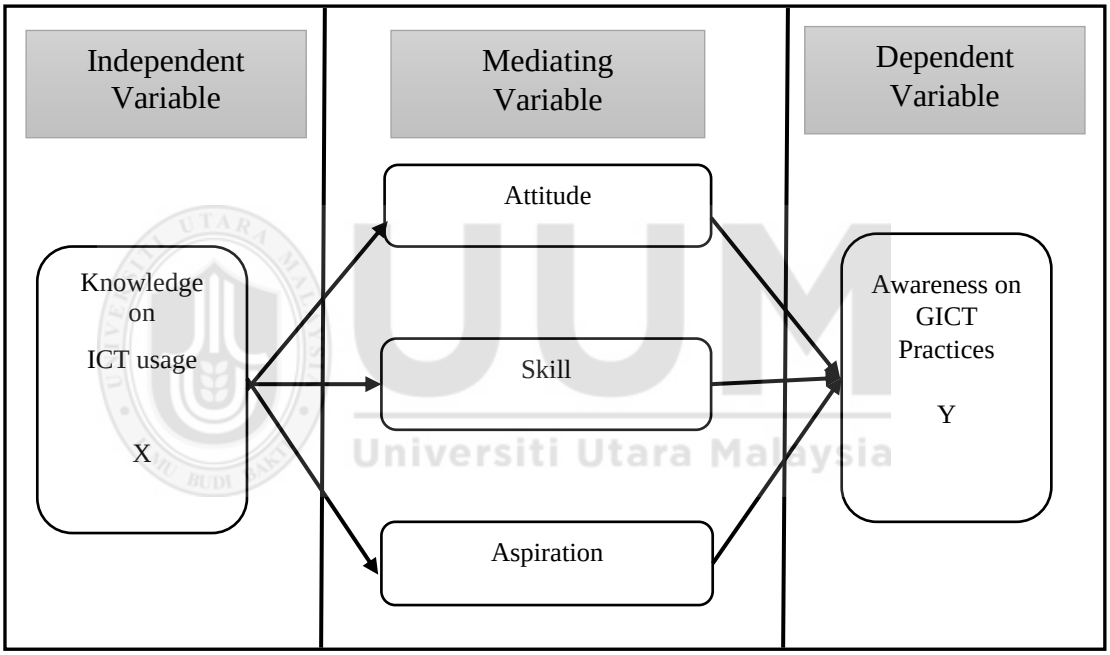

Figure 2.18: ***Theoretical Framework***

Source: Authors Construct, 2020

2.11 Summary of the Chapter

Whilst Malaysia is moving forward to excel in the digital world, the impact of ICT to the environment overall should not be overlooked. There are still some significant barriers to adopting GICT in many organisations that prevents widespread of GICT awareness. Carbon footprints are becoming a serious problem to nations globally and

new measures have to be employed in handling this effect on the environment. Awareness of GICT practices by teachers can as well bring about cascading changes among students and the public in general. Since not much is known on the ground of GICT practices among teachers, this is a viable study. This study could shed some light to the administrators to address the environmental problems in future. In particular, government have to look upon alternate energy production methods to combat the need of energy due to the depletion of natural resources and the enormous increase of ICT devices usage in the country. The next chapter will be discussing on Malaysia's GICT initiatives which includes the ICT move in all Malaysia's Five-year Plans and Green Technology Policy.

CHAPTER THREE

MALAYSIA'S GICT INITIATIVES

3.1 Introduction

Malaysia has evolved tremendously in the electronic field over the last decade. The Malaysian economy has diverted from source-based economy to knowledge-based economy since 1990 with the Sixth Malaysia Plan (1990-1995). One of the many initiatives taken was to form Multimedia Super Corridor (MSC). The idea was to achieve vision 2020 where the nation has knowledgeable workforce to face the dynamic changes and challenges across the globe. To garner this idea the Knowledge Base Economy plan was initiated to manoeuvre the human capital in the direction of research and development and information and communication technology (ICT).

3.2 Malaysia's ICT initiatives

The climacteric event for the ICT industry in Malaysia started in1997 with the inauguration of Multimedia Super Corridor (MSC) which became the national agenda in manoeuvring the country towards a digitally competent nation and become a knowledge-based economy country.

Figure 3.1 shows the chronology of events in the ICT development in Malaysia. Knowledge-based economy is defined as an economy driven by knowledge, creativity and innovation to generate and sustain economic growth.

In the Ninth Malaysia Plan, (2006-2010), intensified efforts were taken to map Malaysia in the global digital mainstream. More investments were made to further upgrade the ICT related infrastructures.

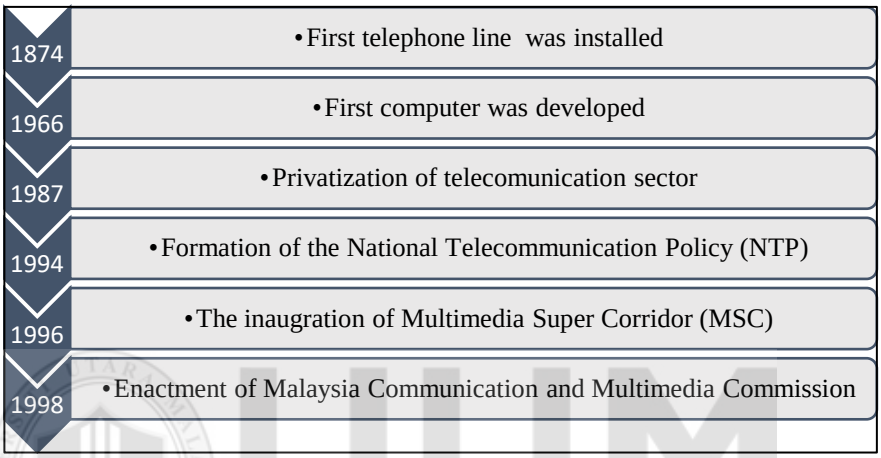

Figure 3.1: *Chronology of ICT development in Malaysia*

Source: Kotelnikov,2007

A considerable number of rural schools and libraries had fixed internet lines and many companies were given MSC (Multimedia Super Corridor) status. Efforts were taken to narrow the digital divide between the urban and rural areas. Among the efforts taken to intensify the ICT usage and narrowing the digital divide is shown in the Table 3.1. In the Tenth Malaysia Plan, (2011-2015), further ICT initiatives were implemented to boost the nation's economy by means of digitalization. Careful and diligent planning was done to upgrade the earlier ICT initiatives. More allocations and effort were taken to promote ICT in the administration of the country among all walks of life in Malaysia. Meanwhile in the Eleventh Malaysia Plan, the government

was focusing on wealth generation by propelling ICT into the knowledge base economy. This was done through innovation and productivity.

Table 3.1: ***Malaysia's ICT Initiatives since 1990***

Malaysia Plan	Year	ICT Initiatives
6th Malaysia Plan	1990-1995	"ICT was emphasized as an enabler in manufacturing sector and formation of National Information technology Council to ensure that ICT is well integrated in the socio-economic fabric of the country"
7th Malaysia Plan	1996-2000	"The National Information Technology Agenda was formulated followed by Multimedia Super corridor (MSC) and prominence was given to E-initiatives such as E-Economy, E-Public Services, E-Community, E-Learning and E-Sovereignty"
8th Malaysia Plan	2001-2005	"National Broadband Plan was formalized and MSC was given further priority to introduce Electronic Government, National Multipurpose Card, Smart School, Telehealth, E-business, R & D Clusters and Technopreneur Development"
9th Malaysia Plan	2006-2010	"217telecentres was established, specific programmes were initiated to equip people to use ICT services,31,000 ICT graduates were produced by MSC-status higher learning institutions', RM 176 million was disbursed for ICT-related training, Intensification of One house One PC initiative, further strengthening of the Smart School Applications and Computerizing programmes by relevant ministries and agencies, a total of RM12.9 billion allocated for ICT-related programmes and projects"
10th Malaysia Plan	2011-2015	"ICT Roadmap Strategic Plan Digital Malaysia Initiatives which include producing selected ICT products and services ICT Satellite Account to measure the development in services, trade, manufacturing, e-commerce and content and media subsectors High Speed Broadband (HSBB) and Broadband for the People (BBGP) As of 2014, 70.2% of the house hold had broadband penetration in Federal Territory, Malacca, Perak,Selangor, Pahang and Johor meanwhile 67 % in Bintulu, Kuching Miri, KotaKinabalu and Menggatal 1.63 million ports were installed to serve 2.4 million premises Submarine cables and systems were upgraded"

11th Malaysia Plan	2016-2020	"1 Gov* Net- a network which is a centrally managed network which provides connectivity to 94 % of Federal Government Buildings 1 Bestari Net Programme to enhance teaching and learning by ICT which linked 10,132 schools nation-wide with Fibers (9 schools), WiMAX (6628 schools), Asymmetric Digital Subscriber Line (ADSL)(1086 schools), Very Small Aperture Terminal (VSAT)(2129 schools and wireless in 280 schools Free-to-Air Digital Terrestrial Television to provide digital television and radio services 1122 telecentres were established as of April 2015 to provide access in rural and suburban areas. The Universal Service Provision Framework under the Communications and Multimedia Act 1998, was amended Kampung Tanpa Wayar Programme whereby 5737 villages were connected And 971 cellular towers were enacted and 1,000,000 netbooks distributed"

Source: MOSTI, 2007

According to the Malaysian Economic Planning Unit, the ICT industry will focus on the services, including potential solutions to generate wealth and increase the involvement of domestic companies. The growth of the ICT industry will increase demand for digital infrastructure that is the cornerstone of the country's competitiveness. Additionally, accessibility and subscription capability are critical to boosting economic growth and constrict the social and economic gap in the rural areas of the less fortunate. Innovation, creativity and productivity will continue to be driven by the skilled workforce that is core to a knowledge-based economy. Preparation of specialized skilled labours is essential to support growth in other sectors of the economy, including research and development for the ICT industry. This move will ascertain that the country benefits from the ICT industry and able to share the global ICT development.

Survey by the Malaysian Communications and Multimedia Commission (MCMC) in 2017 shows that the numbers of internet users in Malaysia have drastically increased. While Internet can be only accessed with ICT tools, therefore these comes to show that the numbers of ICT users have escalated over the years. Figure 2.3 shows the percentage of internet users by state with comparison to the percentage of population in 2016.

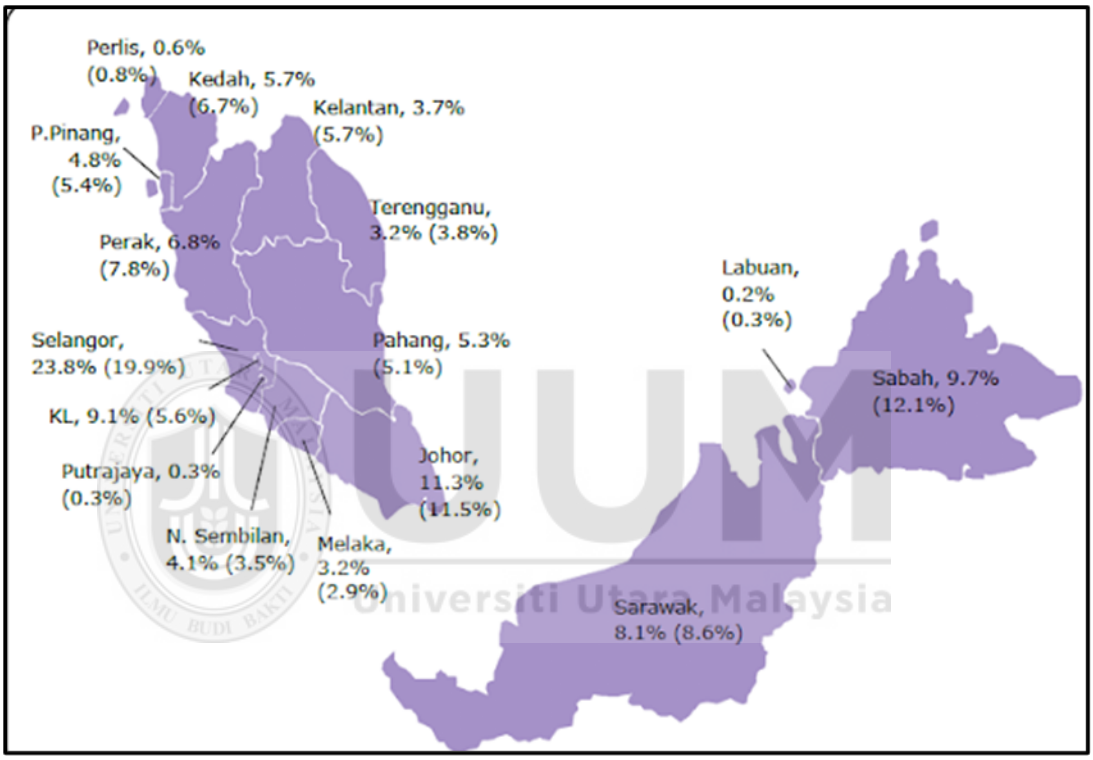

Figure 3.2: ***Percentages of Internet users in Malaysia with comparison to national population in parentheses***
Source: MCMC Internet Users Survey, 2017.

With careful planning and monitoring, the nation has managed to ensure widespread of ICT infusion and acculturation within and across sectors. ICT education and training have been increased as well with the expansion of the ICT infrastructure. Laws and Regulations have been reviewed to promote digital development among the society. Moreover, the research and development in the IT sector have been

generating more output for a continuous learning environment and driving knowledge economy. The following Table 3.2 shows Malaysia's ICT regulations and legislation that has been passed in Parliament to provide support to the MSC.

Table 3.2: Malaysia's ICT Regulations and Legislation

Act	Function
Digital Signature Act 1997	Governs electronic signatures
Computer Crimes Act 1997	Outlaws the fraudulent use of computers and unauthorized access to and modification of the contents in computers
Electronic Government Act 1997	Regulates communication within the public sector and enhances communication between the private and public sector
Multimedia Convergence Act 1997	Streamlines communication, information and broadcasting services
Telemedicine Act 1997	Allows the promotion of medical services
Communication and Multimedia Act 1998	Facilitates the orderly development of the multimedia industries
Intellectual Property Protection Act 1998	Protects copyright laws

Source: Sharazad Haris et al (2019)

These Acts came into motion with the inauguration of Multimedia Super Corridor (MSC) in 1997 to facilitate the nations vision on becoming digitally advance and to be at par with the bigger nations of the world.

Conclusively, the government has taken great efforts to map Malaysia digitally but little is known on GICT practices in Malaysia (Murugesan, 2008).

3.3 Malaysia's Green Technology Policy

Malaysia has long undergone policy reforms towards sustainable development. The planning started as early as 1970s with the introduction of regulations to manage pollution from palm oil industry. After Gartner (2008) reported about the

contribution of ICT to the carbon footprint, nations worldwide are taking great measures in combating environmental issues by investing on technologies which could help to reduce carbon footprint. Various policies and treaties are being initiated and implemented to secure sustainability of the environment. Under the leadership of the then Prime Minister Najib Razak, Malaysia has also taken measures seriously to improving environmental performances, tackling global warming and enhancing resource management. One of the measures is to enact the Malaysia's Green Technology Policy.

The National Green Technology Policy was launched in July 2009 as a driver to accelerate the national economy and promote sustainable development. According to the Ministry of Energy, Green Technology and Water, Green technology is defined as the development of application of products, equipment, and systems used in order to minimise and reduce the negative impact of human activities to conserve the natural environment and resources. There are four areas or denoted as pillars that was taken into consideration in fabricating the National Green Technology Policy, which are energy, environment, economy and social (Fig 3.3). The potentials of administrating the green technology policy to the country are:

i. to reduce environmental degradation caused by technology indulgence in all human activities
ii. minimising the greenhouse gas emission
iii. ensuring that the technology is not harmful to the natural ecosystem by preserving a healthy environment for all life forms
iv. the energy and natural resources are well conserved

v. to encourage moves to use renewable energy and resources.

For measuring the success of the Green Technology Policy and its initiatives, National Key Indicators are the criteria that was set. It provides feedback on mechanisms and opportunities to improve or reinforce efforts, if necessary. National Key Indicators are refined into quantitative and qualitative performance indicators (KPI) for each Malaysian Plan and designs the annual strategic planning for various ministries and government agencies. For example, in the aspect of environment, the country's mission is detecting the GHG emissions in the early stages and work on the reduction in order to improve the air and water quality in the near future. On the other end, in term of economy, green technology industry contributes percentages and values which is significant to the country's GDP.

The Malaysian National Green Technology Policy objectives were well outlined to envelope the economic, environmental and social aspects of the country. Hence the following objectives have been defined in manoeuvring the country's green agenda:

I. To streamline the growth of the Technology Green industry and increase Green Technology contribution towards the national economy ;
II. To assist growth in the Green Technology industry and increase its contribution to the country's economy ;
III. To increase the capacity in the development of Green Technology innovation and increasing competitiveness of Green Technology in international markets ;
IV. To ensure sustainable development and conservation environment for future generations ; and

V. To improve education and awareness public on Green Technology and encouraging the widespread use of Green Technology.

A large amount of money is destined to be invested in the green technology industry through foreign direct investment (FDIs) and domestic direct investments (DDIs) to further increase the total revenue or returns in the country. The Green Technology industry is also capable of creating a vast number of jobs in the manufacturing and services sectors as well as SMEs / SMIs. Meanwhile in the social context, when more cities, townships and communities' practices green technology, it can be classified as Green Township. Moreover, when people in general start practicing green technology ways in their lives, it becomes a culture and such culture is essential in improving the quality of life.

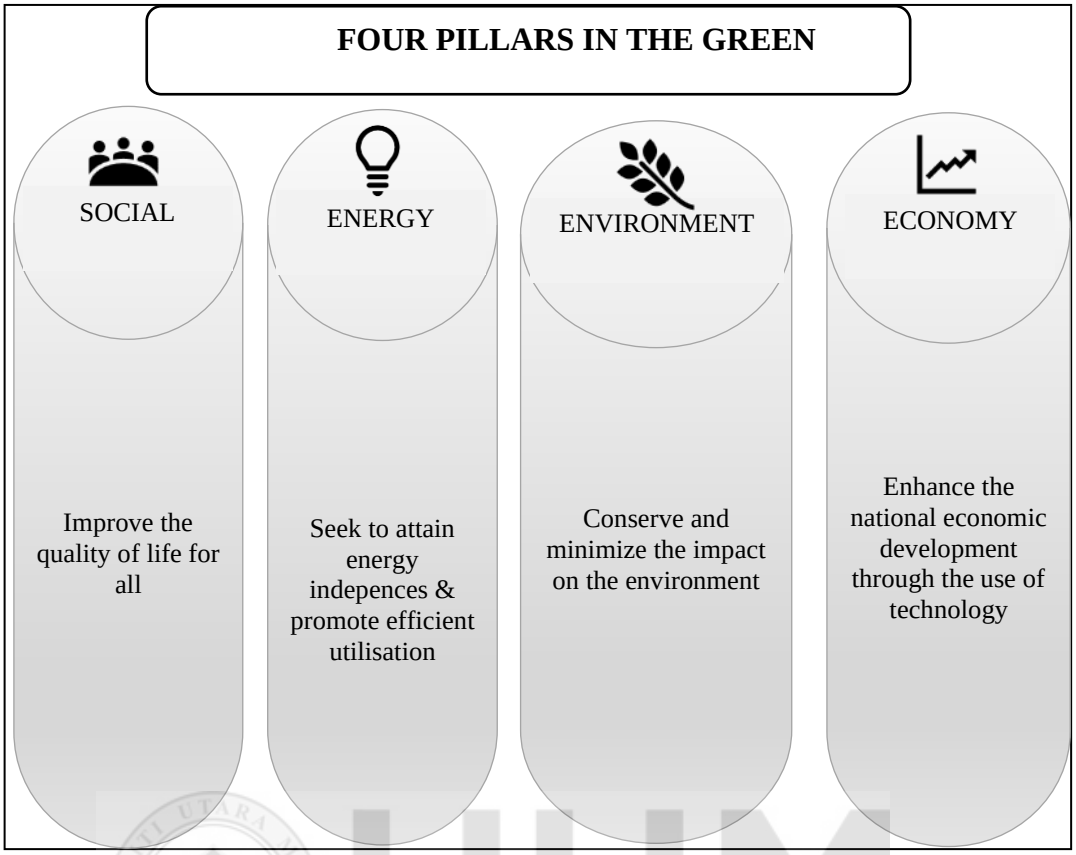

Figure 3.3: ***The Four Pillars in the Green Technology Policy***
Source: Adapted from Green Technology Policy, 2009

Another initiative that was taken in pursuing green growth is the Green Technology Master Plan, (2017-2030) (Fig 3.4) which was prepared by the Ministry of Energy, Green Technology and water (KeTTHA) in 2017 but special focus was given to the energy sector from the four pillars of green technology policy.

One of the five thrusts in the master plan is collaborating with primary and secondary institutions to promote and create awareness about green technology. This indicates that creating awareness is vital in increasing the knowledge on green technology because in the longer run there will be workers in the workforce that will be compliant to adopt green practices in their working environment. In fact, Azmi et al.

(2017) also stressed that creating awareness of green technology is vital to increase knowledge of the employees especially in the industrial sector to reduce the negative impact on the environment.

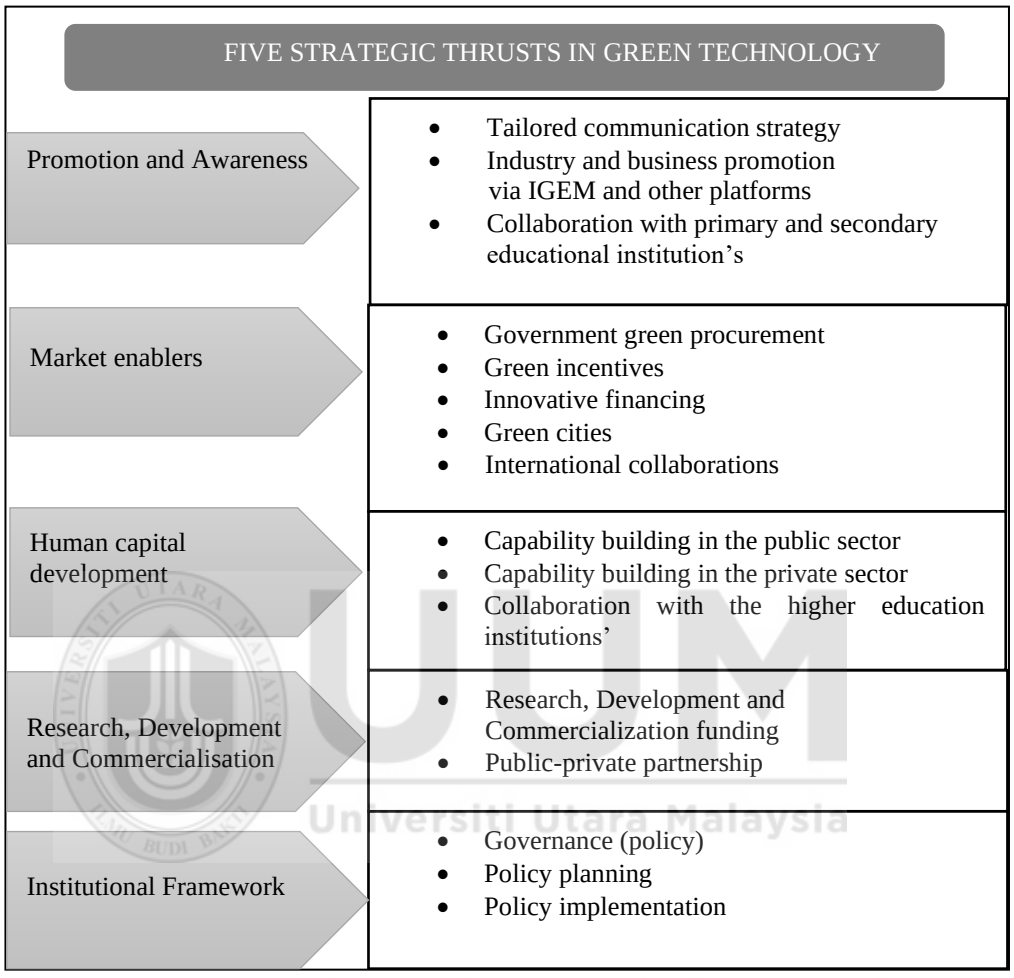

Figure 3.4: ***Five Strategic Thrusts in the Green Technology Master Plan 2017-2030***.

Source: Adapted from Green Technology Master Plan 2017-2030

The Ministry's aims via this master plan are generally to reduce the burden of ICT and improve efficiency through the use of ICT. Using the ICT equipment's wisely can reduce the energy used by data centres and network and email consolidations. Moreover, other actions that need to be taken are to remove active screen savers, switching monitor to standby after 5 minutes of inactivity, shutting down PCs after

office hours, re-using of equipment, procurement of low power consumption CPUs and application of thin client technology. All this has been addressed in the planning, implementation and monitoring framework which is shown in the next section.

3.4 Malaysia's GICT Planning, Implementation and Monitoring Framework

Though Malaysia has put her best foot forward in addressing GICT, a lot of effort is still required in greening the ICT infrastructures and governing the implementation. In this context, the ICT section in the Malaysian Administrative Modernisation and Management Planning Unit (MAMPU) under the Prime Ministers Department has provided a framework (Figure 3.5) as a benchmarking tool and roadmap to promote and administer green growth strategies in the ICT sector.

Attitude, policy, practice, technology and metrics are the main aspects that are taken into account when addressing the planning, implementation and monitoring of GICT. To be specific, the framework highlights the importance of end user IT efficiencies, enterprise IT efficiencies, lifecycle and procurement and IT as a low carbon enabler.

Under the end user IT efficiencies, the framework stresses on being efficient in using the desktop, mobile devices and printers and consumables. Meanwhile, the enterprise IT efficiencies take into account the data centre IT equipment, data centre power and its contribution to the environment, communication between devices, the distributed and outsourced IT systems. Lifecycle and procurement on the other end must advocate and monitor GICT in the procurement, operations and disposals. And

finally in IT as a low carbon enabler, compliances and governance, teleworking, business process, chain supply management and industries specific efficiencies are mooted for GICT practices.

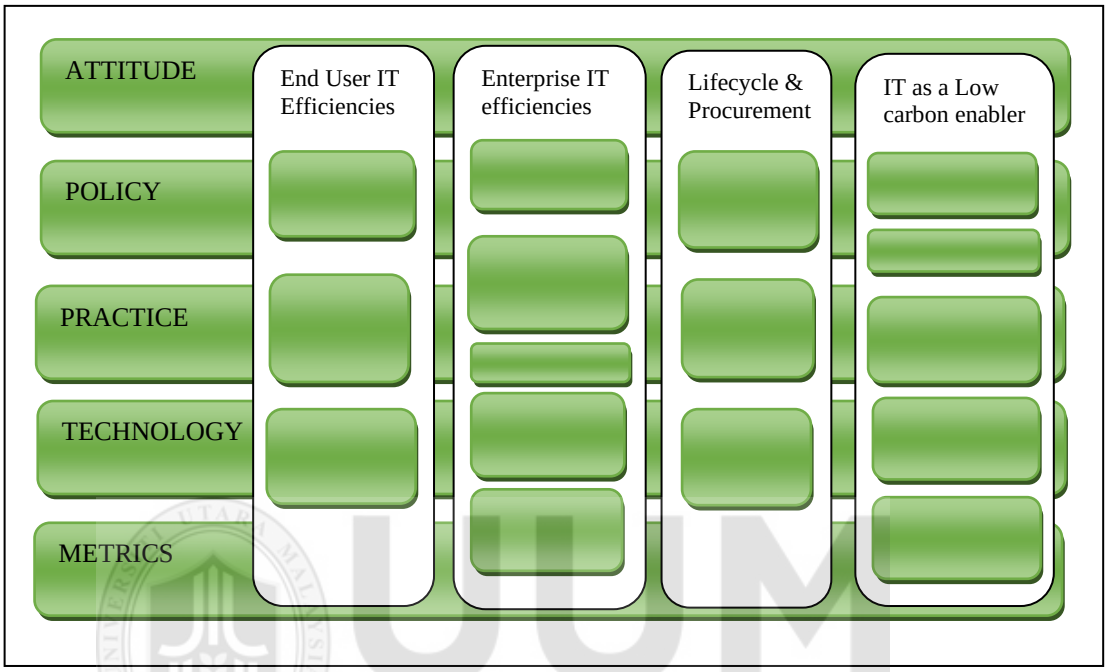

Figure 3.5*: Malaysia's GICT Planning, Implementation and Monitoring Framework*

Source: MAMPU, 2010

In spite of all the efforts in fabricating an exclusive Malaysian policy on green technology and establishing a framework, the extent of implementation and monitoring of this plans is not well documented especially in the government sector. According to Abualkishik et al. (2014) implementation of GICT is found more in foreign-owned companies (45.5%) and only 23.6% among local-owned companies. Meanwhile 26.5% of joint-venture companies are implementing GICT practices. Moreover, they stressed that GICT practices needs more promoting at the local scale.

3.5 GICT in Malaysia's Private Sector

The Ministry of Natural Resources and Environment in 2010 stated that Malaysia has been named as one of the leading countries in practicing sustainable development as early as in the Third Malaysia Plan (1976-1980). Sustainable environmental practices were encouraged among the industries and companies and programmes were organized to raise the level of awareness among its players and also the public.

Study by Ibraheem et al. (2014) stated that there was no concrete evidence about the level of green computing adaptation among the Malaysian organizations. Meanwhile Samuri (2014) also expressed that GICT among Malaysian Industries are at an alarming state.

Ibraheem et al. (2014) studied about the current green practices approach in the Malaysia IT industries such telecommuting, algorithmic efficiency, power management, voice over internet protocol, virtualization and material recycling and was found to be average. The table below shows the means of approaches for their study.

Table 3.3: *Average means of GICT approaches among Malaysia IT industry's*

Green Computing Approaches	**Mean**
Telecommuting	1.626
Algorithmic Efficiency	1.735
Power Management	2.136
Voice over Internet Protocol (VOIP)	1.649
Virtualization	2.105
Materials Recycling	2.719

Source: Ibraheem et al. (2014)

Moreover, their findings showed that the major adopted approaches in Malaysia on GICT is telecommuting, algorithmic efficiency and voice over internet protocol (VOIP). This is shown in Figure 3.6 below.

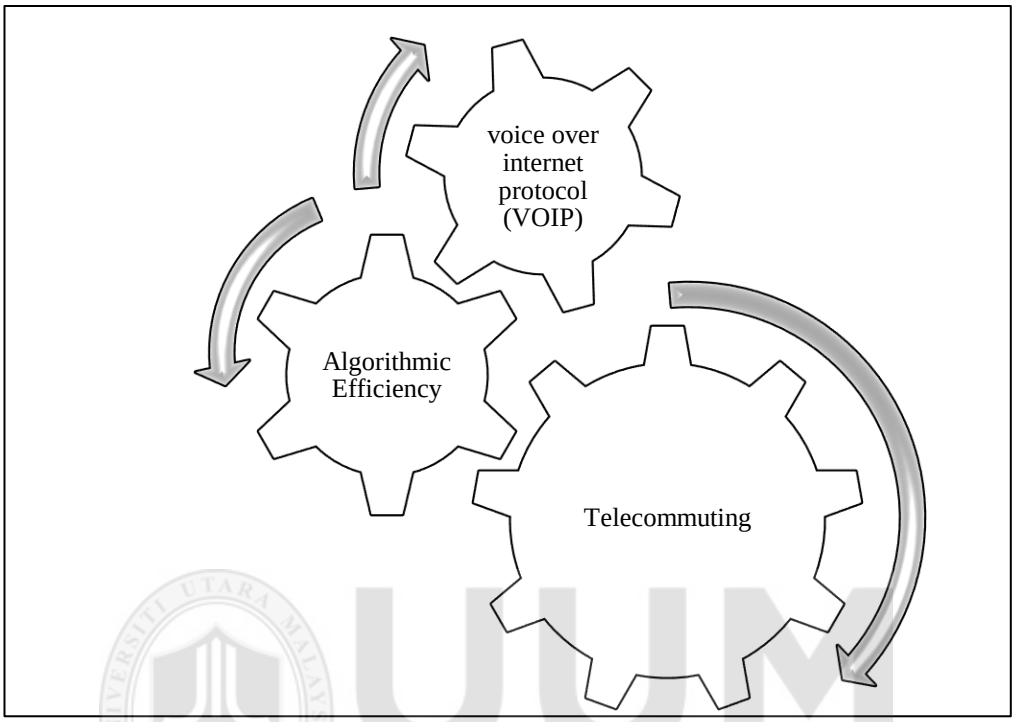

Figure 3.6: ***The major adopted approaches of GICT in Malaysia***

Source: Adapted from Ibraheem et al. (2014)

Ibraheem et al. (2014) also proposed that GICT needs more promoting at the local scale because their findings showed that the GICT approaches are mainly taken by foreign held companies compared to locally owned companies.

Other GICT initiatives taken in Malaysia are as follows

a) e- Revenue

b) e- Procurement

c) MyEG

d) SME e-Commerce project- Mdex.my

e) Online banking

f) Green@Basis Bay data Centre (Green data Centre)

g) DiGi Deep Green

h) ASTRO's Environmental Strategy Plan

i) Green Directory

j) BCIS- Online building consumption input system (reporting system energy efficiency)

3.6 GICT in Malaysia's Education Sector

Malaysian government has taken an in-depth initiative in promoting education via online platform to increase the adoption of technology in education among the younger generation. E-learning has become a means of affordable, convenient and quality learning method. Though E-learning has gained many attentions among the education institutions, the mass usage of the electronic teaching and learning method took place was during the pandemic of Covid-19 in 2020.

Experts have forecasted that the growth of e-learning in Malaysia will be 16.4% over the period from 2016 to 2023 and this can be achieved through cloud computing tablets and smart phones. Meanwhile, pertinent usage of tablets, computers and smart phones for e-learning could increase the energy usage at a given time and space. The next move should be introducing GICT in education to combat the negative outcomes of massive usage of ICT usage.

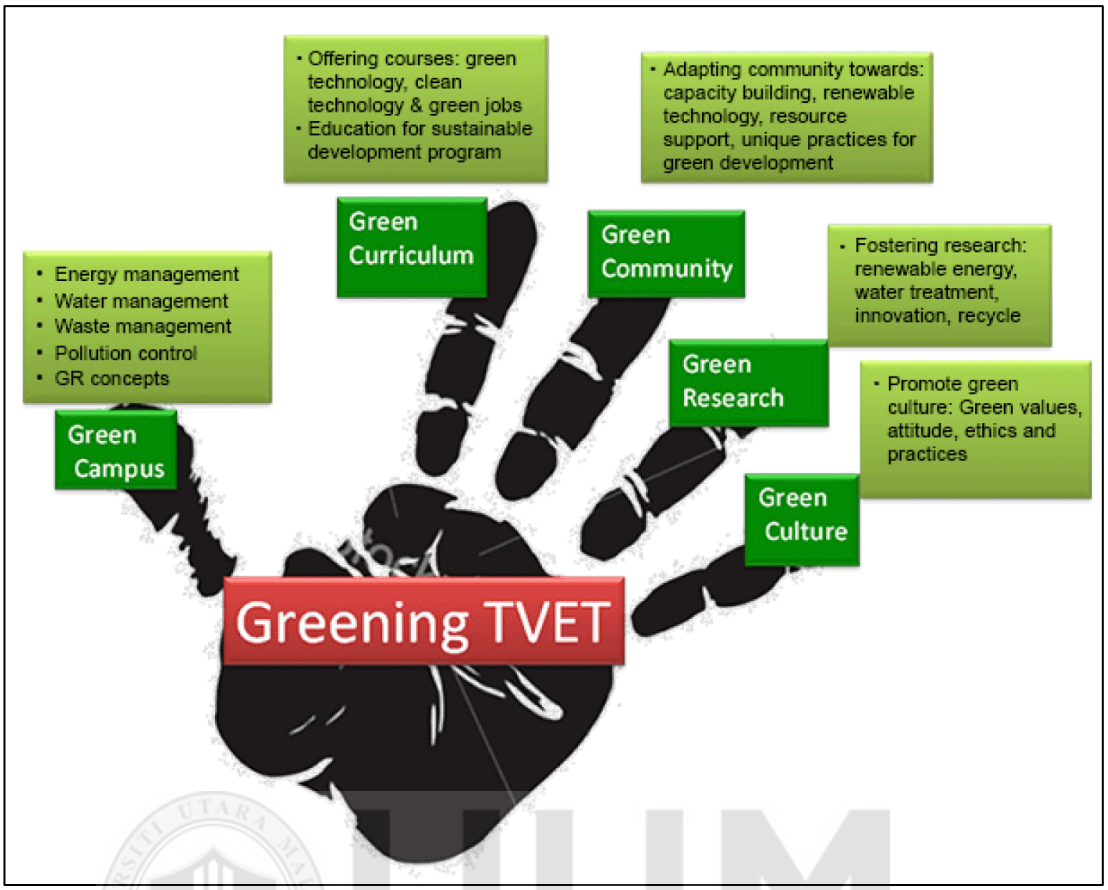

Figure 3.7: ***Malaysia's Greening TVET Framework***

Source: Mohlis Jaafar et al. (2014)

It was indicated in the Third Strategic Thrust of the National Green Technology Plan, that the government needs to intensify the human capital development in green technology by increasing training and education programmes. The task of planning a proper syllabus and courses related to green technology development for local and private institutions lies in the hand of the Ministry of Education. The move was to increase more courses on green technology development to fulfil the market need in Malaysia (Mukhlis,2014). In line with the interest and proclamation of the government, greening the Technical and Vocational Education and Training (TVET) initiatives were taken. This is shown in Figure 3.7

However, the knowledge on GICT has not been seriously advocated in the school's education system. The issue has only been introduced skimpily as e-waste in the science curriculum. In the higher learning institutions, quantitative studies were done in many institutions such as by Abdullahi Bello et al., (2013) and Selyamani.S and Norasnita Ahmad, (2015) among the undergraduates to advocate the importance of GICT.

Conclusively, in spite of all the attention given to integrating ICT in teaching and learning processes in schools, the aspect of cultivating knowledge on sustainably managing ICT or GICT has been left unattended (Rabiatul Adawiah and Mohd Shukri, 2018). Moreover, in the Malaysian context, the lack of collaboration between the initiatives of National ICT Policy and the National Green Technology Policy shows that the Malaysian government has not seriously planned on preparing the younger generation in GICT awareness. Though promoting awareness by collaborating with primary and secondary education system is the first key role in the Five Strategic Thrusts in the Green Technology Master Plan 2017-2030 (Figure 3.4, pg.78), it has not been implemented seriously.

3.7 Summary of the Chapter

Conclusively, developing GICT strategies and agendas need to be addressed by the local parties for a well -spread implementation of GICT practices among the public and the private sector in Malaysia. A well decorated policy without serious commitment to implementation and monitoring will not bring the changes that is

required to combat the forthcoming environmental problems due to unsustainable development which could affect the living being locally and globally.

CHAPTER FOUR

RESEARCH DESIGN

4.1 Introduction

This chapter discusses the design used to obtain the level of awareness on GICT practices among teachers in Malaysia. Awareness on GICT is an important factor in deciding the sustainable development of the country. With the expanding number of ICT users, one cannot simply ignore the negative impact it has on the environment. Development in the digital technology should take into account, preserving the environment for the generations to come.

4.2 Background on study area

The physical and human environment involved in this study is discussed in this section.

4.1.1 Physical Environment

Lying just slightly in the north of the Equator with a total area of 328,550 Km square, Malaysia is comprised of two none contiguous regions namely the Peninsular Malaysia and East Malaysia (Fig 4.1). There are two federal territories and eleven states in the Peninsular Malaysia while East Malaysia consists of one federal territory and two states. (Fig 4.2).

The capital of the country, Kuala Lumpur was the first federal territory which was designated on the 1st February, 1974. Meanwhile Labuan was designated as a federal territory in East Malaysia on the 16th April, 1984. Putrajaya which is the administrative centre was only named much later as a federal territory on the 1st of February, 2001. (Ooi et al. (2020)

With a population of 32,269,670 as of April 2020 (Worldometer, 2020), Malaysia is rich with people of various ethnics, linguistic, cultures and religious diversity due to historic undertakings.

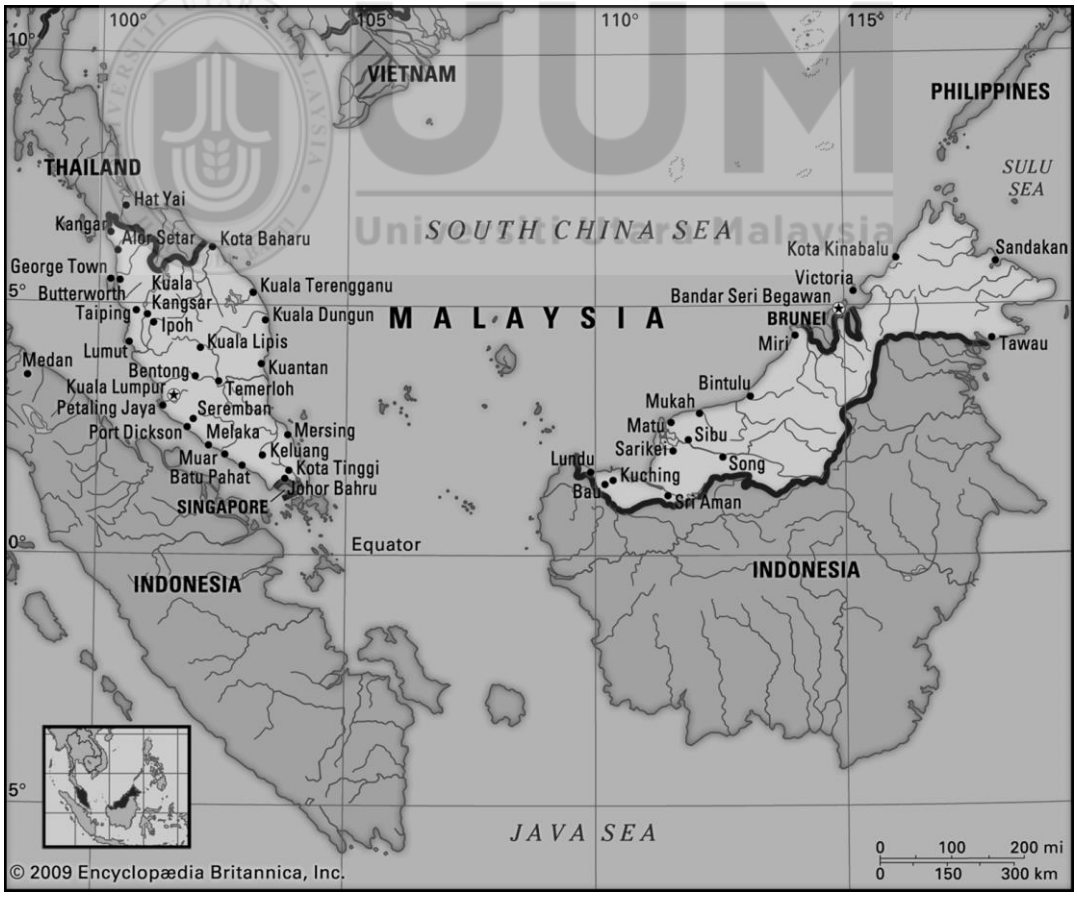

Figure 4.1: ***Location of Malaysia***

Source: Encyclopaedia Britannica, 2009

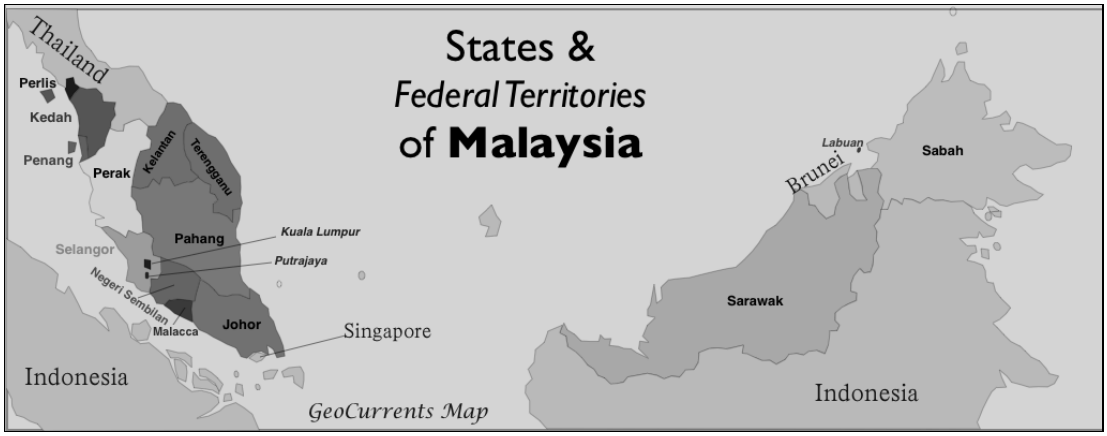

Figure 4.2: ***States and Federal Territories of Malaysia***

Source: Encyclopaedia Britannica, 2020

4.1.2 Human environment

Malaysia is a multi-ethnic country with rich heritage of cultures due to her historic background. Table 4.1 shows the various ethnic groups of multiracial Malaysia which consist of Malays, Chinese, Indians, Indigenous Bumiputera and other groups. To address the diversified people in the country, the government has taken great measures starting in 1970 by restructure and championing various policies to harness a well-balanced social and economic growth in the country.

Table 4.1: ***Ethnic Groups of Malaysia***

Rank	Ethnic Group	Share of Population of Malaysia
I	Malay (or Muslim Malay)	50.1%
II	Chinese Malaysians	22.6%
III	Non-Malay Bumiputera and other Indigenous Groups	11.8%
IV	Indian Malaysians	6.7%
V	Other Groups	8.8%

Source: Sawe, 2019

Though initially rubber and tin were the primary interest in the economic sector, production of palm oil has become the major consideration in exports later. Then with the economic transformation globally the government forecasted that growth in the electronics sector is substantial for the economic growth of the country.

Tremendous evolution in the electronic field took place in Malaysia since 1990 with the formation of the National Information Technology Council. Since then, ICT usage has well infiltrated in all sectors especially in the education sector. Hence, ICT became very prominent in the education syllabus of the country and the usage among teachers as moderators of the digital technology was undeniably prevalent.

According to the Department of Statistics, Malaysia (2019), the total labour force in September 2019 is 7.16 million people and from that number, teachers comprise of 420106 people. Since this study emphasizes the GICT practices among teachers in Malaysia, data on the number of schools and teachers have been obtained for reference and this is shown in Table 4.2 and is discussed further in section 4.4.3.

Table 4.2: ***Statistics of schools, students and teachers in Malaysia.***

Level	Number of Schools	Number of Students	Number of Teachers
Primary	7772	2,727,068	236,797
Secondary	2436	2,007,692	183,309
Total	10,208	4,734,760	420,106

Source: Ministry of Education, Mei 2019.

4.1.3 Reason to choose the study area

Since ICT is viewed as "a major tool for building knowledgeable society" (UNESCO, 2003), the Malaysian Education Ministry has outlined the usage of Information and Communications Technology (ICT) in education as a proper approach in tackling the new era of education in the 21st century. Learning process should be created in a manner that each and every student is enhanced with proper knowledge in facing their future. (Malaysian Education Plan, 2013-2025). Moreover, Albert Sangra and Mercedes (2016) have stressed that ICT has an imperative role in improving the quality of education. This was also stressed by Kavita and Sameer (2013), stating that it is impossible to have an education system which does not integrate ICT.

In 1997, the Multimedia Super Corridor (MSC) has initiated the Smart School Flagship which was overtaken by Smart School Roadmap. Under this initiative, four major waves of development which are the keystone to enhancing a digitally rich education was established. The four major waves and the different stages of development of ICT in schools are shown in Figure 4.3.

According to Wong, Kamariah and Tang (2006), the Smart School project is essential to accentuate a technology driven education system that will fulfil the need to boost ICT literacy among Malaysians. Obviously, the nature and purpose of education has been altered accordingly with the inception of the digital era.

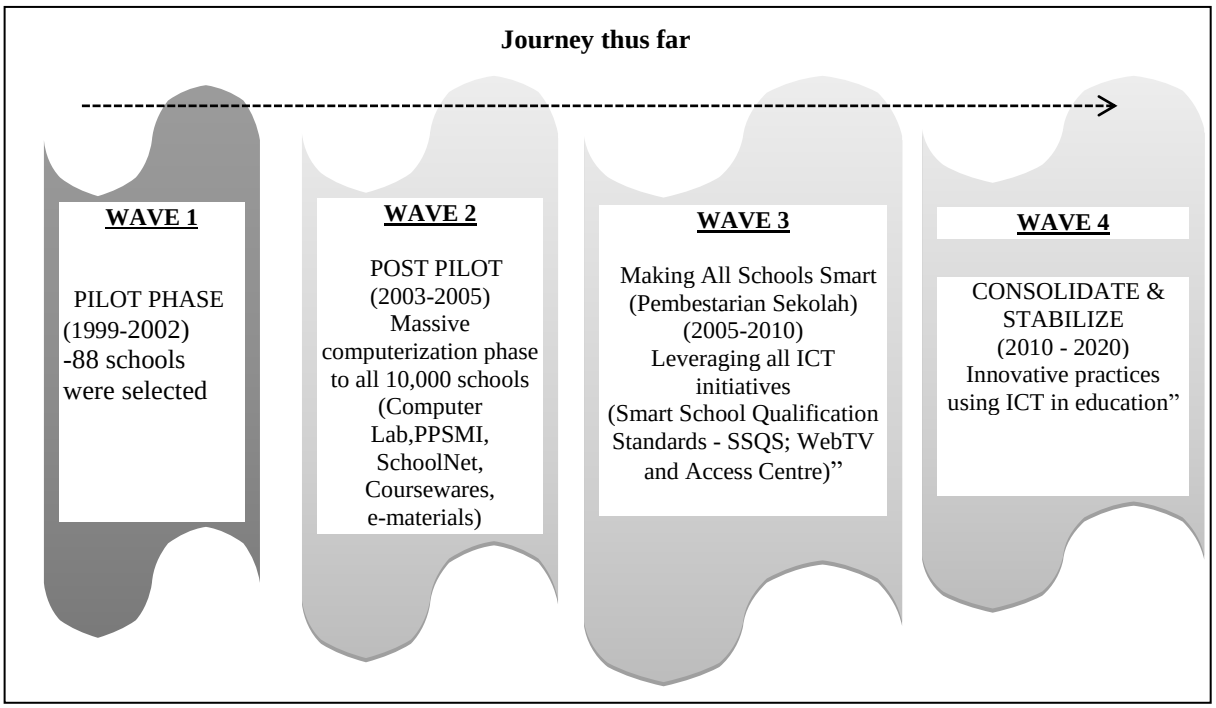

Figure 4.3: ***The Smart Schools Roadmap with key milestones in Wave***

Source: Smart School Roadmap, 2002-2020

The education system has tremendously transformed from capturing and memorizing facts given by teachers to apprehend an unlimited amount of information for an in-depth knowledge on any particular subject. Teachers have a better role to play as facilitators and moderators to ensure the students are able to enhance their knowledge in their fields. This will eventually bring forth students with deeper knowledge to meet the requirements of the demanding workforce to face the progressive economic development.

Study by Chun-Mei Chou et al., (2018), showed that teachers play a substantial role in innovative teaching using the ICT. Significantly, while ICT sector plays an important role in boosting the quality of education and escalating the educational

opportunities for the whole nation, teachers play a vital role in paving the ground for these changes to take place. The role and perspective of a teacher has become crucial in improving the quality of education by means of ICT.

With all the vigorous attempts to map Malaysian education system in the digital era, studies show that teachers in Malaysia may not be adequately prepared to integrate ICT in the teaching and learning process (Luan and Teo, 2009). Moreover, teachers are only able to perform basic computer tasks with some assistance (Juanna et al., 2005). In 2007, Shahril reported, despite being equipped with laptops by the Ministry of Education in 2003, teachers only used the technology for managing student's grades and records. Zaiton (2006) also purported that lack of ICT training was one of the main factors that inhibited teachers to use technology to the fullest potential.

Teachers need to ensure that they possess adequate knowledge in the technology to be able to utilize effectively for instructional purposes. Conclusively, teacher must acquire new competencies to face the proliferation of technology in education (Luan and Teo, 2009). The educators not only will have to possess the right level of knowledge in technology, they must exhibit a positive attitude towards technology.

With researches showing that teachers are still in lack of the knowledge to optimize the ICT tools in the teaching and learning process, what can be said about the knowledge of sustainability in technology? If teachers could impart the knowledge of GICT to students then the application of green concepts will be adhered by ICT users in a wider range. In order for teachers to be the pillars of changes they must

register a decent level of awareness about GICT concept and related to sustainable development. GICT concept is important to materialise with the agenda of sustainable development which is registered in the United Nations Charter. So, it can be concluded that awareness of teachers on GICT practices are essential in achieving the sustainable development. For the desired development to be achieved, it is essential to understand the technology acceptance of teachers beforehand.

Many researches were focused on GICT during 2008-2009 when Malaysia founded the National Green Policy but no comprehensive coverage was done to apprehend the awareness and practices of GICT among teachers in the country. The researches were mainly on solutions and practices for IT in industries and business, meanwhile the importance of examining the end user's practices and compliant behaviour was eminently neglected. With proper exposure and education, Malaysia can play a greater role in reducing carbon dioxide globally.

In this study, the researcher intends to assess the awareness of teachers on GICT practices in the whole of Malaysia. Since this is a quantitative study, an extensive collection of data from teachers from the various states in Malaysia will give a better understanding and clearer correlation between the dependent variable and the intervening variables that is used in determining the level of awareness on GICT. Raman (2017) stated that a widespread data collection will give a more accurate overview of the related matter.

Conclusively, to better assess the awareness on GICT, the study surveyed data from a large number of teachers from all states in Malaysia.

4.3 Research Approach

According to Priya Chetty (2016, pg. 3), "research approach is the researchers plan and the procedure which consist of detail method of data collection, analysis and interpretation". The study stated that research approach is divided into two categories which are:

1. Data collection approach – either qualitative or quantitative or mix method
2. Data analysis approach – either inductive or deductive

According to Trochim (2007, pg.54), "descriptive statistics has the advantage to draw inferences about populations and estimate the parameters." Therefore, quantitative study "requires statistical analysis to test the hypothesis." Abd Rahim Md Nor (2009), Carver and Nash (2005), Given (2008) and Sekaran (2003) have concluded that a quantitative study is a data-oriented approach whereby a sample of populations view is obtained by using survey instruments. Deductive approach is widely used because it sanctions the researcher to reason from generic to specific.

In this study, the researcher is using the quantitative approach which is descriptive in nature to answer the objectives of the research. Though Creswell and Clark (2011) have stressed that one approach alone is not enough to derive answers that arises in the course of researching a topic but study by Babbie Earl (2010), Brians et

al.(2011), McNabb(2008) and Kultar Singh (2007) showed that "a quantitative method is adequate to explore a specific variables contained within the study framework, to seek correlation or relationship between the variables and control the environment in which the data is collected to avoid risk of variables, other than the one being studied." This approach is more appropriate in this study for the colossal users of ICT in the education system in schools are the teachers who outnumbers the clerical workers or administrators.

Moreover, the appropriation of quantitative research on GICT has also been shown in studies by Dookthiram et al., (2012), Batlegang, (2012), Ramachandiran,(2012), Ahmad et al.,(2013), Abdullahi Bello et al.,(2013) and Selyamani.S and Norasnita Ahmad, (2015). In the said studies, survey forms were used to gather data and the samples were students from higher learning institutions.

Quantitative study also accounts for greater objectivity and accuracy of the results obtained whereby a vast source of information can be made comparison. Few variables are carefully chosen for the approach and to ensure validity and reliability of the test. Using a quantitative method will also allow the researcher to establish standard means and analyse by comparing with similar studies. Another great advantage of this method is that "personal bias" can be avoided.

In this study the researcher aims to use survey forms which is done using Google Form to acquire data. By obtaining data from this approach, generalization can be made since a large number of subjects are being used as samples.

4.4 Conceptual Framework and Hypothesis Development

Camp (2001) said that a conceptual framework describes the best way to explain the phenomenon of the variables studied in a research. According to Camp (2001) awareness of GICT practices is generally a minor portion of the whole ICT users. Figure 4.4 below shows the conceptual framework for this study. Each variable of knowledge, attitude, skills and aspiration are interconnected and are the main contributors towards the awareness of teachers towards GICT practices. Generally, the dependent knowledge is affected by factors such as attitude, skill and aspiration while knowledge stands as the independent factor that contributes to the GICT awareness among individuals.

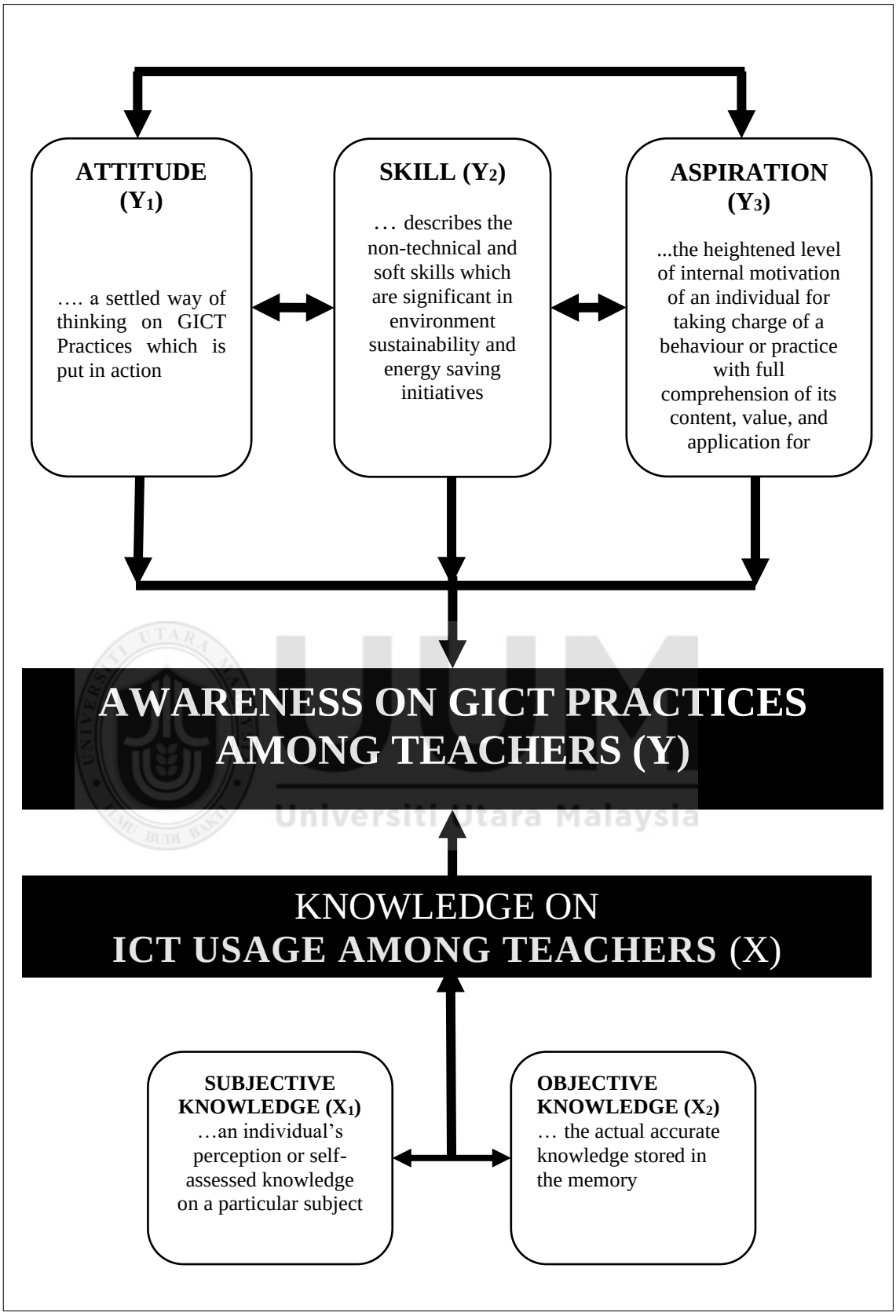

Figure 4.4: ***Conceptual Framework for assessing awareness on GICT***

Source: Authors Construct, 2020

The following are the derivation of hypothesis formed in correlating the variables.

Null hypothesis

H_0 *There is no significant correlation between knowledge on ICT usage and awareness on GICT practices*

General hypothesis

H_1 *There is a significant correlation between knowledge on ICT usage and awareness on GICT practices*

Specific hypothesis

H_2 *There is a significant correlation between subjective knowledge and attitude on GICT practices*

H_3 *There is a significant correlation between subjective knowledge and skills on GICT practices*

H_4 *There is a significant correlation between subjective knowledge and aspiration on GICT practices*

H_5 *There is a significant correlation between objective knowledge and attitude on GICT practices*

H_6 *There is a significant correlation between objective knowledge and skills on GICT practices*

H_7 *There is a significant correlation between objective knowledge and aspiration on GICT practices*

H_8 *There is a significant correlation between attitude and skills on GICT practices*

H_9 *There is a significant correlation between attitude and aspiration on GICT practices*

H_{10} *There is a significant correlation between skills and aspiration on GICT practices*

The operational definition of each variable has been discussed in the chapter 2.

4.5 Research Subjects

Subjects are an essential aspect of a research to decide the objectives are adhered to and the outcome attained accurately answers the research questions.

4.5.1 Sampling

According to Cooper and Schindler, (2001), sample refers to the "targeted group in a represented total population." Sampling means simply selecting a sufficient number of respondents or informants from the targeted population in order to conclude the response of the whole population. This involves "determining the population, sampling frame, sampling method, sample size, and sampling selection" (Sekaran (2000); Zikmund (1999)). Meanwhile according to Neuman.WL (2006), the primary goal is attained by getting a representative sample which means a smaller group of samples a researcher selects from a larger pool of population.

Meanwhile Sekaran (2000) and Churchill and Gilbert (1979) added that a population is the total number of cases which has the designated specifications to the researcher's interest, which could be people or events.

The targeted population in this study construed of all primary and secondary school teachers in Malaysia. The method of selecting the teachers in this study is random sampling whereby teachers are chosen at random from each state. This is a commonly used method of selecting a probability sample and each element in the population of teachers in Malaysia has an equal and independent chance of selection.

4.5.2 Sampling Frame, Sample unit and Sampling Technique

Construction of a sample frame is essential to select the sample in a defined target population. With a well sample frame, the researcher has little to worry about contamination of data and entries of data of the unneeded population. According to Malhotra and Dash (2011) non probability sampling depends upon the researcher's personal judgement than the chance to select the samples.

4.5.3 Sample Size

Neuman W.L (2006) stated that there two ways to determine the sample size. This was quoted from Kraemer and Thiemann (1987) whereby one of the ways of determining the sample size is by assuming the population and use statistical equations in order to gather information through random sampling process. The second method is a rule of thumb which is a conventional or commonly accepted amount. Rules of thumb shows the sample size required for a number of population and was created based on past experience with samples that satisfies the statistical method required.

In this research, the population would mean the total number of teachers in Malaysia. According to the Ministry of Education (May, 2019), the number of teachers in Malaysia stands at 402106 as of May 2019. By following the rule of the thumb, according to Kriejie and Morgan (1970) the appropriate sample size will be 384 teachers. This size of sample has a marginal error of 0.05. But this research is bound to get bigger sample of teachers to fulfil the requirement of pursuing only the quantitative method as supported by Irfan and Amat (2015).

Table 4.3: ***Number of Teachers by State in Malaysia*****.**

State	Number of primary school teachers	Number of secondary school teachers
Sarawak	25552	15657
Sabah	25976	16422
Wilayah Persekutuan	11001	9855
Terengganu	11974	10407
Perlis	2340	2341
Pulau Pinang	10637	9462
Kedah	17372	14187
Perak	21402	17889
Negeri Sembilan	9561	8131
Melaka	7682	6178
Johor	27854	21627
Kelantan	16271	12741
Pahang	14504	11497
Selangor	34671	26915
Total	236797	183309
Total number of teachers	420106	

Source: Ministry of Education, May 2019

Moreover, study by Raman (2017) showed that choosing sample from all the states will give a clearer distinctive data for a study that has population of a whole country. The population in this study will be 420106 which is total number of teachers as of Mei, 2019. Table 4.3 shows the number of teachers in the primary and secondary schools in each state. A number of 5 teachers was chosen randomly from 90 schools both primary and secondary schools from each state to answer the online

questionnaire. This number of samples from each state will add up to 6300 teachers which is a viable number for a quantitative study as reported by Irfan and Amat (2015). According to Kriejie and Morgan (1970), this sample size of 6300 will have a confidence level of 99 percent and a marginal error of 0.05.

4.6 Data Collection

There are two categories of data that is needed in this study namely primary and secondary data. Primary data as explained by Ranjit Kumar (2011) is the first-hand information about the research which is gathered through interview and surveys. Questions are carefully created to obtain answers that fits the research questions. Meanwhile secondary data represents information that are obtained from recorded documents such as reports and government publications, earlier researches, census registry, personal records and certificates, client charter histories and services registers.

Since this study is harbouring on quantitative mode, data is obtained through an online questionnaire. Moreover, a survey is an efficient method as suggested by Sekaran (2000) to obtain data from a large group of samples. Therefore, letters were sent by email to 90 schools in each state randomly requesting the participation of 5 teachers from each school. The letter contains the QR Scan code (Figure 4.5) and URL (Uniform Resource Locator) for the questionnaire (Appendix I) that is required to be answered by the teachers from each state. In this study effort was also taken to obtain information on the planning, implementation and monitoring. A number of 35 emails was sent to the 14-education department and ICT personnel in Malaysia's

Natural Disaster Management Agency under the Prime Ministers Department (NADMA) and Ministry of Energy, Science, Technology, Environment and Climate Change (KeTTHA)which contains the QR Scan code (Figure 4.6) (Appendix XI) to collect qualitative data on administration and monitoring of GICT practices.

Figure. 4.5: ***QR Scan code used to access the teachers questionnaire***
Source: Author's construct

Figure. 4.6: ***QR Scan code used to access the IT personnel's questionnaire***
Source: Author's construct

A number of 1008 teachers from all over Malaysia responded to the emails sent and data was recorded on an excel sheet and later converted to SPSS for further analysis. The statistical and demographical record of the respondents are further discussed in Section 5.1 of Chapter 5.

4.6.1 Research Instrument

Zikmund (1997) and Sekaran (2000) stressed that a survey using questionnaires are an efficient and systematic method to acquire data for the researcher to identify precisely what should be inquired and how to achieve relevant and accurate answer based on the evaluation on the variables of interest. In this study, a questionnaire is being used to obtain data from teachers on their knowledge, attitude, skills and aspiration on GICT practices. Each item in the instrument has been carefully identified with the variables and uses Likert Scale 5 as answers to choose from. Aaker, Kumar and Day (1998) and Dilman (1978) suggested a number of steps and guide in developing items for a questionnaire. The steps are shown in Figure 4.7.

Meanwhile Churchill (1987) added that "it is not possible for a single item to provide perfect representation of the concept."Frazer and Lawley (2000), suggests that "questionnaire preparation should also look into question content development, question wording, response formatting and questionnaire layout." All these ideas have been thoroughly analysed in forming the instrument in this study.

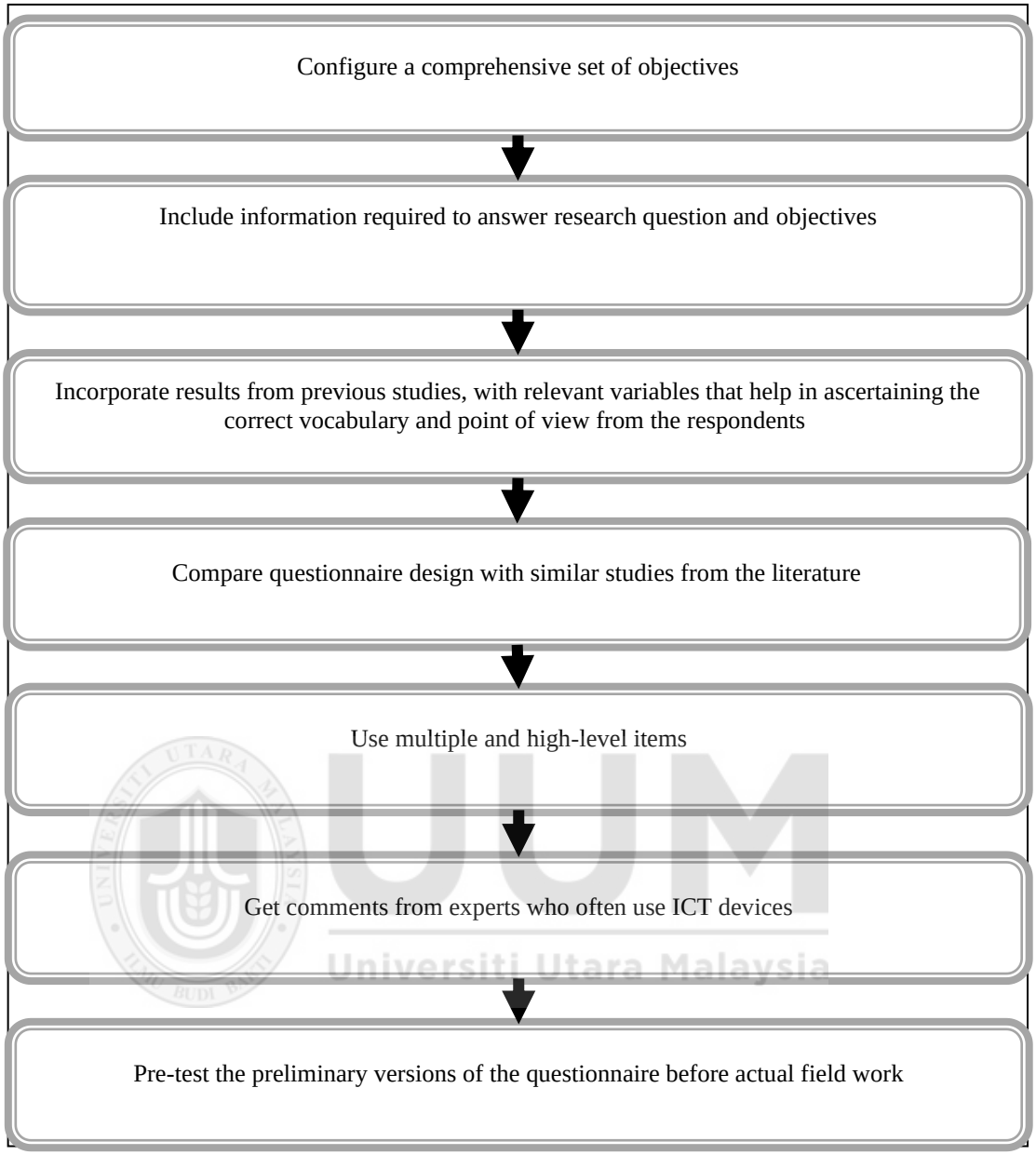

Figure 4.7: ***Steps and guide in developing questionnaire items***

Source: Aaker, Kumar and Day (1998) and Dilman (1978)

4.6.2 Question Content Development

The research questions and objectives were adhered to in deciding the content of the questions. The objective of this study is to "determine the level of GICT awareness among teachers in Malaysia." After an extensive literature review, the variables that

need to be tested in this research were identified. The variables are knowledge, attitude, skills and aspiration on GICT practices. All these variables, are measured by using the questionnaire. Items are based on the knowledge and practices of the respondents only and answering them is not an uphill task. Item development was based on the fundamental of being brief, direct to the point and easily understandable as suggested by Cooper and Schindler (2001), Frazer and Lawley (2000) and Zikmund (1997).

The question contents for this study were acquired by reviewing earlier studies done on adoption of green practices (Abdullahi (2010), Selyamani and Norasnita (2015) and Vijay Kumar (2015) and application of technology acceptance model (Fred Davis (1986) and Luan and Teo (2009).

4.6.3 Question Wording

Cooper and Schindler (2001), Frazer and Lawley (2000) and Zikmund (1997) suggested that the questions must be kept simple and brief as possible. Moreover, its best to avoid ambiguity and leading questions. Standard wording principles were strictly followed during the questionnaire designing process. Nuemann (2006) stated that in constructing a questionnaire, the researcher must adhere to certain principles. Jargon, slang, abbreviation, vagueness, emotional and bias language, double-barrelled and leading questions must be circumvented in creating a professional questionnaire. The researcher therefore, constructed questions that are short, simple, direct to the field of study and covers all aspects of GICT for acquiring a comprehensive data on the awareness of teachers on GICT practices

There are five sections in the questionnaire which have been carefully designed to obtain data for the study as follows:

a). Section A consist of the demographic data

b) Section B on knowledge on GICT

c) Section C on attitude of teachers towards green aspects of ICT

d) Section D on skills in handling ICT equipment the greener way

e) Section E on aspiration of the teachers in GICT practices.

Table 4.4 till Table 4.8 shows the description of constructs and the corresponding items that have been created to acquire the relevant data in order to test the variables and acquire the correlation.

The items of demographic data were acquired while reading other literatures on GICT.

Table 4.4: ***Construct of items for demographic data***

Section	Item Label	Description
A. Demographic	D1	Level of children being taught
	D2	The residing state
	D3	Years of experience as a teacher
	D4	Age of respondent
	D5	Gender of respondent

Source: Authors Construct, 2020

Nominal scales are used for demographic data collection by which the researcher will be able to decide later if any of the demographic data are working as the

confounding variable in the study. For instance, "Does gender make a difference in the respondent's awareness on GICT practices?"

The following Table 4.5 shows two section of knowledge that needs to be identified. According to Abdullahi Bello (2010), Radecki and Jaccard (1995), Brucks (1985), Carlson et al. (2009) and Boccaletti and Moro (2000) the aspect of knowledge pertaining to GICT have been divided to subjective knowledge and objective knowledge due to the relevance and vitality of deciphering an individual's acceptance of the new idea. This have been discussed in section 2.8.2 of Chapter 2.

Table 4.5: ***Construct of items for knowledge in GICT practices***

Section	Item Label	Description- This section is to decipher the knowledge of teachers on GICT
Bi. Subjective Knowledge	SKN1	Green Computing
	SKN2	Malaysian Green Technology Policy
	SKN3	E-waste
	SKN4	Energy Star
	SKN5	e-PEAT
	SKN6	Carbon Footprint
	SKN7	80plus
Bii. Objective Knowledge	OKN1	ICT equipment's are made of dangerous material
	OKN2	ICT equipment's contributes to global warming
	OKN 3	ICT equipment's if disposed in landfill excretes dangerous chemical like mercury and lead
	OKN 4	ICT equipment's that becomes obsolete in a short period of time is the reason for accumulation of e-waste
	OKN 5	ICT equipment's such as computers if left on throughout the day will use more energy and emit CO2 to the environment.
	OKN6	Laptops consumes more energy compared to Desktops
	OKN7	Usage of "Energy Star" equipment's increases energy consumption
	OKN8	"Screen Saver" saves electricity
	OKN9	Laser printers consume less electricity than ink printers

	OKN10	17 inches monitor needs more electricity to function compared to a 14 inches monitor
	OKN11	Sleep Mode uses the same amount of electricity as Screen Savers
	OKN12	To "off" the switch and pull out the plug saves more energy than leaving computers in "sleep mode"
	OKN13	"Cathode Ray Tube" Monitor is more efficient in saving energy
	OKN14	Usage of Laptop, Smartphone and Tablet is more energy saving and reduces carbon dioxide emission compared to desktops

Source: Adapted from Abdullahi Bello (2010), Selyamani and Norasnita (2015), Murugesan (2008), Mallard (2010) and Bokolo and Mazlina (2016)

Table 4.6: ***Construct of items for attitude in GICT practices***

Section	Item Label	Description- This section is about the teachers' attitude towards GICT
C. Attitude **(Adapted from Abdullahi Bello, 2010)**	AT1	Willing to use green aspects of ICT even if it is more expensive
	AT2	Willing to spare time and energy in practicing green aspects of ICT
	AT3	Voluntarily use paper for printing without wastage
	AT4	Willing to forgo comfort in the effort to preserve the environment
	AT5	Practicing green aspects of ICT can help me contribute towards environmental sustainability
	AT6	Practicing green aspects of ICT does not affect my work
	AT7	Practicing green aspects of ICT can increase productivity in school
	AT8	Practicing green aspects of ICT does not take a lot of time
	AT9	Practicing green aspects of ICT in our daily work is easy
	AT10	Practicing green aspects of ICT does not need enormous effort

Table 4.7: ***Construct of items for skills in GICT practices***

Section	Label Item	Description- This section is about the teachers' skills in GICT
D. Skills	SK1	I use ICT equipment's such as computer in my daily teaching and learning process
	SK2	I make sure that the computer switch is turned off and plugged from the socket when not in use
	SK3	I always activate the screen saver when I am not using the computer
	SK4	I make sure that the computer goes into the hibernate/standby mode if inactive within 5 minutes
	SK5	I use a small monitor to avoid electricity wastage
	SK6	I optimize paper usage by printing on both sides or use recycled papers
	SK7	I always go for grey scale printing to avoid colour wastage
	SK8	I only off the computer at the end of the working day
	SK9	I always activate the power management setting on my computer
	SK10	I make sure the Bluetooth and Wi-Fi is off when not in use
	SK11	Brightness of the screen in my computer and phone are always low to save energy

Source: Adapted from Abdullahi Bello (2010), Selyamani and Norasnita (2015), Murugesan (2008), Mallard (2010) and Bokolo and Mazlina (2016).

Table 4.8: ***Construct of items for aspirations in GICT***

Section	Item Label	Description- This section is about the teacher's aspiration towards GICT
E. Aspiration	ASP1	I am aware of the importance of GICT
	ASP2	GICT practices helps reduce electricity usage and lessen CO2 emission
	ASP3	I am concern about the GICT practices in sustaining the environment
	ASP4	Proper usage of ICT equipment's is not a threat to the environment
	ASP5	Government needs to monitor and enforce usage of GICT in order to sustain the environment
	ASP6	Carbon emission could be reduced in ways such as file sharing, online teaching, digital archive management, video conferencing, distance learning, e-government and e-management
	ASP7	Education towards voluntariness in GICT should start at the

		early stage to make way for environmental sustainability
	ASP8	I am still able to perform well at work by practicing green aspects of ICT
	ASP9	I am clear about the green aspects of ICT such as computer
	ASP10	I will apply the green aspects of ICT in future
	ASP11	I plan to apply the green aspects of ICT always

Source: Adapted from Abdullahi Bello, (2010), Mossharrof and Noreha (2015), Jayaratne (2010)

The questions used in this study in Section B till Section E are close-ended so that the context of the question remains the same for all respondents" as supported by Gendall and Hoek (1990). Other than the items for demographic analysis, there are 53 close ended questions testing the respondents according to the variable and one final open-ended question was asked to state the respondents' comment regarding GICT.

All the questions use in this survey have been modified from previous studies on technology adoption and GICT awareness to meet the need of this study. In other words, the wording was carefully designed to give the respondents better understanding on GICT itself and make it easier for them to response. The scale development was based on earlier studies and to facilitate easier analysis. Meanwhile, the questions on the constructs that are being tested such as knowledge, attitude, skills and aspiration uses the ordinal scales.

An open-ended questionnaire was also prepared for IT personnel in each states education department, Malaysia's Natural disaster Management Agency under the Prime Ministers Department (NADMA) and Ministry of Energy, Science,

Technology, Environment and Climate Change (KeTTHA). These questions as shown below in Table 4.9 were adapted from the literature review based on studies by Molla(2008), SaniaKhan et al. (2011), Bokolo and Mazlina (2016) and Sarita et al. (2018)

Table 4.9: ***Construct of items for IT personnel about planning and implementation of GICT***

1.	What are the features that must be present during the procurement of ICT products according to the standards set by the government?
2.	What is the procedure for disposing of ICT Products in the government sector in Malaysia
3.	How long are the ICT items are stored before disposal?
4.	Who is responsible for the disposal of ICT goods?
5.	In your opinion, is the implementation or practice of green ICT strategy at the departmental and school level practiced efficiently? If not why?
6.	Do you play an active role in planning, implementing and coordinating the efforts and implementation measures of Green ICT in the Department?
7.	What are the programs implemented at the departmental level to implement the practice of Green ICT culture among officers in the department and teachers in schools
8.	Is the monitoring of the implementation of green ICT is carried out by the department or ministry? If so, how?
9.	What is your comment on the planning, implementation and monitoring of Green ICT in our country?

Source: Adapted from Molla(2008), SaniaKhan et al. (2011), Bokolo and Mazlina (2016) and Sarita et al. (2018)

4.7 Scale Development and Pilot study

This study uses the five-point rating scale developed by Rensis Likert in 1932. The five-point Likert scale which was selected was based on its high reliability, popularity, and appropriateness to the nature of this study, is as follows:

1. Strongly Disagree
2. Disagree
3. Not Sure
4. Agree
5. Strongly Agree

Though some studies suggested that the response of "not sure" should not be used or perhaps use "not applicable" but Frazer and Lawley (2000) advocated that when respondents answer "not sure", it helps the researcher to determine the state of their knowledge in the particular aspect.

In Section B for subjective knowledge on GICT practices (SK1-SK7), a different five-point rating scale was used based on Abdullahi Bello's study in 2012. The five-point scales are:

1. None
2. Little
3. Moderate
4. Good
5. Very Good

This scale was constructed to evaluate the level of subjective knowledge among respondents since the items are normally are based on terminology and concepts.

A pilot survey was conducted preliminarily among teachers in SMK Seri Mahawangsa, Jitra, Kedah Darulaman to identify the potential problems in order to check the reliability and validity of the questions in the questionnaire.

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4.8 Data Collection Method

The questionnaire was prepared using Google Form to reduce the usage of papers in doing the survey. Upon completion of the pilot study, the link was emailed to 90 schools in 13 states and 1 Federal Territory to be distributed to 5 teachers from each school. The responses from teachers automatically entered an excel sheet that was converted to SPSS for further analysis.

In order for the respondents to access the questionnaire easily, a QR code was also generated and sent together with the link in the emails.

4.9 Statistical Analysis

There are two types of statistical analysis in this study. The first analysis would be to assess the validity and reliability of the items used and secondly to test the relation between the variables. Responses received in the Google Form are converted to Excel worksheet and imported to SPSS. The SPSS software version 25 was used to analyse the data obtained. In addition, the mean score analysis for the variables was

used to determine the level of knowledge, attitude, skills and aspiration among teachers on GICT.

The average mean that was also calculated to identify the level of the respondents and the mean scores were plotted in a radar diagram. The actual targeted result was calculated and plotted together to compare the variation between the response and the targeted result.

Moreover, the Pearson's Correlation was also used to assess the relationships between variables. It gives a sense of strength and direction to the relationship that exists between two variables studied (Hishamuddin Md. Som, 2005; Ahmad Mahdzan Ayob, 2007; de Vaus, 2008).

The value of correlation coefficient (r) which varies from +1 and -1 denotes the strength of relationship between the studied variables. The relationship between the variables will be weaker as the correlation coefficient value decreases towards zero. de Vaus (2008), has shown the interpretation of values correlation coefficients as follows:

i. 0.90+	-	It's almost perfect
ii. 0.70 - 0.89	-	The shape is too high and too strong
iii. 0.50 - 0.69	-	High connection
iv. 0.30 - 0.49	-	Simple relationship
v. 0.10 - 0.29	-	Low to medium range
vi. 0.01 - 0.09	-	The relationship is very small and weak

vii. 0.00 - No relationship

There are two correlation methods commonly used in in a quantitative study to determine the relationship between variables, which are Pearson's linear correlation and Spearman rank correlation. Pearson's linear correlation or Pearson *r* correlation is the most widely used statistics to measure the degree of relationship between linearly related variables. Using this method, the researcher can identify if knowledge, attitude, skills and aspiration of teachers are linearly related in this study. Spearman correlation is another method of finding correlation for non-parametric test which is used to measure the degree of connection between two variables which has an ordinal scale. Spearman correlations are also frequently used in the field of Social Sciences because most of the variables in this field are not scalable intervals (Hishamuddin Md. Som, 2005).

In the context of this study, the researcher used Pearson's Coefficient to determine the correlation between the variables and a T-test was also done to identify the different between the variables according to gender or if gender is a confounding variable.

4.10 Reliability Analysis of the Instrument

Reliability and validity measures are testing how good the measurement of data is and it is expected to give the same response every time an experiment is conducted even at a different circumstance. According to Ranjit Kumar (2011), validity is acquiring data for what the researcher intended to measure. Regardless, Kerlinger

(1973), proposed an inquiry for validation as "Are we really evaluating what we think we want to measure?"

Ranjit Kumar (2011) also stressed that validity is easier to establish if the questions are about tangible matters. Meanwhile, reliability according to Ticehurst and Veal (2000), is getting the same respond of data even when it is done recurrently maybe at a later date or when the subjects are different. By way of explanation, reliability indicates the extent to which the measure is error free or bias and thus offers congruous measurement even when done at a different time frame and across the various items in the instrument. According to Sekaran (2000), reliability measurements help to assess the accordance of measure, and designate the accuracy in the measurement. The items created in this study are related to tangible matters such as knowledge about the GICT. In other words, the questions are valid and reliable as suggested by the relevant studies.

Table 4.10 Result *of Reliability Test on the Instrument*

Reliability Statistics		
Cronbach's Alpha	Cronbach's Alpha Based on Standardized Items	N of Items
0.862	0.889	53

Source: Authors Construct

According to Pavot, Diener, Colvin and Sandvik (1991), the items for this study has good internal consistency, with a Cronbach Alpha coefficient reported of 0.889 (as seen in Table 4.10). Nunnally (1978) recommended a minimum value of 0.7

Cronbach Alpha coefficient should be attained for a reliable scale and internal consistency.

4.11 Summary of the Chapter

Methods used in this study have been thoroughly discussed in this chapter. Items for the questionnaire and interview were created by doing extensive literature review. In general, Chapter Four described the methodology of this study from the beginning up to the findings in assessing the level of awareness on GICT among teachers in Malaysia. This includes a description of the research design, data collection, sampling design, questionnaire design and data processing. This is to get a clearer picture on how to assess the level of awareness on GICT practices among teachers in Malaysia. Chapter Five will further discuss in depth the findings of this research.

CHAPTER FIVE

FINDINGS ON GICT PRACTICES AMONG TEACHERS IN MALAYSIA'S EDUCATION SECTOR

5.1 Introduction

In the past decade, the issue of global warming and climate change has altered many perceptions of societies on the way they handle technology. Initiatives and strategies were taken to reduce the environmental footprint of technology as the idea of GICT emerged as an answer to many environmental issues. In the developed nations, using ICT in the greener ways have been advocated as a moral responsibility. Their education system has been enhanced and modified to create awareness, knowledge, skills and values needed for the people to play crucial part in creating a sustainable future.

In upholding these responsibilities, teachers play a significant role in moulding the students and turning societies towards sustainability. This study was carried out with the intention of putting the idea of going green in ICT among teachers while assessing the level of awareness on GICT among teachers in Malaysia. Since this is a quantitative study, an online questionnaire was prepared and emailed to schools

around Malaysia to gather data. In this chapter, findings from the online survey are analysed by using SPSS and the outcomes are displayed.

5.2 Demography of Respondents

In order to get respondents for this research, emails were sent out to 90 schools comprising of primary and secondary levels from each state in Malaysia. The email was addressed to the Headmaster or Principal of the schools requesting for participation of 5 teachers randomly. A number of 1008 teachers responded from 13 states and 1 Federal Territory and the demography of the teachers are shown in Table 5.1- Table 5.5

Table 5.1: ***Number of respondents by school and gender***

Level being taught	Male	Female	Frequency	Percentage
Primary	142	198	340	33.7
Secondary	160	508	668	66.3
Total	302	702	1008	100.0

Source: Authors Construct after data collection, 2020

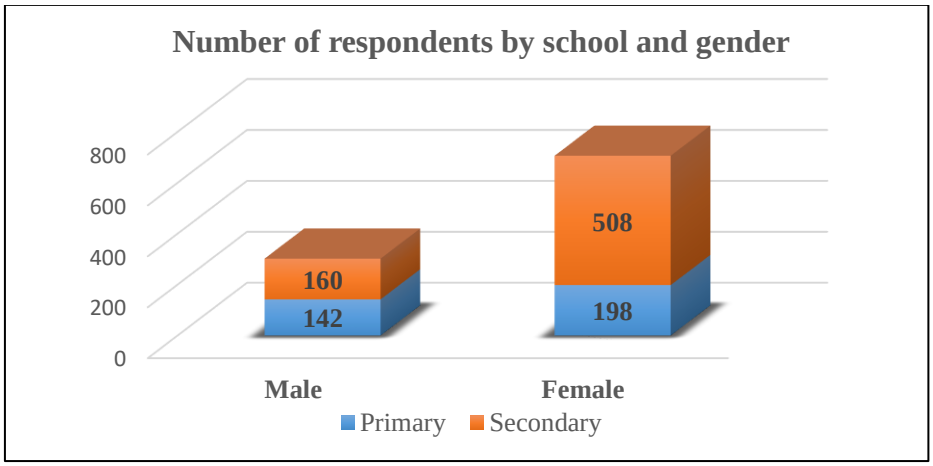

Figure 5.1: ***Number of respondents by school and gender***

Source: Authors Construct after data collection, 2020

From the online questionnaire sent to the 13 states and 1 Federal Territory, 340 teachers from primary schools comprising of 142 male teachers and 198 female teachers responded. Meanwhile respondents who are teaching in secondary schools comprise of 160 male teachers and 508 female teachers.

Majority of teachers who responded to the email are from the states of Kedah (120 teachers or 11.9 %), Penang (108 teachers or 10.7 %), Kuala Lumpur Federal Territory (150 teachers or 14.9%), Terengganu with 150 teachers or 14.9% and Kelantan with 135 teachers or 13.4 % as shown in Table 5.2 and Figure 5.2 meanwhile their years of service as teachers is shown in Table 5.3.

The data indicates that in terms of teaching experience or service, a number of 60 teachers (6.0%) have been in service less than 5 years, 132(13.1%) teachers have been in service between 6- 10 years, 252(25.0%) respondents have been in teaching service in the category of 11-15 years,154(15.3%) in the category of 16-20 years, 220(21.8%) in the category of 20-25 years and finally 190 or 18.8% have been teaching for more than 25 years.

Table 5.2: ***Number of respondents by state***

States	Frequency	Percentage
Perlis	20	2.0
Kedah	120	11.9
Penang	108	10.7
Perak	41	4.1
Selangor	34	3.7
Melaka	81	8.0
Negeri Sembilan	40	4.0
Kuala Lumpur Federal Territory	150	14.9
Johor	43	4.3
Pahang	23	2.3
Terengganu	150	14.9
Kelantan	135	13.4
Sabah	39	3.9
Sarawak	24	2.4
Total	1008	100.00

Source: Authors Construct after data collection, 2020

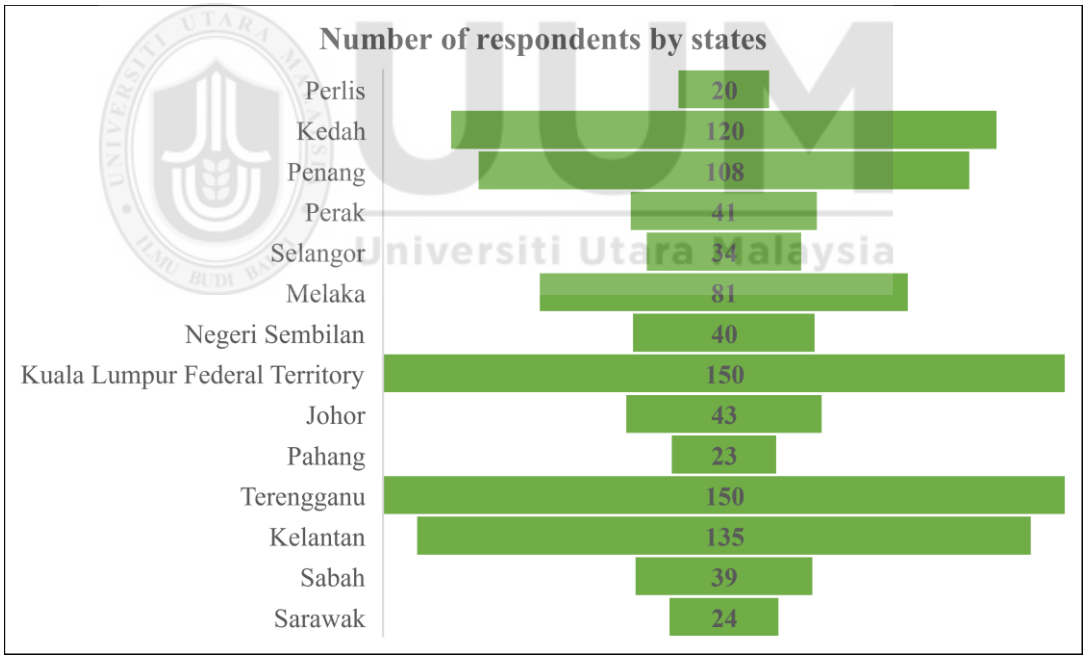

Figure 5.2: ***Number of respondents by states***

Source: Authors Construct after data collection, 2020

Table 5.3: ***Respondent's duration of service in the teaching profession***

Years of service in teaching	Frequency	Percentage
Less than 5 years	60	6.0
6 - 10 years	132	13.1
11 - 15 years	252	25.0
16 – 20 years	154	15.3
20 – 25 years	220	21.8
More than 25 years	190	18.8
Total	1008	100.00

Source: Authors Construct after data collection, 2020

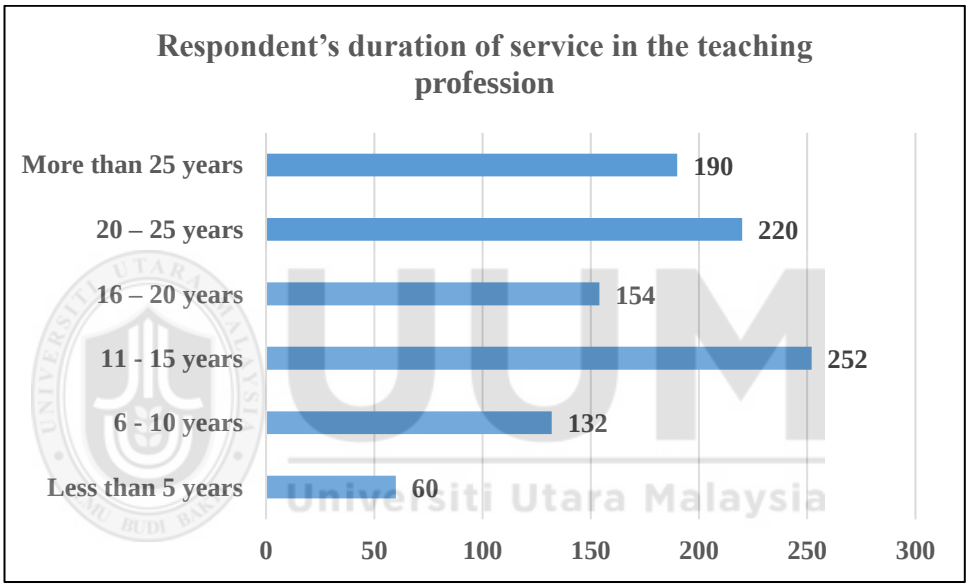

Figure 5.3: ***Respondent's duration of service in the teaching profession***

Source: Authors Construct after data collection, 2020

Table 5.4 exhibits the respondents' age category. A number of 162 teachers are in the age category of 25-34 years old, a majority of respondents are in the 35-44 years category which is 40.5 percent or 408 respondents, 322 (31.9%) of respondents in the 45-54 age category and 116 (11.5%) respondents are 50-60 years old category. Table 5.5 shows the subject the respondents are teaching at school and a number of 276

respondents are teaching languages which stands at 27.4 percent of 1008 respondents.

Table 5.4: ***Respondents age category***

Category of respondents age	Frequency	Percentage
25-34 years old	162	16.1
35-44 years old	408	40.5
45- 54 years old	322	31.9
55-60 years old	116	11.5
Total	1008	100.00

Source: Authors Construct after data collection, 2020

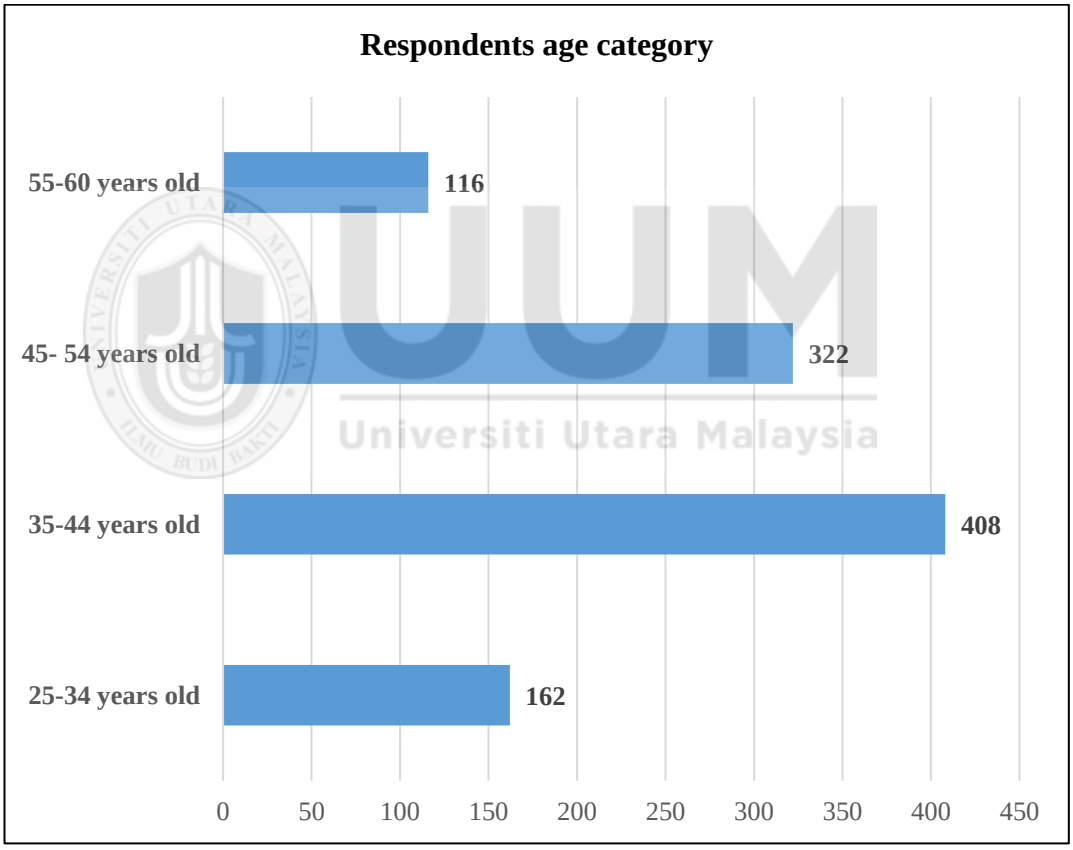

Figure 5.4: ***Respondents age category***

Source: Authors Construct after data collection, 2020

Table 5.5. ***Subjects taught by respondents at school***

Subjects taught at school	Frequency	Percentage
Language	276	27.4
Sciences	172	17.0
Mathematics	136	13.5
Technic and Engineering	54	5.4
Art	14	1.4
Religious studies	78	7.7
Physical and health education	24	2.4
History	62	6.2
Geography	40	4.0
General Studies	44	4.4
Others	108	10.7
Total	1008	100.00

Source: Authors Construct after data collection, 2020

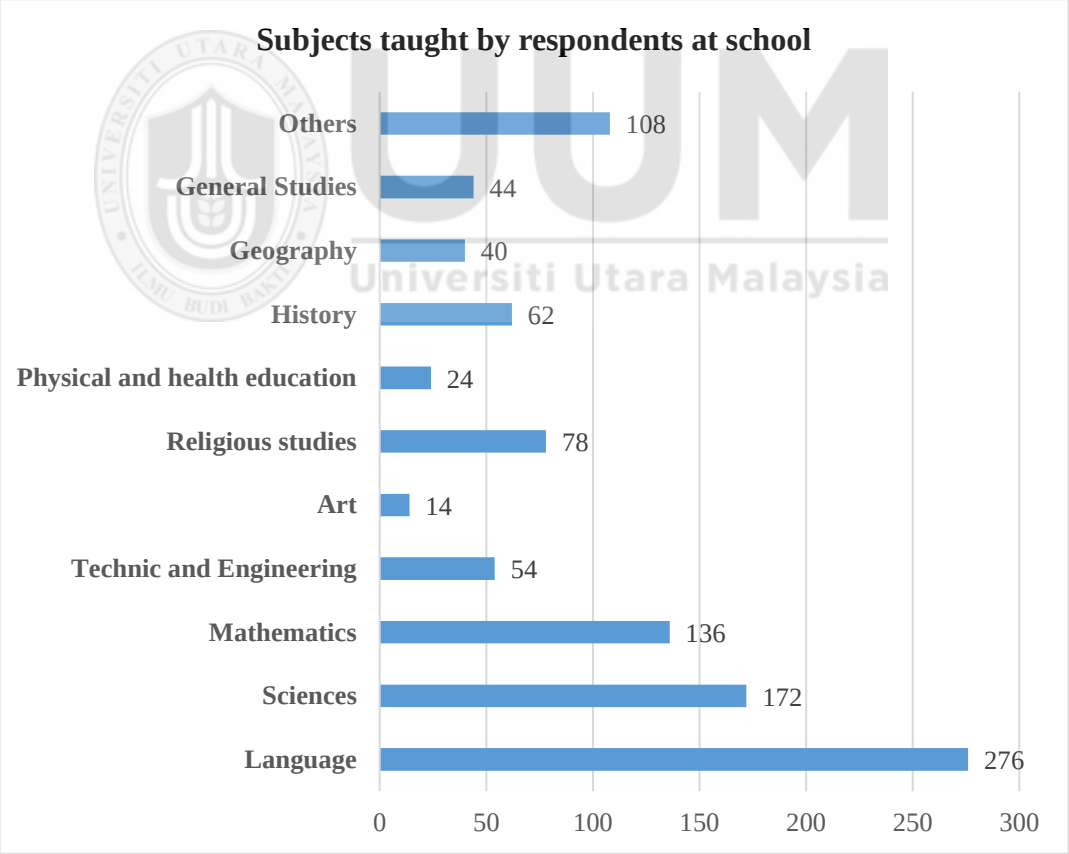

Figure 5.5: ***Subjects taught by respondents at school***

Source: Authors Construct after data collection, 2020

5.3 Aspect of Knowledge on ICT

The amount of information held in an individual's memory is defined as an aspect of knowledge. Moreover Brucks (1985), categorized knowledge as objective and subjective knowledge. According to Brucks (1985) subjective knowledge is also known as perceived knowledge or how much does a person knows about a particular subject meanwhile objective knowledge is an accurate factual information about the particular subject. This was further supported by Ahmad and Nordin (2014) and Semakula Isa (2016) whose findings revealed that subjective knowledge incorporates vocabulary, nature of computer and electronic waste.

5.3.1 Output for Subjective Knowledge on ICT

Radecki and Jaccard (1995, pg. 832) stressed that knowledge is what an individual believe they actually know. Table 4.6 and 4.7 shows the descriptive output for each level of knowledge which exhibits the mean, median and standard deviation.

The output for all the items in subjective knowledge is summarized in Table 5.6. The mean, median and standard deviation are shown for each item. The detail data for this variable is shown in Appendix II. The outcome for subjective knowledge on green computing (SKN1) concepts shows that the mean is 2.23 with median 2.00 and a standard deviation of 0.923. Green computing is a term inclusive of all efforts in computing that makes a significant contribution in reducing CO_2 emission towards a lesser environmental problem. The output shows that the respondents' knowledge about green computing is considerably little.

Meanwhile the mean for (SKN2) subjective knowledge on Malaysia's Green Technology Policy is only 2.60 with a median of 3.00 and standard deviation of 0.874. To accelerate the national economy and promote sustainable development, the National Green Technology Policy was launched by the government in July 2009. Green technology is noted to be the solution for improving environmental performances such as tackling global warming while enhancing resource management to address the global challenges of development. The output for these item shows that the respondents have moderate knowledge about the Malaysia's Green Technology Policy.

Table 5.6: ***Empirical Results for Subjective Knowledge Items***

Items	Mean	Median	Std. deviation
SKN1- Green Computing	2.23	2.00	0.923
SKN2-Malaysia's Green Technology Policy	2.60	3.00	0.874
SKN3- E-waste	2.71	3.00	0.862
SKN4- Energy Star	2.32	2.00	1.011
SKN5- E-PEAT	1.61	1.00	0.756
SKN6- Carbon Footprint	2.10	2.00	0.977
SKN7- 80plus	1.56	1.00	0.749
Average	216	2.00	0.879

Source: Authors Construct after data collection, 2020

E-waste (SKN3) is a term to define electronic waste that are being dumped at landfills. Most of the electronic waste comes from home appliances and ICT waste is known to be the second largest e-waste. The mean for subjective knowledge on E-waste is 2.71 with the standard deviation of 0.862 and a median of 3.00. This shows that the respondents have a moderate knowledge on e-waste.

SKN4 is about Energy Star which is a label to indicate the energy efficiency for hardware's used in computers or laptops. The output for Energy Star shows a mean of 2.32, median of 2.00 and a higher standard deviation of 1.011. This indicates that the knowledge about Energy Star is little. Most of the respondents have either only seen the label on their computer or laptop without knowing the application behind it or have no idea what it is all about.

Subjective Knowledge (SKN5) on carbon footprint among respondents shows a mean of 1.61, median of 1.00 with a standard deviation 0.756. Carbon footprint is the total amount of greenhouse gases emitted due to our actions in our daily life and ICT equipment's such as computers are known to have a big carbon footprint. Researches show that a single computer left on throughout a year emits 1500 tons of CO_2. The output for this item shows that the respondents only have little knowledge about carbon footprint.

Meanwhile the output for E-Peat (SKN6) and 80Plus (SKN7) shows much smaller mean comparatively which is 2.10 and 1.56, median of 2.00 for SKN6 and 1.00 for SKN7. Meanwhile the standard deviation stands at of 0.977 for SKN6 and 0.749 for SKN7. E-Peat is an abbreviation to "Electronic Product Environmental Assessment Tool". This label shows that the product has been assessed and registered for the impacts on environment. On the other end 80Plus is a voluntary certification to promote energy efficiency in computers power supply units. Output for E-Peat and

80Plus shows that the knowledge about these two concepts are practically none or something the respondents never came across before.

5.3.2 Output for Objective Knowledge on ICT

Objective knowledge is an accurate factual information that is stored in one's memory. The following Table 5.7 shows the output for all the items tested in objective knowledge, meanwhile the details are on Appendix III. For each of the item the mean, median and standard deviation is obtained. In this section of objective knowledge, each item that was tested is elaborated individually due to the specificity of the item.

OKN1 states that ICT equipment's are made of dangerous material and the outcome from the data shows a mean of 3.08, median of 3.00 with a standard deviation of 0.921.

Though there are many dangerous materials in a computer, five substances are known to be very harmful. Those are Cadmium, Beryllium, Mercury, Lead and Chromium. These substances can cause severe damage to the environment and human lives (Sampasaha, 2015). About 382 respondents or 37.9% are not sure that there are dangerous elements in the computers. Ironically 618(61.3%) respondents agree that ICT equipment's that end up in the landfills excrete dangerous material such as lead and mercury.

The output for OKN2 which states that ICT equipment's contribute to global warming shows a mean of 3.47, median of 4.00 with standard deviation of 0.893. Though there are 526(52.2%) respondents who agree to the above statement, 230(22.8%) of the respondents are not sure about it and 170(17.0%) teachers disagree. This indicates that the majority of respondents are not aware of the CO2 emission from computers and other ICT equipment's which leads to global warming.

On the other end, majority of respondents, 608 (60.3%) of them agree on statement OKN4 which states that ICT equipment's that becomes obsolete in a short period of time is the reason for accumulation of e-waste. The output for this item has a mean of 3.72, median of 4.00 with standard deviation of 0.711.

OKN5 states that ICT equipment's such as computers if left on throughout the day will use more energy and emit CO2 to the environment. The output denotes that the respondents agree on the above statement. The mean of the output is 3.52 with median 4.00 and standard deviation of 0.838. The higher value of standard deviation shows that there are many who still disagrees or unsure whether computers consume energy and emits CO_2.

Laptops and Tablets consume lesser energy compared to desktops. However, the output shows otherwise. The mean for OKN6 which states laptops consume more energy compared to desktops is 2.90, with median 3.00 and standard deviation of 0.860. This is due to the rise in the number of respondents who are not sure which is about 410 teachers or 40.7% and those who disagree to the statement about 306

teachers or 30.4%. The output for OKN7 which states usage of "Energy Star" equipment's increases energy consumption has a mean of 2.65, median 3.00 and standard deviation of 0.924. The higher value of standard deviation shows that there are many who still disagrees or unsure regarding the function of Energy Star labels.

Table 5.7: ***Empirical Results for Objective Knowledge Items***

Item	Mean	Median	Std. deviation
OKN1- ICT equipment's are made of dangerous material	3.08	3.00	0.921
OKN2-ICT equipment's contribute to global warming	3.47	4.00	0.893
OKN3-ICT equipment's disposed in landfills excretes dangerous chemical like mercury and lead	3.86	4.00	0.762
OKN4-ICT equipment's that becomes obsolete in a short period of time is the reason for accumulation of e-waste	3.72	4.00	0.711
OKN5- ICT equipment's such as computers if left on throughout the day will use more energy and emit CO2 to the environment	3.52	4.00	0.838
OKN6- Laptops consume more energy compared to desktops	2.90	3.00	0.860
OKN7- Usage of "Energy Star" equipment's increases energy consumption	2.65	3.00	0.924
OKN8- "Screen Saver" saves electricity	3.54	4.00	0.886
OKN9- Laser printers consume less electricity than ink printers	3.18	3.00	0.789
OKN10- 17 inches monitor needs more electricity to function compared to a 14 inches monitor	3.38	3.00	0.807
OKN11- Sleep Mode uses the same amount of electricity as Screen Savers	2.89	3.00	0.929
OKN12- To "off" the switch and pull out the plug saves more energy than leaving computers in "sleep mode"	4.16	4.00	0.714
OKN13- "Cathode Ray Tube" Monitor is more efficient in saving energy	3.04	3.00	0.761
OKN14- Usage of Laptop, Smartphone and Tablet is more energy saving and reduces carbon dioxide emission	3.37	3.00	0.752
Average	**3.34**	**3.43**	**0.825**

Source: Authors Construct after data processing, 2020

Screen Savers are computer programs that blanks the screen or fill it with moving images or patterns when the computer is left idle for a long time. Screen savers do not save energy but uses the same amount of energy as when the screen is in the normal use (Abdullahi Bello, 2012). In fact, certain graphics or intensive screen savers are known to use up more energy and prevent the computer from entering sleep mode.

The output for OKN8 which states "Screen Savers saves electricity" shows that teachers are not aware of the screen saver function in computers. The mean for this item is 3.54, with median 4.00 and standard deviation of 0.886. A number of 580 teachers or 57.5% agree that screen savers save energy. Many have been led to believe that screen savers actually do save energy.

OKN9 that states Laser printers consume less electricity than ink printers have a mean of 3.18, median 3.00 and standard deviation of 0.789. This statement is not true because a laser printer which is designed for commercial use or heavy-duty printing can consume up to 1000 watts of electricity in the longer hours its being utilized. An inkjet printer on the other hand, is designed for business purpose or home use, only consumes between 300 to 500 watts of electricity during usage.

Other than that, the power consumption of a business class inkjet printer during a standby mode is 30 to 50 watts. A commercial laser printer meanwhile uses nearly 100 watts to stay idle. Here again, the teachers who are respondents in this study are

not aware of the difference in the energy saving capacity of inkjet printers compared to laser printers.

The next item tested OKN10 is states “17 inches monitor needs more electricity to function compared to a 14 inches monitor”. This statement is true in nature because the bigger the screen the more energy is needed to light up the screen as seen in Table 5.8.

However, the output shows only 414 (41.1%) teachers agree to the statement, meanwhile 396 (39.3%) teachers are not sure and 136(13.5%) of the respondents do not agree that a 17 inches monitor needs more electricity to function compared to 14 inches monitor which contributes to a mean of 3.38, median of 3.00 and standard deviation of 0.807.

The next Item OKN11 states that Sleep Mode uses the same amount of electricity as Screen Savers which is not true. This is because in sleep mode the screen does not function and so there is no extra electricity needed to illuminate the screen. The mean output is 2.89, with median 3.00 and standard deviation of 0.929. About 294 (29.2%) respondents agree with the statement, 318(31.5%) are not sure and 332(32.9%) disagree.

However, the next item OKN 12 shows a more positive respond from the teachers with 602(59.7%) agree and 302 (30.0%) respondents strongly agree that to “off” the switch and pull out the plug saves more energy than leaving computers in “sleep

mode", which is true. The mean for this item is 4.16 and median 4.00 with standard deviation of 0.714.

Table 5.8: ***Power Consumption Comparison between LED, LCD, CRT & Plasma Screen in watts per hour***

Screen Size	LED	LCD	CRT	Plasma
15 inches	15	18	65	---
17 inches	18	20	75	---
19 inches	20	22	80	---
20 inches	24	26	90	---
21 inches	26	30	100	---
22 inches	30	40	110	---
24 inches	40	50	120	---
30 inches	50	60	---	150
32 inches	55	70	---	160
37 inches	60	80	---	180
42 inches	80	120	---	220
50 inches	100	150	---	300

* LED- Light Emitting Diode
LCD- Liquid Chrystal Display
CRT- Cathode Ray Tube

Source: Energy Use Calculator, 2021

As mentioned earlier in Table 5.8, cathode ray tube monitors are not very efficient in energy saving. OKN13 states that "Cathode Ray Tube Monitor is more efficient in saving energy". The mean for this item is 3.04 however, with median 3.00 and standard deviation of 0.761. This indicates that not many teachers are aware of what is CRT, LED and LCD and how they function.

Finally, OKN14 in this section states "Usage of Laptop, Smartphone and Tablet is more energy saving and reduces carbon dioxide emission in comparison to

desktops". The output for this item shows many respondents about 436 or 43.3% of the respondents are not sure about it with only 424 (42.1%) agreeing to the statement. The mean for this item is 3.37, with median 3.00 and standard deviation of 0.752.

5.4 Aspect of Attitude in GICT Practices

Attitude in GICT is a settled way of thinking on GICT practices which is put into action. There are 10 items tested in this section as shown in Table 5.9. and the details are on Appendix IV AT1 denotes the willingness of respondents to use green aspects of ICT even if it is more expensive. The output shows a mean of 3.75, median of 4.00 with standard deviation of 0.778. About 65.5% or 660 of the teachers agree to spend more in order to practice green aspects of ICT. Meanwhile 162 (16.1%) are not sure and 76 (7.5%) do not agree on spending for green aspects of ICT.

AT2 states the willingness of respondents to spare time and energy in practising green aspects of ICT which gave an output with a mean of 3.86, median of 4.00 with standard deviation of 0.658. About 74.0% or 746 respondents agreed to spare time and energy to practice green aspects of ICT. Meanwhile 120 (11.9%) are not sure and 56 (5.6%) do not agree on the matter.

The mean for AT3 which states "I voluntarily use paper for printing without wastage" is 3.79 with median 4.00 and standard deviation of 0.872. 630 (67.7%) of respondents agreed to voluntarily use papers for printing without wastage but there

are still 102(11.0%) respondents who disagree and 60 (6.5%) who are not sure about it.

Table 5.9: ***Empirical Results for Aspect of Attitude Items***

Items	Mean	Median	Std. Deviation
AT1- I am willing to use green aspects of ICT even if it is more expensive	3.75	4.00	0.778
AT2- I am willing to spare time and energy in practicing green aspects of ICT	3.84	4.00	0.658
AT3- I voluntarily use paper for printing without wastage	3.79	4.00	0.872
AT4- I am willing to forgo comfort in the effort to preserve the environment	3.83	4.00	0.706
AT5-Practicing green aspects of ICT can help me contribute towards environmental sustainability	4.16	4.00	0.545
AT6-Practicing green aspects of ICT does not affect my work	3.98	4.00	0.690
AT7-Practicing green aspects of ICT can increase productivity in school	3.85	4.00	0.688
AT8-Practicing green aspects of ICT does not take a lot of time	3.74	4.00	0.726
AT9-Practicing green aspects of ICT in our daily work is easy	3.81	4.00	0.665
AT10-Practicing green aspects of ICT does not need enormous effort	3.58	4.00	0.765
Average	**3.83**	**4.00**	**0.709**

Source: Authors Construct after Data Processing, 2020

The mean for AT4 which states "I am willing to forgo comfort in the effort to preserve the environment" is 3.83 with median 4.00 and standard deviation of 0.706. 672 (66.7%) of respondents agreed to forgo their comfort in the effort to preserve the environment but there are still 54(5.4%) respondents who disagree and 164 (16.3%) who are not sure.

AT5 denotes "Practicing green aspects of ICT can help me contribute towards environmental sustainability." The output shows a mean of 4.16, median of 4.00 with standard deviation of 0.545. About 216(23.2%) respondents strongly agree and

71.2% or 662 of the teachers agree to this statement. Meanwhile 48 (5.2%) of the respondents are not sure.

The mean for AT6 which states “Practicing green aspects of ICT does not affect my work” is 3.98 with median 4.00 and standard deviation of 0.690. 714 (70.8%) of respondents agree that practicing green aspects of ICT does not affect their work but there are still 26(2.6%) respondents who disagree and 126 (12.5%) who are not sure.

126(13.5%) respondents strongly agree and 572(61.5%) respondents agree that practicing green aspects of ICT can increase productivity in school (AT7) but there are a number of 204 (21.9%) respondents who are not sure and 24 (2.6%) who disagree. The mean for AT7 is 3.85 with median 4.00 and a standard deviation of 0.688.

AT8 denotes “Practicing green aspects of ICT does not take a lot of time”. The output shows a mean of 3.74, median of 4.00 with standard deviation of 0.726. About 120(11.9%) respondents strongly agree and 54.4% or 548 of the teachers agree to this statement. Meanwhile 300 (29.8%) of the respondents are not sure.

The mean for AT9 which states “Practicing green aspects of ICT in our daily work is easy” is 3.81 with median 4.00 and standard deviation of 0.665. 624 (61.9%) of respondents agreed with the statement but there are still 248(24.6%) respondents who are not sure and 22 (2.2%) who disagree.

Finally, AT10 which states “Practicing green aspects of ICT does not need enormous effort” has a mean of 3.58, median of 4.00 and standard deviation of 0.765 where 544(54.0%) of the respondents agree that green practices in ICT does not need great effort but there are still a number of 304 (30.2%) of respondents who are not sure.

Generally, all items in the aspect of attitude tested shows a median of 4.00 which denotes teachers agree that attitude is an essential component in awareness of green practices in ICT.

5.5 Aspect of Skill in GICT Practices

Skill which describes the non-technical and soft skills which are significant in environment sustainability and energy saving initiatives is another variable that was tested for response from the 1008 teachers. Table 5.10 shows the empirical results for the aspect of skill in green practices of ICT among teachers in Malaysia and the details are on Appendix V.

SK1 which denotes that ICT equipment’s are being used in the respondents’ daily life has a mean of 4.25, median of 4.00 and standard deviation of 0.821.ICT is an eminent part of teaching learning and this has been proven by the number of 512(51.4%) respondent who agree and 388(41.7%) who strongly agree to the statement SK1.

On the other hand, SK2 tests the respondents on whether they make it appoint to turn off and unplug the socket when they are not using their computers. The output shows

a mean of 4.34, median of 4.00 with standard deviation of 0.714. 514(51.0%) respondents agreed and 438(43.5%) strongly agreed to the statement which indicates that the teachers are well aware of saving energy by unplugging the computer socket when it is not in use.

Table 5.10: ***Empirical Results for Aspect of Skill Items***

Items	Mean	Median	Std. Deviation
SK1- I use ICT equipment's such as computer in my daily teaching and learning process	4.25	4.00	0.821
SK2- I make sure that the computer switch is turned off and unplugged from the socket when not in use	4.34	4.00	0.714
SK3- I always activate the screen saver when I am not using the computer	3.42	4.00	1.151
SK4- I make sure that the computer goes into the hibernate/ standby mode if inactive within 5 minutes	3.89	4.00	0.809
SK5- I use a small monitor to avoid electricity wastage	3.15	3.00	0.994
SK6- I optimize paper usage by printing on both sides or use recycled papers	4.19	4.00	0.657
SK7- I always go for grey scale printing to avoid colour wastage	3.83	4.00	0.878
SK8- I only off the computer at the end of the working day	2.31	2.00	1.152
SK9- I always activate the power management setting on my computer	3.54	4.00	0.850
SK10- I make sure the Bluetooth and Wi-Fi is off when not in use	3.91	4.00	0.987
SK11- Brightness of the screen in my computer and phone are always low to save energy	4.13	4.00	0.754
Average	3.67	3.70	0.899

Source: Authors Construct, 2020

Meanwhile, knowledge about screen saver application in computers or laptops are still low among the respondents because many still opt for screen savers when they are not using the computer. This is well seen from SK3 output which shows a mean of 3.42, median of 4.00 and standard deviation of 1.151. The standard deviation value which is higher than 1 show that this aspect of skill is still a mystic among teachers because a number of 132 (13.1%) teachers strongly agree and 510(50.6%) agrees to activate screen savers while 220(21.8%) disagrees.

Another skill tested in this section is the ability to set the respondents PCs to hibernate or standby mode when inactive within 5 minutes (SK4). The mean of the output shows a value of 3.89, median of 4.00 and standard deviation of 0.809. 676(67.1%) respondents agree that they set the standby mode in their PCs' while 164(16.3%) respondents strongly agree.

SK5 which states "I use a small monitor to avoid electricity wastage" has a mean of 3.15, median of 3.00 and standard deviation of 0.994. This output complies with the item in the aspect of knowledge (OKN10) which indicates the respondents are not aware that size of the screen matters in energy consumption or they prefer a bigger screen in their PCs'. The standard deviation is almost 1 because of the large numbers of teachers who agree with SK5 that is 398(39.5%) respondents and 324(32.1%) who disagrees.

Meanwhile SK6 shows a very optimistic response from the teachers saying that they optimize paper usage by printing on both sides or use recycled papers. The mean shown is 4.19 with median 4.00 and a standard deviation of 0.657. About 656 (65.1%) teachers agreed that they use duplex mode in printers to avoid paper wastage and 288(28.6%) teachers strongly agree.

SK7 is another aspect of skill tested on printing worksheets for teaching and learning process. SK7 states "I always go for grey scale printing to avoid colour wastage" which has an output mean of 3.83, median of 4.00 and standard deviation of 0.878. A

number of 182(18.1%) teachers strongly agree and 600 (59.5%) teachers agree that they prefer grey scale printing but 122 (12.0%) teachers disagree to the idea.

However, SK8 shows positivity in handling ICT equipment's such as computer that is to off the PC when not in use and not wait till the end of the day. The mean for the statement "I only off the computer at the end of the working day" is 2.31, with median 2.00 and standard deviation of 1.152. About 242(24.0%) of the respondents strongly disagree and 484 (48.0%) disagrees. The higher standard deviation accounts for the number of teachers who still agree upon the statement that is 180 or 17.9% of the total number of respondents.

SK9 states "I always activate the power management setting on my computer" has a mean of 3.54, median of 4.00 and standard deviation of 0.850. A number of 484 (48.0%) of the respondents agree on the matter with 310 (30.8%) still unsure.

Meanwhile the mean for SK10 which states "I make sure the Bluetooth and Wi-Fi is off when not in use" is 3.91, median 4.00 with standard deviation of 0.987. A number of 126 (12.5%) respondents disagree to the statement but 524 (52.0%) agree and 276 (27.4%) strongly agree. Moreover, 624(61.9%) of respondents agree that their computer screen brightness is always low to save energy and 290 (28.8%) strongly agree. The average mean for this item is 4.13 with median 4.00 and standard deviation of 0.754. Conclusively, many respondents do have the basic skill such as reducing brightness of the PC screen in order to save energy.

5.6 Aspect of Aspiration towards GICT Practices

The final aspect that was tested to assess the awareness of GICT practices among teachers in Malaysia is aspiration. Aspiration is explained as the elevated level of internal motivation of a person which exhibits as a behaviour or practice while being fully aware of its content, application, and value in achieving desired benefits. There are 11 items tested and reported in this section as shown in Table 5.11 and the details are on Appendix VI.

Item ASP1 which denotes "I am aware of the importance of GICT" shows an output of 3.91 as mean, 4.00 as median and 0.653 as standard deviation. A number of 684(67.9%) of respondents agree that they are aware of the importance of GICT. Meanwhile about 162(16.1%) of the respondents are still not sure.

On the other hand, ASP2 which states "GICT practices helps to reduce electricity usage and lessen CO2 emission" has a mean of 4.16, median of 4.00 with standard deviation of 0.603. The number of respondents who agree upon this statement has increased while the number of disagreeing respondents are much lesser. As seen in Table 4.11, 650 (64.5%) of the respondents agree with the statement and only 6(0.6%) have disagreed.

The output for ASP3 shows a similar pattern where 696 (69.0%) of respondents agreed on being concern about GICT practices in sustaining the environment and 194(19.2%) strongly agree. The mean for this item is 4.06 with median 4.00 and standard deviation of 0.598.

Table 5.11: ***Empirical Results for Aspect of Aspiration Items***

Item	Mean	Median	Std. Deviation
ASP1- I am aware of the importance of GICT	3.91	4.00	0.653
ASP2- GICT practices help to reduce electricity usage and lessen CO_2 emission	4.16	4.00	0.603
ASP3- I am concern about the GICT practices in sustaining the environment	4.06	4.00	0.598
ASP4- Proper usage of ICT equipment's is not a threat to the environment	4.16	4.00	0.595
ASP5- Government need to monitor and enforce usage of GICT in order to sustain the environment	4.28	4.00	0.593
ASP6- Carbon emission could be reduced in ways such as file sharing, online teaching, digital archive management, video conferencing, distance learning, e-government and e-management	3.99	4.00	0.721
ASP7- Education towards voluntariness in GICT should start at the early stage to make way for environmental sustainability	4.01	4.00	0.569
ASP8- I am still able to perform well at work by practicing green aspects of ICT	3.76	4.00	0.719
ASP9- I am clear about the green aspects of ICT such as computer	4.19	4.00	0.595
ASP10- I will apply the green aspects of ICT in future	4.15	4.00	0.576
ASP11- I plan to apply the green aspects of ICT always	4.13	4.00	0.571
Average	**4.09**	**4.00**	**0.612**

Source: Authors Construct after Data Processing, 2020

ASP4 states "Proper usage of ICT equipment's is not a threat to the environment" and the output shows a mean of 4.16, with median 4.00 and standard deviation of 0.595. About 672(66.7%) of respondents agree to this statement and 256(25.4%) strongly agree. The next item (ASP5) states "Government need to monitor and enforce usage of GICT in order to sustain the environment." Majority of the respondents about 616(61.1%) teachers agree with this statement and 342 (33.9%) strongly agree. The output has a mean of 4.28 and median of 4.00 with standard deviation of 0.593.

The output for ASP6 however shows that there a number of 182(19.6%) respondents who are unsure about the statement which says Carbon emission could be minimized

by adhering to online teaching, file sharing, distance learning, digital archive management, e-government applications, video conferencing, and e-management in procurements. Though there are 518(55.7%) who agrees and 208(22.4%) who strongly agrees, the standard deviation shown is 0.721 with mean of 3.99 and median of 4.00.

ASP7 states that "Education towards voluntariness in GICT should start at the early stage to make way for environmental sustainability." About 650(69.9%) of the teachers agree that the education on GICT practices should start at an early age and 146(15.7%) teachers strongly agree but there are a number of 128(13.8%) teachers who are not sure. The mean and median for this item is 4.01 and 4.00 while the standard deviation stands at 0.569.

A number of 556(59.8%) respondents agree that they can still perform well at work by practicing green aspects of ICT and 100(10.8%) strongly agree with statement ASP8. However, there are a number of 234(25.2%) of the teachers responded to this research who are not sure about it. The mean output for ASP8 is 3.76 with mean 4.00 and standard deviation of 0.719.

Meanwhile 610(65.5%) of the respondents agree that they are clear about the green aspects of ICT such as computer and 260(28.0%) respondents strongly agree. The mean for ASP9 is 4.19 with median 4.00 and standard deviation of 0.595. Furthermore, 644(69.2%) of the respondents agree that they will apply the green

aspects of ICT in future and 218(23.4%) respondents strongly agree which gives a mean of 4.15, median of 4.00 with standard deviation of 0.576 for ASP10.

Finally, the output for ASP11 shows that 642(69.0%) of the respondents agreed to applying the green aspects of ICT always and a number of 214(23.0%) strongly agreed which gives a mean of 4.13 with median 4.00 and standard deviation of 0.571. Conclusively, the majority of response from the teachers for the aspect of aspiration shows that they agree to go green in ICT practices.

5.7 Independent-sample T-test for gender

In this section the values for the independent variable and dependent variable were also tested using T-test to compare the output for male and female teachers. Tanya (2013) stressed that male brains may be customized for motor skills and on the other hand, female brains are optimized for intuitive thinking and combining analytical. This provoked a question in the research whether there is a difference between male and female teachers in the aspect of knowledge and awareness on green practices in ICT. The results are shown in Table 5.12.

An independent t-test can decipher whether there is a statistically significant difference for the two gender groups in the mean scores. A reversal in directionality of the effect is indicated with a negative t-value but this has no relevancy on the significance of the difference between the group.

Table 5.12: *T-test between genders on independent variable knowledge and dependent variable awareness on GICT*

Knowledge	Gender	N		Mean			Std. Deviation		
	Male	302		63.37			8.13		
	Female	706		61.25			7.11		
Awareness	Male	302		123.85			14.75		
	Female	706		124.16			11.02		
		Levene's Test for Equality of variances		T-test For Equality of Means					
		F	Sig.	t	df	Sig. (2-tailed	Mean difference	95% Confidence Interval of the difference	
								Lower	Upper
Knowledge	Equal variances assumed	0.14	0.71	4.16	1006	0.000	2.13	1.12	3.13
Awareness	Equal variances not assumed	11.38	0.001	-0.319	450.98	0.750	-0.30	-2.16	1.55

Source: Author's construct, 2021

The method of determining the significance is by looking at the Sig. value for Levene's test. If the value is larger than 0.05, data in the row of **Equal variances assumed** is referred. On the other hand, if the Sig. value for Levene's test is less than 0.05, this means the variance for the gender groups are not the same. In this case the **Equal variances not assumed** is referred. In Table 5.12, **Equal variances assumed** is referred since the Sig. value from the Levene's test shows a value of **0.71.**

To detect whether there is a significant difference between the genders, the column labelled Sig, (2 tailed) is referred, which appears under the section labelled t-test for the equality of means (Table 5.12). The output shows a value of 0.000 which is less than 0.05. This denotes that **there is a significant difference in scores between the male and female teachers in the aspect of knowledge on ICT usage**. The male

respondents show a mean of 63.37 and standard deviation of 8.13. Meanwhile the mean for female respondents is 61.25 with a standard deviation of 7.11. The magnitude of the difference in the means is 2.13 with 95% Confidence Interval of the difference: 1.12 to 3.13 is **small** and the proportion of variance, eta square =0.017 (the calculation of eta square is shown below).

$$\text{Eta square} = \frac{t^2}{t^2 + (N1 + N2 - 2)}$$

$$= \frac{4.16^2}{4.16^2 + (302+706 - 2)}$$

$$= 0.017$$

Cohen (1988, pg. 284) has categorized the difference between groups with the eta square reading as follows:

0.01 = "small effect"

0.06 = "moderate effect"

0.14 = "large effect"

In the aspect of the dependent variable (awareness on GICT practices), the Sig. value for Levene's test is referred again (Table 5.12), which shows a value of 0.001, that denotes a value less than 0.05, which means the variance for the gender groups are not the same. In this case the **Equal variances not assumed** is referred.

To detect whether there is a significant difference between the genders, the column labelled Sig, (2 tailed) is referred in Table 5.12, which appears under the section labelled t-test for the equality of means. The output shows a value of **0.750** which is

more than 0.05. This denotes that **there is no significant difference in scores between the male and female teachers in the aspect of awareness on GICT practices**. The male respondents show a mean of 123.85 and standard deviation of 14.75. Meanwhile the mean for female respondents is 124.16 with a standard deviation of 11.02. The magnitude of the difference in the means is -0.30 with 95% Confidence Interval of the difference: -2.16 to 1.55 is very **small** and the proportion of variance, eta square =0.00001(the calculation of eta square is shown below).

$$\text{Eta square} = \frac{t^2}{t^2 + (N1 + N2 - 2)}$$

$$= \frac{(-0.319)^2}{(-0.319)^2 + (302+706 - 2)}$$

$$= 0.00001$$

Conclusively, there is a significant difference in scores between the male and female teachers in the aspect of knowledge on ICT usage but no significant difference in scores between the male and female teachers in the aspect of awareness on GICT practices.

5.8 Independent-sample T-test to Compare Primary and Secondary School Teachers

The output in Table 5.13 shows a value of **0.001 and 0.142** in the column labelled Sig, (2 tailed) under the section labelled t-test for the equality of means. This denotes that **there is no significant difference in scores between the primary and**

secondary teachers on the aspect of knowledge but there is a significant difference in scores on awareness of GICT practices.

Table 5.13: *T-test between primary and secondary teachers on independent variable knowledge and dependent variable awareness on GICT*

Knowledge	School	N		Mean			Std. Deviation		
	Primary	340		63.0118			6.93245		
	Secondary	668		61.3114			7.70086		
Awareness	Primary	340		124.8588			10.36178		
	Secondary	668		123.6617			13.09368		
		Levene's Test for Equality of variances		T-test For Equality of Means					
		F	Sig.	t	df	Sig. (2-tailed	Mean difference	95% Confidence Interval of the difference	
								Lower	Upper
Knowledge	Equal variances assumed	3.052	0.081	3.426	1006	0.001	1.70039	0.726	2.674
Awareness	Equal variances not assumed	10.062	0.002	1.468	1006	0.142	1.19715	-0.403	2.797

Source: Author's construct, 2021

5.9 Relationship between knowledge, attitude, skill and aspiration

This section reveals the significance of the relationship between the variables X, X_1, X_2 and Y, Y_1, Y_2 and Y_3. The value of correlation coefficient (r) which varies from +1 and -1 indicates the strength of relationship between the variables studied. As the correlation coefficient value decreases towards zero, the relationship between the variables will be weaker. de Vaus (2008), has shown the interpretation of values correlation coefficients as follows:

i. 0.90+ - It's almost perfect

ii. 0.70 - 0.89 - The shape is too high and too strong

iii. 0.50 - 0.69 - High connection

iv. 0.30 - 0.49	-	Simple relationship
v. 0.10 - 0.29	-	Low to medium range
vi. 0.01 - 0.09	-	The relationship is very small and weak
vii. 0.00	-	No relationship

Glen (2020) asserted that "a correlation measures the extent of overlay, or how much two variables tend to differ together. Meanwhile the amount of variation any two variables are inclined to overlay is referred to as their shared variance. The percentage of shared variance is always represented by the square of the correlation coefficient, r^2. Table 5.13 shows the Pearson Coefficient investigated for the variables of X and Y. The relationship between subjective knowledge (X_1) and attitude (Y_1) which was investigated using the Pearson Coefficient shows a **simple relationship** between the two variables, with r = 0.339, n=1008 and p < 0. 001.

The percentage of shared variance is only 10.43 percent. On the other hand, the relationship between subjective knowledge (X_1) and skill (Y_2) shows a **low relationship** between the two variables, with r = 0.299, n=1008, p < 0.001 and percentage of shared variance of 7.90 percent.

Meanwhile the relationship between subjective knowledge (X_1) and aspiration (Y_3) which was investigated using the Pearson Coefficient shows a **simple relationship** between the two variables, with r = 0.359, n=1008 and p < 0.001. The percentage of shared variance is only 13.32 percent

Table 5.14: ***Correlation between Knowledge on ICT Usage and Awareness on G ICT Practices***

Correlation between knowledge on ICT usage and awareness on GICT		Attitude (Y1)	Skill (Y2)	Aspiration (Y3)
Subjective knowledge (X1)	r	0.339**	0.299**	0.359**
	Sig.	0.000	0.000	0.000
	Hypothesis	Accepted	Accepted	Accepted
	Interpretation of r	Simple relationship	Low	Simple relationship
	Percentage of shared variance	10.43 percent	7.90percent	13.32 percent
Objective knowledge (X2)	r	0.310**	0.408**	0.382**
	Sig.	0.000	0.000	0.000
	Hypothesis	Accepted	Accepted	Accepted
	Interpretation of r	Simple relationship	Simple relationship	Simple relationship
	Percentage of shared variance	9.80 percent	17.50 percent	15.30 percent
Knowledge on ICT usage (X)	**Awareness on GICT practices (Y)**			
	r		0.546**	
	Sig.		0.000	
	Hypothesis		Accepted	
	Interpretation of r		High connection	
	Percentage of shared variance		30 percent	

N=1008 **Note: ** Correlation is significant at the 0.01 level (2-tailed).**

Source: Authors Construct after Data Processing, 2020

The relationship between objective knowledge (X_2) and attitude (Y_1) which was investigated using the Pearson Coefficient shows a **simple relationship** between the two variables, with r = 0.310, n=1008 and p < 0. 001.The percentage of shared variance is only 9.80 percent. On the other hand, the relationship between objective knowledge (X_2) and skill (Y_2) also shows a **simple relationship** between the two variables, with r = 0.408, n=1008, p < 0.001 and percentage of shared variance of 17.50 percent. Meanwhile the relationship between objective knowledge (X_2) and aspiration (Y_3) which was investigated using the Pearson Coefficient shows a **simple relationship** between the two variables, with r = 0.382, n=1008 and p < 0.001. The percentage of shared variance is 15.30 percent.

Findings using the Pearson Coefficient for independent variable, X, in this study (knowledge on ICT usage) and dependent variable, Y, (awareness of GICT practices) shows a relationship with **high connection**. The output shows an r = 0.546, n=1008, $p < 0.001$ and percentage of shared variance of 30.00 percent.

Conclusively these outcomes have proven the following hypothesis to be true.

General hypothesis

H_1 *There is a significant correlation between knowledge on ICT usage and awareness on GICT practices*

Specific hypothesis

H_2 *There is a significant correlation between subjective knowledge and attitude on GICT practices*

H_3 *There is a significant correlation between subjective knowledge and skills on GICT practices*

H_4 *There is a significant correlation between subjective knowledge and aspiration on GICT practices*

H_5 *There is a significant correlation between objective knowledge and attitude on GICT practices*

H_6 *There is a significant correlation between objective knowledge and skills on GICT practices*

H_7 *There is a significant correlation between objective knowledge and aspiration on GICT practices*

Meanwhile, the relationship between Y_1, Y_2 and Y_3 was also investigated using the Pearson Coefficient. The findings showed that the hypothesis H_8, H_9 and H_{10} which is shown below can be accepted. The output from the Pearson Coefficient investigation is shown in Table 5.14.

H_8 *There is a significant correlation between attitude and skills on GICT practices*

H_9 *There is a significant correlation between attitude and aspiration on GICT practices*

H_{10} *There is a significant correlation between skills and aspiration on GICT practices*

Table 5.15 shows the relationship between attitude (Y_1) and skill (Y_2) which was investigated using the Pearson Coefficient shows a **simple relationship** between the two variables, with r = 0.501, n=1008 and p < 0. 001.The percentage of shared variance is only 24.01 percent. On the other hand, the relationship between attitude (Y_1) and aspiration (Y_3) also shows a **high connection** between the two variables, with r = 0.686, n=1008, p < 0.001 and percentage of shared variance of 46.24 percent.

Meanwhile the relationship between skill (Y_2) and aspiration (Y_3) which was investigated using the Pearson Coefficient shows a **high connection** between the two variables, with r = 0.588, n=1008 and p < 0.001. The percentage of shared variance is 34.00 percent.

Table 5.15: ***Correlation between mediating variables that affects the awareness on GICT Practices***

Correlation between mediating variable that affects the awareness on GICT		**Attitude (Y1)**	**Skill (Y2)**	**Aspiration (Y3)**
Attitude (Y1)	r		0.501**	0.686**
	Sig.		0.000	0.000
	Hypothesis		Accepted	Accepted
	Interpretation of r		Simple relationship	High Connection
	Percentage of shared variance		24.01percent	46.24 percent
Skill (Y2)	r	0.501**		0.588**
	Sig.	0.000		0.000
	Hypothesis	Accepted		Accepted
	Interpretation of r	Simple relationship		High Connection
	Percentage of shared variance	24.01percent		34.00 percent
Aspiration (Y3)	r	0.686**	0.588**	
	Sig.	0.000	0.000	
	Hypothesis	Accepted	Accepted	
	Interpretation of r	High Connection	High Connection	
	Percentage of shared variance	46.24 percent	34.00 percent	

N=1008 **Note: ** Correlation is significant at the 0.01 level (2-tailed).**

Source: Authors Construct after Data Processing, 2020

Meanwhile Pearson Correlation test was also done for subjective and objective knowledge (Table 5.16) as suggested by Brucks, (1985) and Carlson et al., (2009). The relationship shows a value of 0.132 which is considered low to medium range with percentage of variance of 2.13 percent. This shows that lack of subjective knowledge in GICT does not have a serious repercussion towards the outcome of objective knowledge.

Table 5.16: ***Correlation between knowledge that affects the awareness on GICT***

Correlation between knowledge that affects the awareness on GICT		**Objective Knowledge (X2)**
Subjective Knowledge (X1)	r	0.132**
	Sig.	0.000
	Interpretation of r	Low to medium relationship
	Percentage of shared variance	2.13 percent

Source: Authors Construct after Data Processing, 2020

Conclusively, all hypothesis created in this study have been accepted because the outcome shows some connection between the variables as either lo and still higher tw, simple or high. Moreover, Pearson's Correlation is also calculated separately by gender among the respondents. Table 5.17 shows the correlation between knowledge that affects the awareness on GICT based on gender. The correlation between knowledge and awareness for the male teachers shows a value of 0.573 which is a **high connection** and higher than the correlation between the variables for female teachers which stands at 0.542.

Table 5.17: ***Correlation between knowledge that affects the awareness on GICT based on gender***

Gender			Knowledge
Male teachers	Awareness	Pearson Correlation	.573**
		Sig. (2-tailed)	.000
		N	302
Female teachers	Awareness	Pearson Correlation	.542**
		Sig. (2-tailed)	.000
		N	706

Source: Authors Construct after Data Processing, 2020

Meanwhile correlation between the mediating variables were also calculated for each gender and this is shown in Table 5.18a and Table 5.18b. The correlation between

attitude and skill has a connection with a value of 0.664 and also between attitude and aspiration with a value of 0.689 for the male teachers. Meanwhile the correlation between skill and aspiration is a connection of too high and too strong for the male teachers. This outcome shows that men have slightly better knowledge about GICT in comparison to female teachers.

In the case of the female teachers, the correlation between attitude and aspiration has a high connection of 0.689 and the correlation of skill and aspiration has a high connection of 0.518.

Table 5.18a*: Correlation between mediating variables that affects the awareness on GICT Practices among male teachers*

Gender			SK	OK	AT	SKILL	ASP
Male teachers	SK	Pearson Correlation		.163**	.328**	.308**	.374**
		Sig. (2-tailed)		.004	.000	.000	.000
		Interpretation of r		Low to medium range	Simple relationship	Simple relationship	Simple relationship
		N		302	302	302	302
	OK	Pearson Correlation	.163**		.447**	.415**	.447**
		Sig. (2-tailed)	.004		.000	.000	.000
		Interpretation of r	Low to medium range		Simple relationship	Simple relationship	Simple relationship
		N	302		302	302	302
	AT	Pearson Correlation	.328**	.447**		.664**	.689**
		Sig. (2-tailed)	.000	.000		.000	.000
		Interpretation of r	Simple relationship	Simple relationship		High connection	High connection
		N	302	302		302	302
	SKILL	Pearson Correlation	.308**	.415**	.664**		.702**
		Sig. (2-tailed)	.000	.000	.000		.000
		Interpretation of r	Simple relationship	Simple relationship	High connection		Too high and too strong
		N	302	302	302		302
	ASP	Pearson Correlation	.374**	.447**	.689**	.702**	
		Sig. (2-tailed)	.000	.000	.000	.000	
			Simple relationship	Simple relationship	High connection	Too high and too strong	
		N	302	302	302	302	

Source: Authors Construct after Data Processing, 2020

Table 5.18b*: Correlation between mediating variables that affects the awareness on GICT Practices among female teachers*

Gender			SK	OK	AT	SKILL	ASP
Female teachers	SK	Pearson Correlation		.112**	.350**	.310**	.367**
		Sig. (2-tailed)		.003	.000	.000	.000
		Interpretation of r		Low to medium range	Simple relationship	Simple relationship	Simple relationship
		N		706	706	706	706
	OK	Pearson Correlation	.112**		.226**	.406**	.348**
		Sig. (2-tailed)	.003		.000	.000	.000
		Interpretation of r	Low to medium range		Low to medium range	Simple relationship	Simple relationship
		N	706		706	706	706
	AT	Pearson Correlation	.350**	.226**		.387**	.689**
		Sig. (2-tailed)	.000	.000		.000	.000
		Interpretation of r	Simple relationship	Low to medium range		Simple relationship	High connection
		N	706	706		706	706
	SKILL	Pearson Correlation	.310**	.406**	.387**		.518**
		Sig. (2-tailed)	.000	.000	.000		.000
		Interpretation of r	Simple relationship		Simple relationship		High connection
		N	706	706	706		706
	ASP	Pearson Correlation	.367**	.348**	.689**	.518**	
		Sig. (2-tailed)	.000	.000	.000	.000	
		Interpretation of r	Simple relationship	Simple relationship	High connection	High connection	
		N	706	706	706	706	

Source: Authors Construct after Data Processing, 2020

Conclusively, the aspiration to go green and practice GICT is very high among teachers especially men teachers. As described by Jayaratne (2010), level of aspiration can be determined by ascertaining an individual's intention in practicing what has been learnt. So, it is irrefutable to say that the outcome of this study in the

level of aspiration, has a positive correlation towards the respondent's intention to change.

5.10 Standard Multiple Regression Analysis

When several explanatory variables are used in statistical techniques to prognosticate the outcome of the independent and dependent variable, it is known as multiple linear regression. The multiple regression model is based on the assumption that there is a liner relationship between the dependent and independent variable. Moreover, the other independent variables must not be too highly correlated with one another. In this case the correlation between the dependent variable, awareness and independent variable, knowledge is 0.546 (Table 5.19) which is a high connection but not in the range of too strong from 0.700-0.899.

Table 5.19: ***Correlation between dependent variable awareness and independent variable knowledge***

		AW	KN
Pearson Correlation	AW	1.000	.546
	KN	.546	1.000
Sig. (1-tailed)	AW	.	.000
	KN	.000	.
N	AW	1008	1008
	KN	1008	1008

AW=Awareness KN = Knowledge

Source: Authors Construct, 2022

Table 5.20 shows the regression statistics and how exclusively the regression model is able to fit the dataset. Multiple R is a correlation coefficient which denotes the

strength of the linear relationship between the dependent variable and independent variable. If the multiple R is 1, it indicates a perfect linear relationship while a value of 0 indicates no linear relationship. In this study, the multiple R is 0.546 which denotes a fairly strong linear relationship between awareness and knowledge.

Table 5.20: ***Regression Statistics***

Model	R	R Square	Adjusted R Square	Std. Error of the Estimate
1	.546[a]	.298	.298	10.26473

a. Predictors: (Constant), KN

b. Dependent Variable: AW

Source: Authors Construct,2022

The coefficient of determination is also known as R-squared, r^2, which is the proportion of the variance in the dependent variable that can be explained by the independent variable. The value of r^2 of 1 denotes that the response variable or the dependent variable, awareness can be perfectly explained without error by the predictor or independent variable, knowledge.

R-squared in this study is 0.298 which indicates 29.80% of the variance of the dependent variable, awareness can be explained by the independent variable knowledge. Meanwhile the standard error of the regression in this study is 10.26 units which is the distance of the observed value, awareness falls from the regression line.

Table 5.21: ***ANOVA[a]***

Model		Sum of Squares	df	Mean Square	F	Sig.
1	Regression	45076.763	1	45076.763	427.816	0.000[b]
	Residual	105996.915	1006	105.365		
	Total	151073.679	1007			

a. Dependent Variable: AW

b. Predictors: (Constant), KN

Source: Authors Construct, 2022

Table 5.21 which shows the degrees of freedom, sum of squares, F statistics and overall significance of the regression model. The regression degree of freedom shown in the result is 1 which gives the residual degree of freedom as 1006 and total degree of freedom is 1007

The f statistic is calculated as regression mean square. In the table, this data is 105.365 which indicates that this regression model provides a better fit to the data than a model that contains no independent variable.

The last data from table 5.21 that needs explaining is the p-value associated with the F statistic. If this p-value is smaller than the significance level, then there is sufficient evidence to conclude that the regression model fits the data better than the model with no predictor or independent variable, knowledge. The **p-value** here **is 0.000** which is very much smaller than the common significance level of 0.05. This indicates that as a whole the regression model is **statistically significant**.

Table 5.22: ***Coefficients[a] for the independent variable knowledge***

Model		Unstandardized Coefficients		Standardized Coefficients			95.0% Confidence Interval for B		Correlations			Collinearity Statistics	
		B	Std. Error	Beta	t	Sig.	Lower Bound	Upper Bound	Zero-order	Partial	Part	Tolerance	VIF
1	(Constant)	68.789	2.692		25.553	0.000	63.506	74.071					
	KN	0.897	0.043	0.546	20.684	0.000	0.808	0.978	0.546	0.546	0.546	1.000	1.000

a. Dependent Variable: AW

Source: Authors Construct, 2022

The coefficients table (Table 5.22) gives us numbers which are necessary to estimate regression equation.

$$AWARENESS = 68.79 + 0.897(0.546) = 69.27$$

Base on this calculation, it can be agreed that awareness has **69.27% of chance being influenced by knowledge**. The more the knowledge of a person on GICT, the more the awareness on GICT and the more one practices GICT.

Meanwhile the normal P-Plot of regression standardized Residual (Figure 5.6) shows that the points always follow and approach the diagonal line.

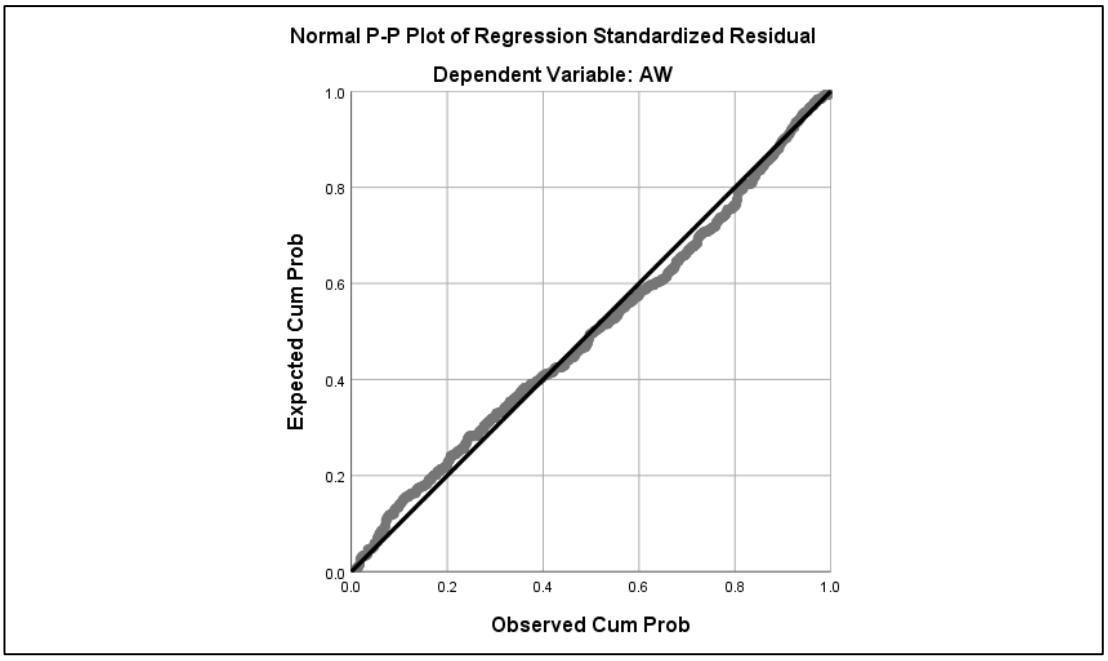

Figure 5.6: ***Normal P-P Plot of Regression Standardized Residual***

Source: Authors Construct, 2022

Thus, it can be concluded that the residual value is normally distributed and the regression analysis procedure has been fulfilled.

5.11 Response from the open-ended question

In the survey, a number of 674 teachers from 1008 respondents of this study, recorded their opinions regarding GICT practices. This is about 72.47 percent from the total number of respondents. Each comment was carefully read and grouped according to several themes and the percentage of their comments were calculated. Table 5.23 shows the responses which have been categorized and the number of respondents related to their opinions.

A majority of 304 respondents or 45.11 percent strongly agree that GICT should be practiced by everyone to sustain the environment for the future generation. Some respondents stressed that energy conservation is crucial and proper attention should be given to e-waste management and paperless work should be given priority to reduce environmental degradation and preserve the environment.

20 respondents which is about 2.97 percent intends to practice green applications in ICT whenever possible. This denotes that this study has provoked some awareness among the respondents on the importance of green practices in ICT.

However, 56 respondents or 8.31 percent have admitted that they are not well informed on the matter due to lack of exposure. They advocated that more emphasize should be given to practices of GICT. Moreover these 56 respondents also intend to find out more about GICT practices.

On the other hand, a number of 74 respondents or 10.98 percent feels that GICT practices should be taught in schools right from young to create the awareness on GICT practices. This move in the longer run will create a society that practices green applications in all endeavours of life.

30 respondents or 4.45 percent feel that government should make the move to implement GICT practices through courses and workshops. Government should also constantly execute monitoring and enforcement in all sectors for better implementation on GICT practices.

Table 5.23: ***Comments by the respondents according to themes***

Comments according to the themes	Number of respondents	Percentage
Strongly Agrees that GICT should be practiced by everyone to sustain the environment for the future generation	304	45.11
Intend to practiced GICT from now onwards	20	2.97
Not well informed due to lack of exposure, more emphasize should be given and intends to find out more about GICT practices	56	8.31
Feels that GICT practices should be taught in schools right from young to create the awareness on GICT practices	74	10.98
Government should make the move to implement through courses and workshops while monitoring and enforcement should be done at all times.	30	4.45
Public should be informed on the importance of GICT and practices should be applied in all public sectors for energy and resources conservation	152	22.55
Teachers should be well informed about GICT practices so that the idea reaches all walks of life	38	5.63
Total	674	100

Source: Authors Construct, 2021

A larger group of 152 or 22.55 percent of respondents expressed that public should be informed on the importance of GICT and practices should be applied in all public sectors for a better energy and resources conservation.

And finally, a number of 38 (5.63%) respondents emphasized that teachers should be well informed about GICT practices so that the idea reaches all walks of life. They

feel that teachers are the sparks who can bring about the prudent changes in a society which in the longer run provoke the idea of sustainable development in a country.

The following are few samples of comments given by the respondents for the open-ended question which is worth recording in this section.

> "*Very good aspect of ICT which should be applied by all users especially in the government and private agencies. This awareness when put into practice can reduce the electronic pollution. The need to go paper less should be explored and expanded in all sectors of government. This is because some requirements of jobs need submission of both soft copy and hard copy which is basically the same thing. There are also many archival materials that need to be stored for a long period of time in a department. In my opinion a data base system is better than storing documents in the form of hard copies."*

> "*GICT is already being taught in science subjects. Touched slightly in the title of energy, such as e-waste for example. However, in my opinion, knowledge and awareness is still lacking. The knowledge of GICT should be disseminated in a wider range to all walks of life, through social medias in Malaysia. It is important for all members of the community to know about GICT, not just as a part of school syllabus but applied in their daily life. To achieve that, all parties should play their role. Only then Malaysians can become a knowledgeable society*."

> "*A good knowledge that should be implemented at an early stage through education to students. Moreover, application of GICT*

should be implemented in all affairs of teachers in schools to ensure that it is optimally practiced."

"*Knowledge of the GICT is very essential in a community. Wide spread of these knowledge is vital in dealing with the problem of* CO^2 *emissions and global warming*."

"*In Malaysia, the practice of GICT has been used unconsciously through e-wallets, e-mail, e-shopping, e-paper, e-banking and etc. All these applications are part of GICT. However, not many people are aware of GICT terms. Moreover, GICT hardware are costly compared to conventional hardware*."

"*Government needs to make the move to spread the idea about GICT. Most teachers use ICT gadgets / equipment in their daily life to solve problems / tasks / work. Features of gadgets that provide electricity savings / GICT etc. are less taken into account by teachers. Teachers need to be given proper exposure so that this knowledge and information can be escalated to students and the community*."

In this study, effort was also taken to obtain information on the planning, implementation and monitoring by the government, but it was futile. A number of 35 emails was sent to the 14-education departments and ICT personnel in National Disaster Management Agency in the Prime Ministers Department (NADMA) and Ministry of Energy, Science, Technology, Environment and Climate Change (KeTTHA), but none of the personnel's answered the online google form open-ended questions (Appendix XI). This could only mean that there is **no action taken on implementation and planning done in the country or none is recorded.**

5.12 Summary of the Chapter

Generally, the respondents have shown great anticipation in answering the online questionnaire. A number of 1008 responses have been recorded and analysed using SPSS. The mean and standard deviation for all items has been tabulated and discussed. Moreover, a T-test was also conducted to determine the difference between gender in knowledge of ICT and awareness of GICT practices. The standard multiple regression was also conducted to determine the model fit and accepted. In the next chapter, the findings are modulated into finding the awareness on GICT among teachers.

CHAPTER SIX

ASSESSING AND DEVELOPING

FRAMEWORK FOR GICT AWARENESS

6.1 Introduction

Information and Communication Technology (ICT) can play a salient role in reducing carbon dioxide in the atmosphere while generating substantial economic benefits for the country. People generally will adopt or practice a technology if they believe that it has a value in their daily life. Despite the enormous importance of the GICT practices among people in general, the findings have shed some light into the level of awareness among teachers in Malaysia. The following sections will discuss further on the findings and reveal some issues that is a hindrance in practicing GICT. Suggestions are also given with a hope that this work can be of use in propagating the GICT practices among Malaysians. Moreover, it is the authors hope that this research will be of great help to any future researchers who can advocate the importance of GICT practices.

6.2 GICT awareness among teachers in Malaysia

For this study an online questionnaire was sent to 1260 number of schools from 13 states and 1 Federal territory requesting the participation of 5 teachers from each

school. However only a total number of 1008 teachers responded to the questionnaire. The responds were from 326 primary school teachers comprising of 138 male teachers and 188 female teachers and 604 teachers from secondary schools comprising of 142 male teachers and 462 female teachers. For each variable or aspect, the mean of the response for each item from the teachers were plotted in comparison to the targeted result (shown as standard in the legend) in a radar chart. According to Hanna and Carter (2016), radar charts are the most effective way to show the performance of the respondents to a standard group's performance. These radar charts are seen in Figure 6.1, Figure 6.2a, Figure 6.2b, Figure 6.3, Figure 6.4 and Figure 6.5.

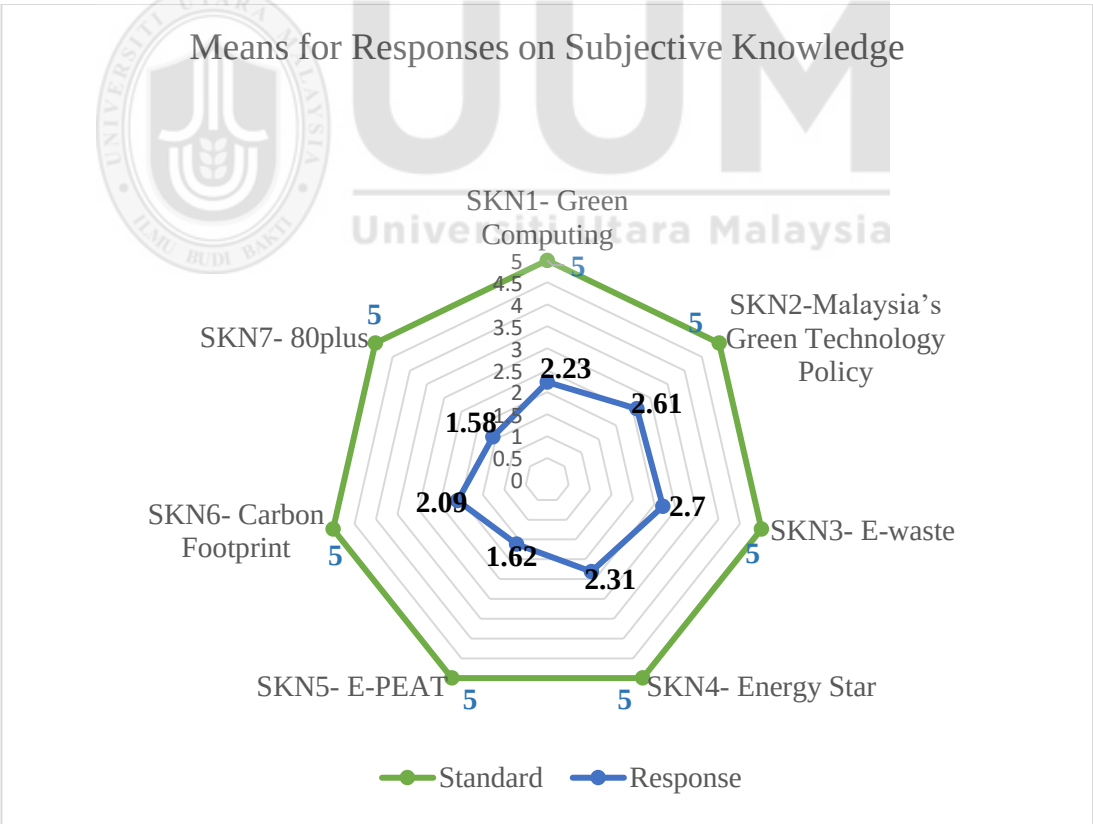

Figure 6.1: ***The means for responses on subjective knowledge in radar diagram***

Source: Authors Construct, 2021

Brucks (1985) on the other hand, divided knowledge to objective and subjective types. An individual's perception or self-assessed knowledge on a particular subject is known as subjective knowledge. Meanwhile the actual accurate knowledge stored in the memory is objective knowledge. In other words, perceived or subjective knowledge is what individuals think they know about a subject concurrently objective knowledge measures what they actually know on the related matter.

Radecki and Jaccard (1995) stressed that what individuals believe they know is a function of what they actually know." Some studies even show empirical correlation between the two knowledge (Brucks, 1985; Carlson et al., 2009). Brucks (1985) found that between objective and subjective knowledge there is a significant positive correlation of 0.54. On the other hand, Carlson et al. (2009) found a correlation of 0.37 between the variables in their research. On that account, it is reasonable to expect the measures of objective knowledge with perceptions of subjective knowledge to be positively correlated.

According to Boccaletti and Moro, (2000), the relationship between objective and subjective knowledges are essential for it could decipher a measure to evaluate an individual's acceptance of a new idea, such as GICT. Courtney (2008) stressed that the biggest obstacle to the adoption of green computing practices and solutions is the lack of knowledge in many organizations. And this state of ignorance is a cause for worry due to its impact on the economy of a country with impending energy consumption and wasteful spending. Insufficiency of knowledge in GICT is the main

reason for an organization to refuse the implementation of the idea. In this study there found to be a correlation of 0.146 between subjective and objective knowledge. This is probably because teachers are lacking in exposure on the matters related to subjective knowledge.

Figure 6.1 shows the radar image of the means from the teachers' responses about subjective knowledge on GICT. The data shows that the teachers who responded have limited knowledge on subjects tested such as green computing, Malaysia's Green Technology policy, E-waste, Energy Star, E-Peat and 80 Plus. The teachers may have come across concepts such as green computing, Malaysia's Green Technology policy and E-waste because these topics are often found in some school syllabus but to know about Energy Star, E-Peat and 80 Plus, one must take an extra effort to acquire the information on these terms. Generally, these terms are found only as stickers on laptops and PCs.

Figure 6.2a and 5.2b shows the means for responses from teachers on objective knowledge. The items were directed towards assessing their knowledge in green aspects of using computers and laptops. The Figure 6.2a clearly shows the knowledge of the respondents on OKN1, OKN2, OKN3, OKN4 and OKN5 is moderate, meanwhile the knowledge on OKN6 and OKN7 is very low.

Majority of respondents in this study are not aware of the hazardous components in the computers and laptops. There are many harmful materials in computers but the substantial ones are chromium which are found in the metal plates, circuit boards,

switches, relays and housing of the computers. On the other hand, the mother board and connectors often contain Beryllium. Cadmium is commonly found in chip resistors, semi-conductors, infrared detectors, stabilizers, cables, wires and the lamp which are being used to illuminate the screen. Another harmful material in computers is mercury which are also used in manufacturing the circuit boards, switches and relays of computers. The other harmful material which is used in the monitors and circuit boards in computers is lead.

As mentioned earlier in the subjective knowledge section, respondents are not aware of the energy saving labels and hard wares which are used in PCs and laptops. Many are not even aware of the energy consumption of these devices which is depicted in the mean output for OKN6 and OKN7 (Figure 6.2a)

Figure 6.2b shows another 7 aspects of objective knowledge on GICT which was tested. The mean for responses for OKN8, OKN9, OKN11 and OKN13 is not satisfactory. Screen Savers (OKN8) are computer programs that blanks the screen or fill it with moving images or patterns when the computer is left idle for a long time. Screen savers do not save energy but uses the same amount of energy as when the screen is in the normal use (Abdullahi Bello, 2012). In fact, certain graphics or intensive screen savers are known to use up more energy and prevent the computer from entering sleep mode. The output shows that the respondents are not aware of this function or probably they decided upon the word “savers”.

Hypothetically, a laser printer, which is designed for commercial use or heavy-duty printing uses up to 1000 watts of electricity in its daily long runs, meanwhile an inkjet printer only consumes between 300 to 500 watts of electricity during printing since it is made for business purposes or home use. Nevertheless, a business class inkjet printer consumes up to 30 to 50 watts of electricity during standby mode. On the other hand, a commercial laser printer can draw nearly 100 watts during standby mode. The output mean for this aspect is shown in OKN9.

The standard output for these items should be 1, however the mean depicted for these items show a mean from 3-4, which indicates that the teachers are not aware about the energy consumptions of these devices.

Attitude has been noted, presumably to have a major influence on GICT implementations since it is considered by researchers as an aspect that plays a vital role in technology acceptance (Molla and Cooper, 2010). According to Molla (2009), Weng and Lin (2011), Wabwoba et al., (2012), Thongmak (2016) and Mosharoff Hussain et al., (2014), attitude on an individual explains the persons extent of awareness and interest they have on environmental sustainability in an organization.

The output of means for the aspect of attitude is convincingly better than knowledge as shown in Figure 6.3. The results show that the respondents have a better approach to the sustainable practices in GICT. An average mean which is approximately 3.84 shows that the teachers who are respondents in this study have a positive attitude

towards GICT such as using papers that they use to print worksheets optimally without wastage. The response as recorded in Chapter 5, section 5.3 also shows that a majority of the respondents are willing to forgo their comfort and spare time and energy to adapt to green practices in the effort to preserve the environment. This shows that the teachers have a positive attitude towards going green for environmental sustainability.

Moreover, the response shows a majority of the teachers opined those green practices in ICT does not take much effort and can increase productivity in school as resources will not be wasted on energy and material such as papers.

The next aspect that was tested for in this study is skill. Skills that are required in handling ICT infrastructures are generally known as generic green skills (Mohd Zolkifli et al., 2018). With the revolution of green technology and pervasiveness of GICT, academicians and researchers have emphasized the importance of acquiring generic green skills among ICT users. Though the exact meaning of this term is still considered as ambiguous among researchers, it is commonly used to describe the non-technical or soft skills which are significant in environment sustainability and energy saving initiatives.

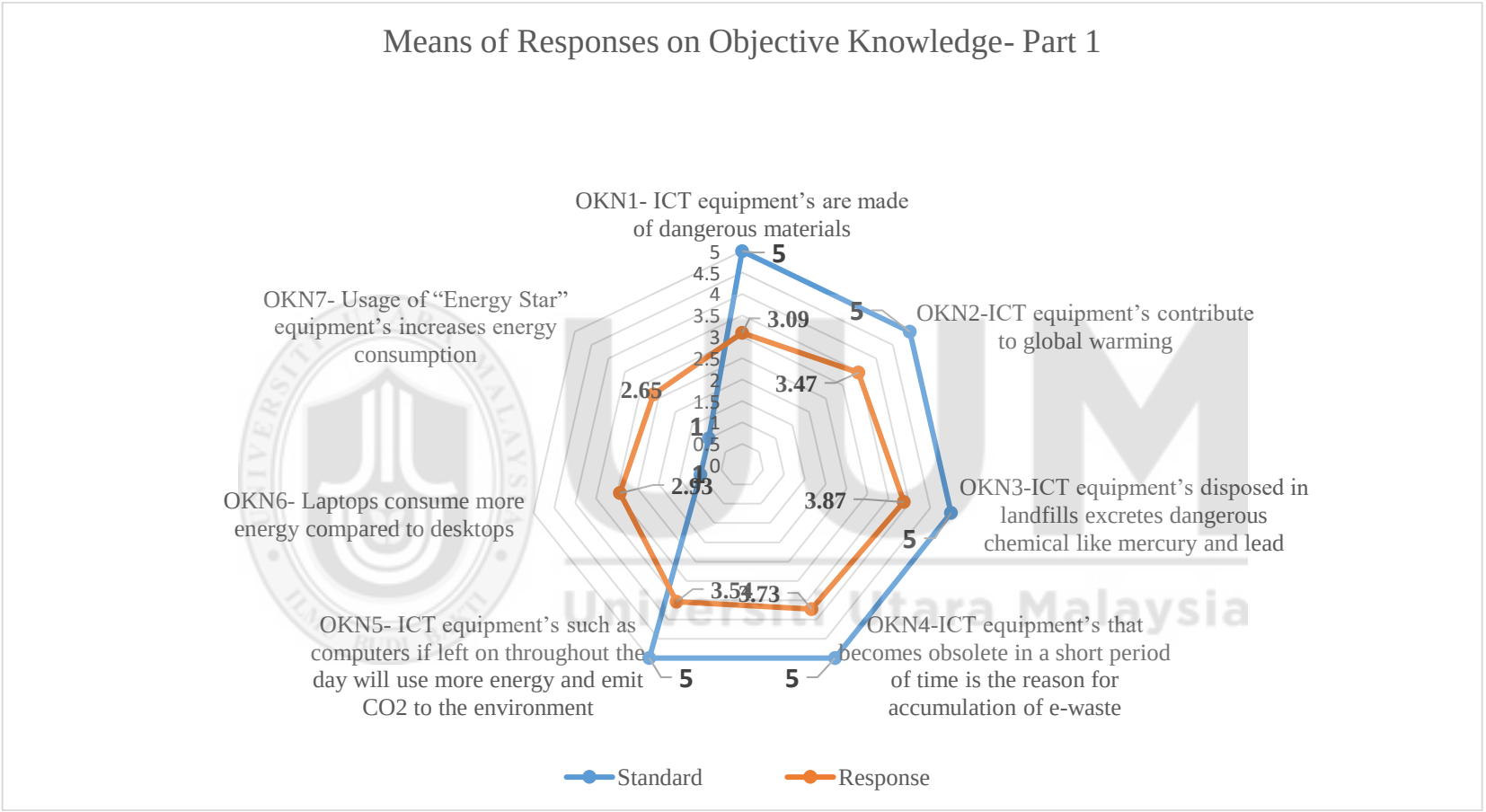

Figure 6.2a: ***The means for responses on objective knowledge in radar diagram (Part 1)***

Source: Authors Construct, 2021

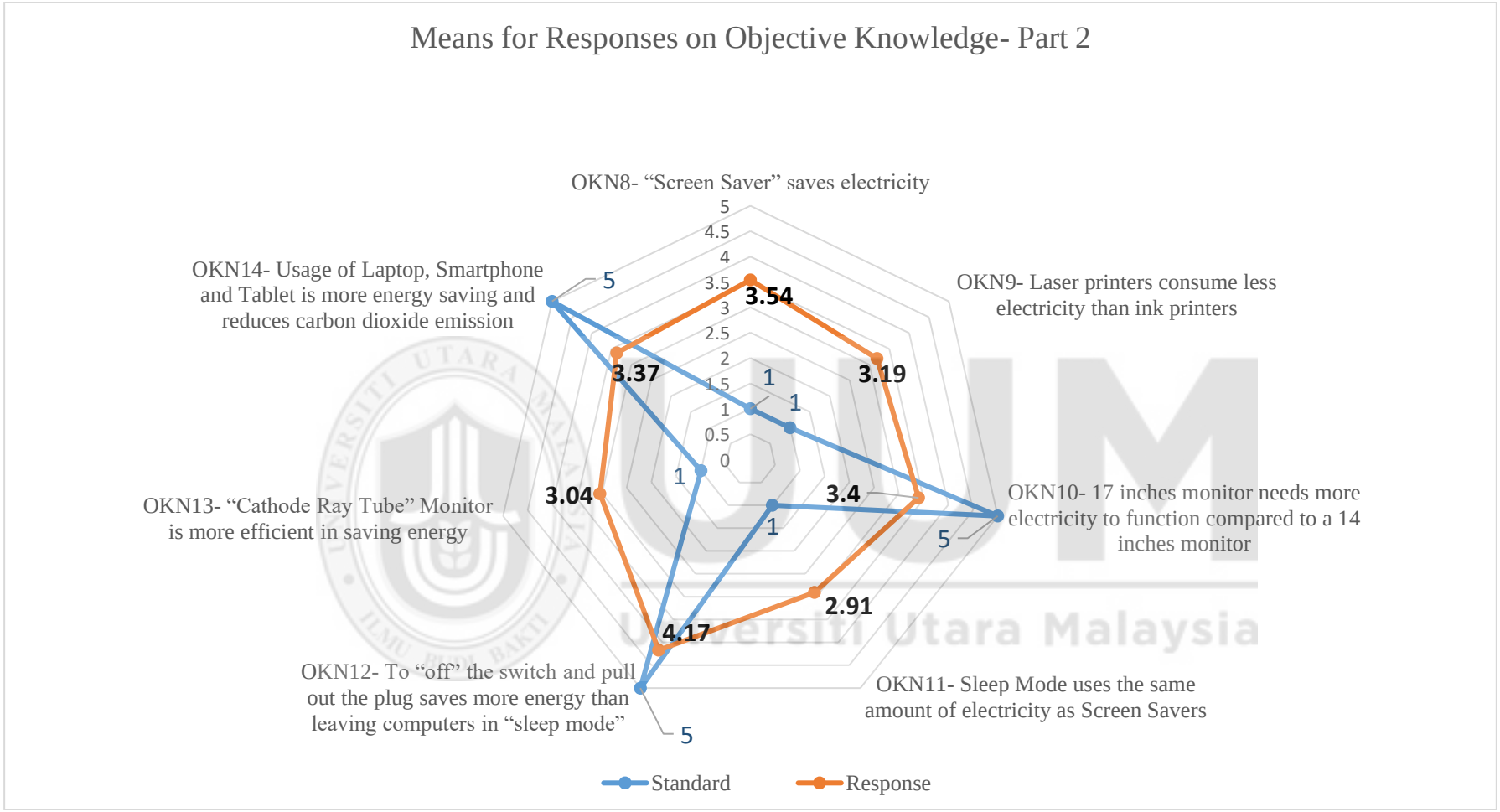

Figure 6.2b: ***The means of responses on objective knowledge in radar diagram (Part 2)***

Source: Authors Construct, 2021

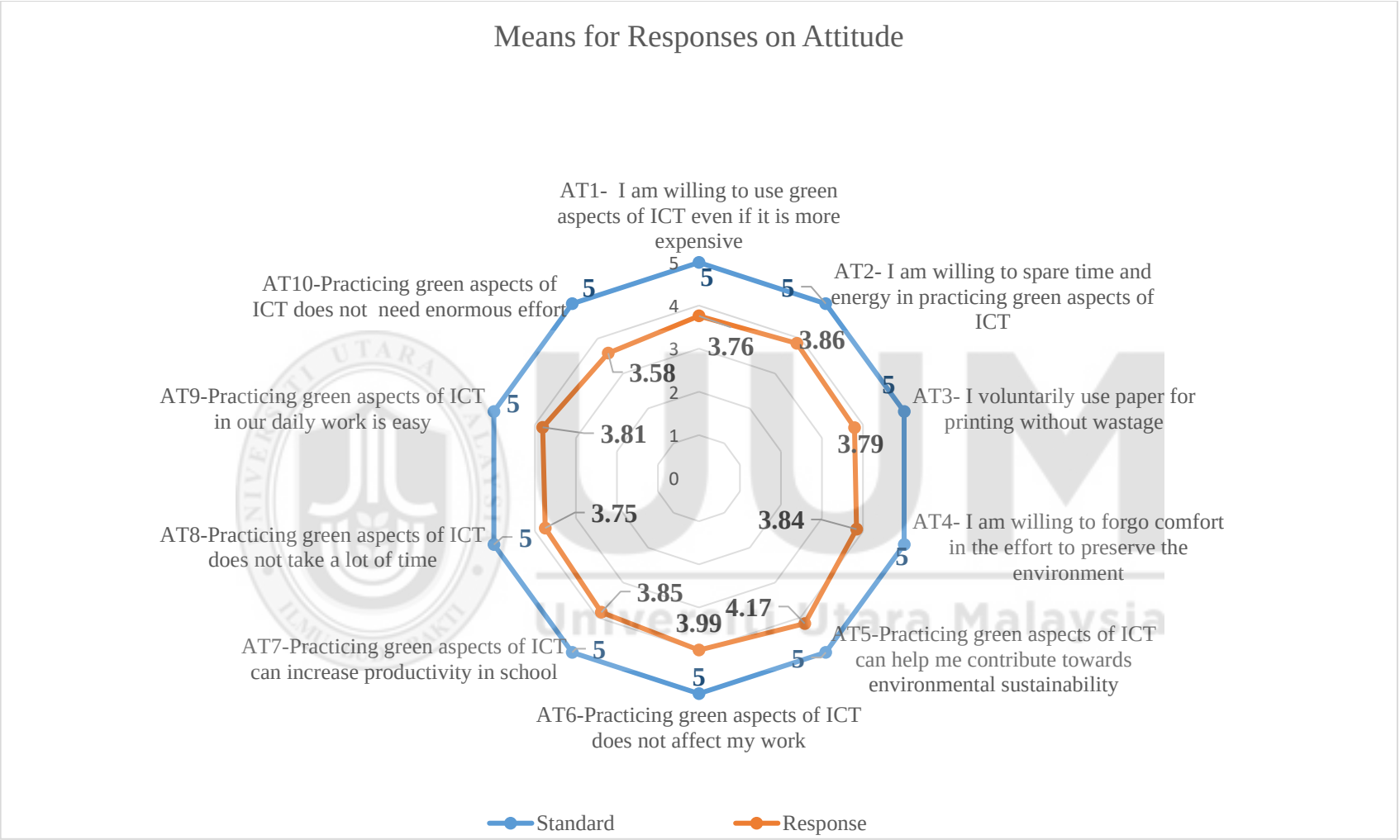

Figure 6.3: ***The means of responses on attitude in GICT practices in radar diagram***

Source: Authors Construct, 2021

Figure 6.4 shows the means for each item tested in this section. Green soft skills such as switching off the PC and unplugging from the socket when not in use, activating the hibernate/Standby mode if the computer is inactive within 5 minutes, using small monitors to avoid electricity wastage, optimizing paper usage by printing on both sides or use recycled papers, choose grey scale printing to avoid colour wastage, activating the power management setting on computer, making sure the Bluetooth and Wi-Fi is off when not in use and lowering the brightness of the screen in PCs and phone to save energy, were tested and the response was rather encouraging for an average mean of 3.67 was obtained which denotes that the aspect of skill on GICT practices among teachers are moderate.

The unsatisfactory response that was seen in this section was about setting the screen savers when the computer is not in use and leaving the computer or laptop on throughout the respondents working hours. This denotes that some respondents are not aware of the energy consumption of computers or laptops when left on throughout a day. Studies show that a PC left on over a year generates about a ton of CO^2 and uses an average of 60 to 500 watts of electricity (Murugesan, 2008).

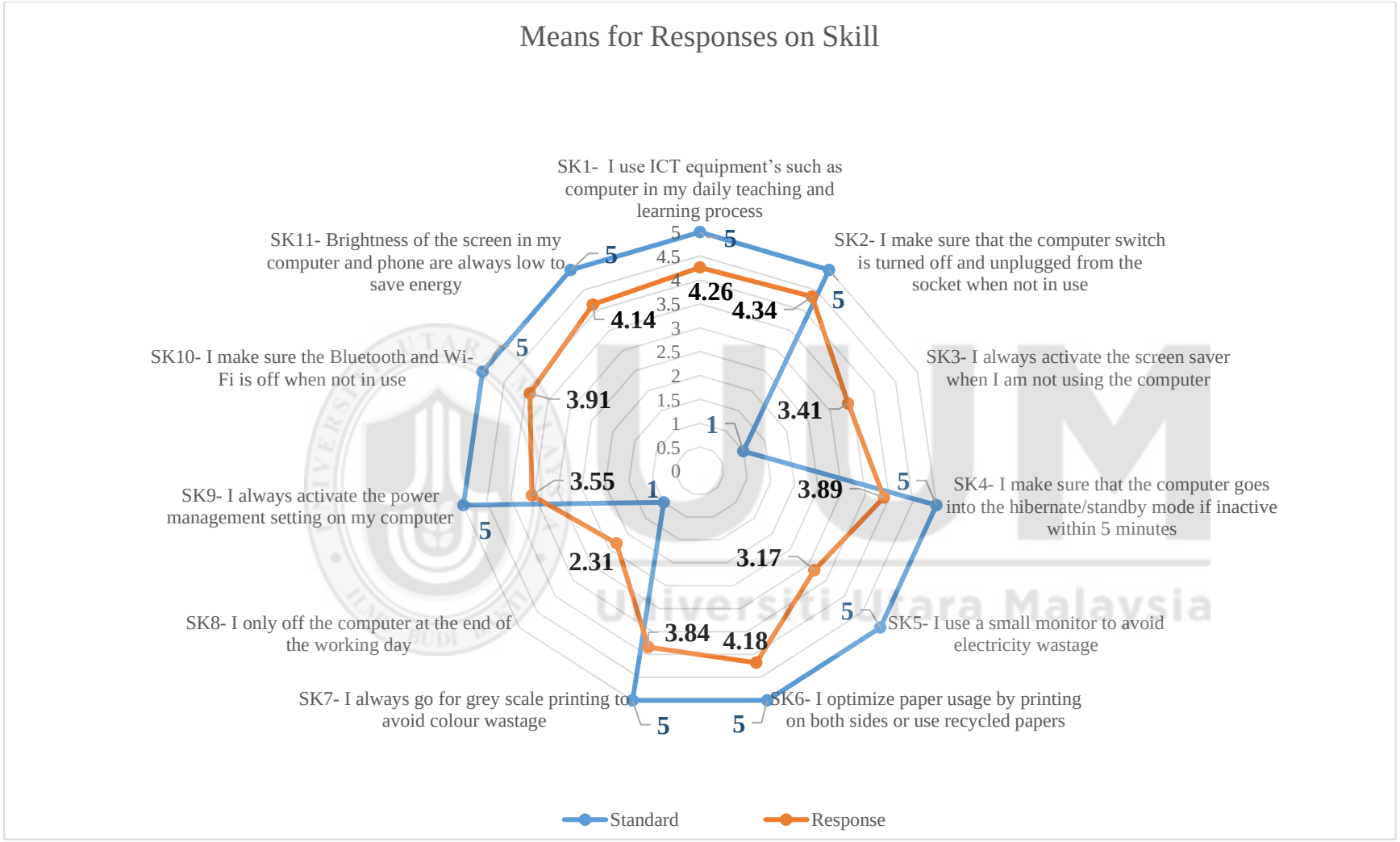

Figure 6.4: ***The means of responses on skill in GICT practices in radar diagram***

Source: Authors Construct, 2021

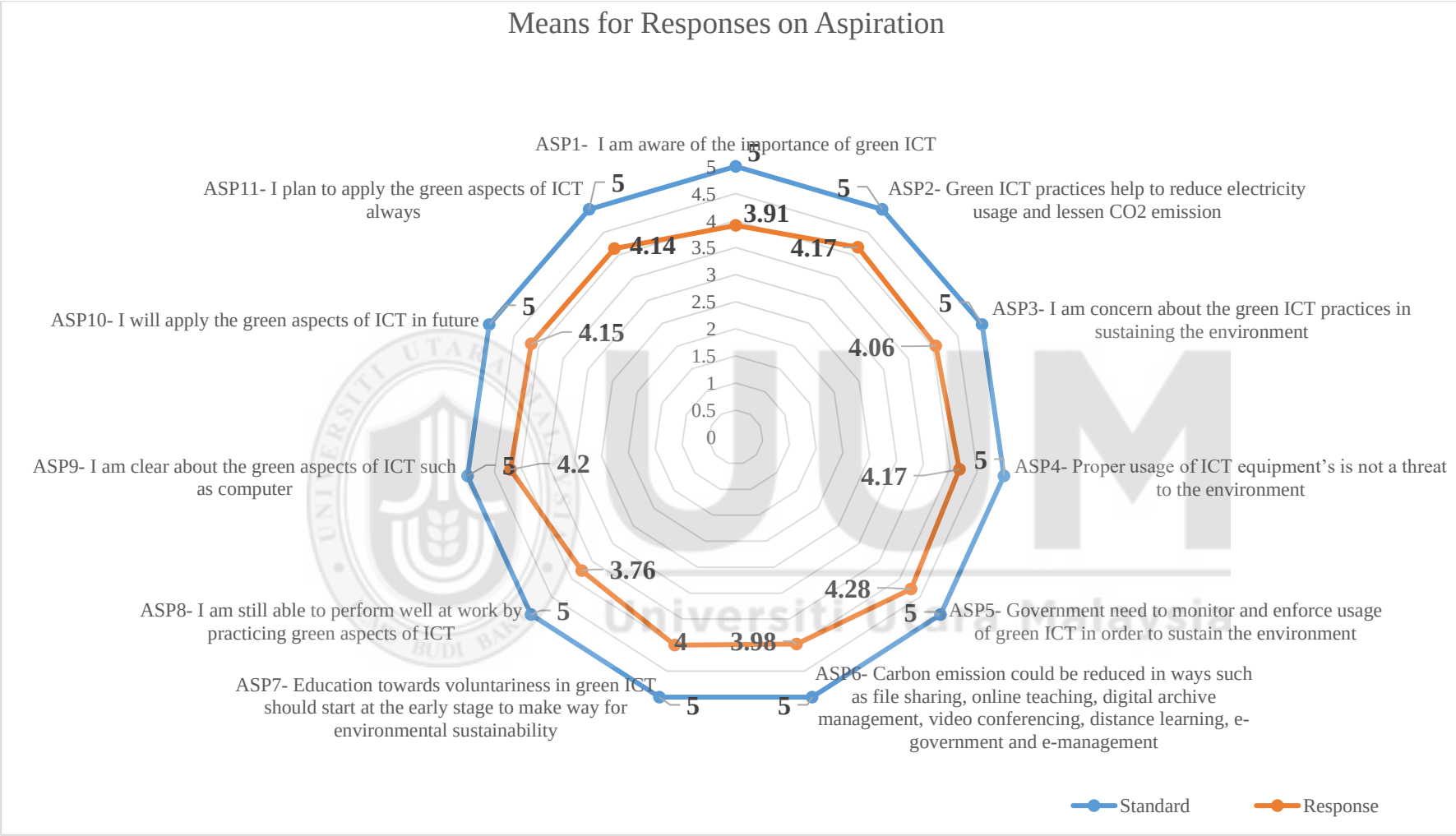

Figure 6.5: ***The means of responses on aspiration in GICT practices in radar diagram***

Source: Authors Construct, 2021

Figure 6.5 shows the means for responses on aspiration in GICT practices on radar diagram. Jayaratne (2010) describes aspiration as the enhanced level of internal motivation of a person to show in the behaviour or practices what the individual wants to achieve with full comprehension of its content, value, and application. An individual's level of aspiration has a positive correlation towards one's intention to change.

The means from the study shows a promising outcome. The average of means shows a value of 4.09 for the aspect of aspiration among the respondents. The items tested clearly indicates that the respondents are aware of the importance of GICT. Perhaps the process of answering the questionnaire itself has created the awareness among the respondents. This is clearly seen in this section where the majority of teachers agree that GICT practices help to reduce electricity usage and lessen CO_2 emission. In addition, they agree that carbon emission could be reduced in ways such as e-government applications, digital archive management, online teaching, distance learning, file sharing, video conferencing, and e-management in all procurement.

Moreover, a prominent figure of the respondents has agreed that education towards voluntariness in GICT should start at the early stage to make way for environmental sustainability. This also substantiated by the response in the open-ended question whereby the respondents feel that GICT practices should be taught in schools right from young to create the awareness on GICT practices and teachers should be well informed about GICT practices so that the idea reaches all walks of life.

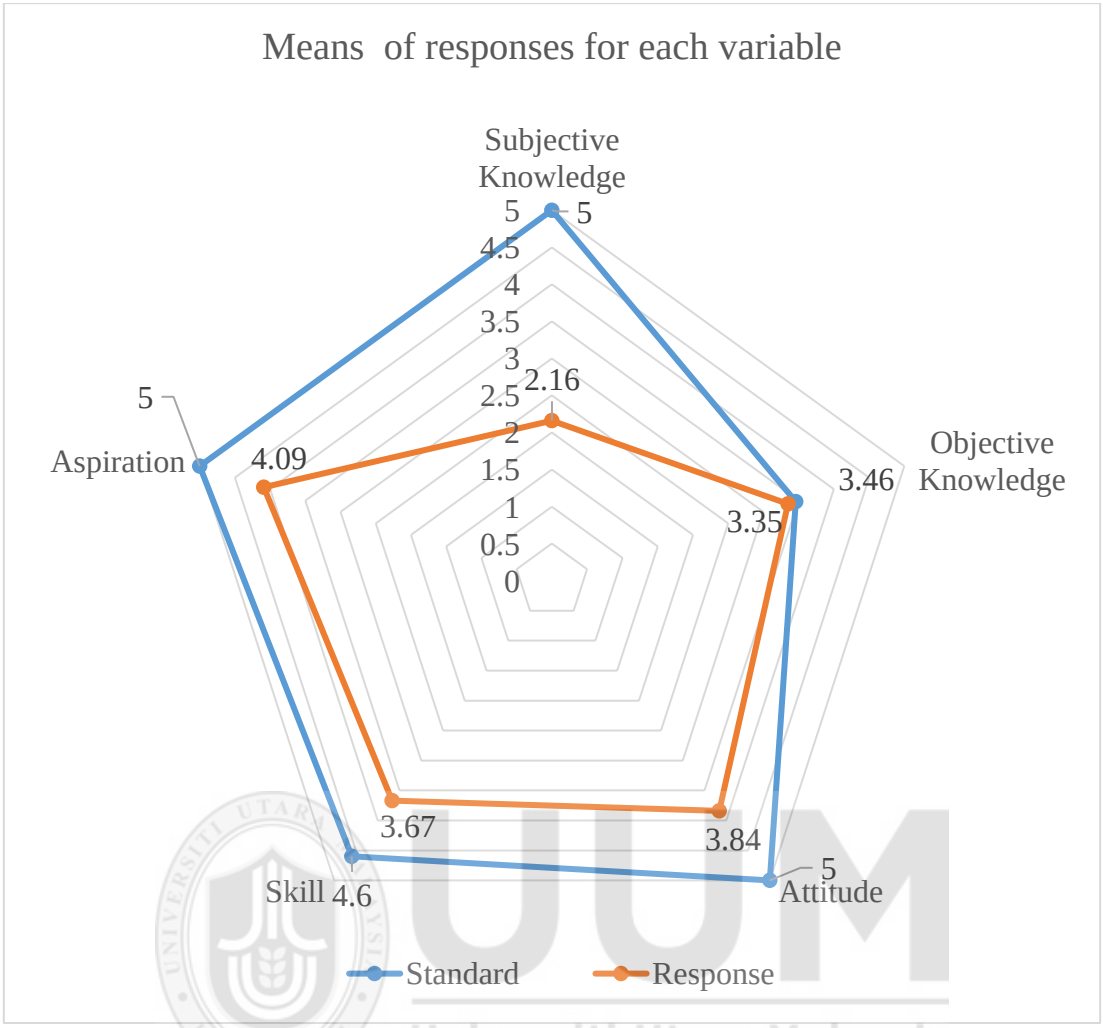

Figure 6.6: ***The means of responses for each variable on radar diagram***

Source:Authors Construct, 2021

Figure 6.6 depicts the average mean for each variable from the teachers' response in comparison to the targeted mean. The area of the polygon for the responses stands at 54.95% in comparison to the area of targeted results. The percentage was calculated by determining the area of the polygon (Kaczynski, 2008). From the findings, it can be concluded that the **awareness of GICT practices among the teachers who responded in this survey is moderate.**

The relationship between the variables were also investigated using Pearsons Coefficient and the relationship between subjective knowledge (X_1) and attitude (Y_1) shows a **simple relationship** between the two variables, with r = 0.323, n=1008 and p < 0. 001.The percentage of shared variance is only 10.43 percent. A simple relationship between subjective knowledge and attitude shows that there is a connection between the two variables but not a very strong one. Thus, someone with less subjective knowledge on GICT can still have a very positive attitude towards green practices in ICT.

On the other hand, the relationship between subjective knowledge (X_1) and skill (Y_2) shows a **low relationship** between the two variables, with r = 0.281, n=1008, p < 0.001 and percentage of shared variance of 7.90 percent. This output shows that a respondent with less subjective knowledge on GICT can still be good in generic green skills.

Meanwhile the relationship between subjective knowledge (X_1) and aspiration (Y_3) which was investigated using the Pearson Coefficient shows a **simple relationship**

between the two variables, with r = 0.365, n=1008 and p < 0.001. The percentage of shared variance is only 13.32 percent. A simple relationship between subjective knowledge and aspiration shows that there is a connection between the two variables but not a very strong one. Thus, someone with less subjective knowledge on GICT can still have a very high aspiration towards green practices in ICT.

The relationship between objective knowledge (X_2) and attitude (Y_1) which was investigated using the Pearson Coefficient shows a **simple relationship** between the two variables, with r = 0.313, n=1008 and p < 0. 001.The percentage of shared variance is only 9.80 percent. A simple relationship between objective knowledge and attitude shows that there is a connection between the two variables but not a very strong one. Thus, someone with less objective knowledge on GICT can still have a very positive attitude towards green practices in ICT.

On the other hand, the relationship between objective knowledge (X_2) and skill (Y_2) also shows a **simple relationship** between the two variables, with r = 0.418, n=1008, p < 0.001 and percentage of shared variance of 17.50 percent. A simple relationship between objective knowledge and skill shows that there is a connection between the two variables but not a very strong one. Thus, someone with less objective knowledge on GICT can still have positive green generic skills towards green practices in ICT.

Meanwhile the relationship between objective knowledge (X_2) and aspiration (Y_3) which was investigated using the Pearson Coefficient shows a **simple relationship**

between the two variables, with r = 0.391, n=1008 and p < 0.001. The percentage of shared variance is 15.30 percent. A simple relationship between objective knowledge and aspiration shows that there is a connection between the two variables but not a very strong one. Thus, someone with less objective knowledge on GICT can still have very high aspiration towards green practices in ICT.

Simple relationship between subjective knowledge and attitude, skill or aspiration and between objective knowledge and attitude, skill and aspiration cannot be negated. As the greater the absolute value of correlation the stronger will be the relationship between the variables. Since this is one of the pioneering studies on GICT awareness and moreover with the lack of awareness among Malaysians on green practices (Sekaran, 2008) the output shows a simple relationship between the said variables.

Findings using the Pearson Coefficient for independent variable, X, in this study (knowledge on GICT) and dependent variable, Y, (awareness of GICT practices) on the other hand, shows a relationship with **high connection**. The output shows an r = 0.544, n=1008, p < 0.001 and percentage of shared variance of 30.00 percent. From the output, it can be concluded that knowledge on GICT plays an important role in creating awareness on GICT practices.

Conclusively these **outcomes have proven all the hypothesis** constructed in this study **to be true**.

General hypothesis

H_1 *There is a significant correlation between knowledge on GICT and awareness on GICT practices*

Specific hypothesis

H_2 *There is a significant correlation between subjective knowledge and attitude on GICT practices*

H_3 *There is a significant correlation between subjective knowledge and skills on GICT practices*

H_4 *There is a significant correlation between subjective knowledge and aspiration on GICT practices*

H_5 *There is a significant correlation between objective knowledge and attitude on GICT practices*

H_6 *There is a significant correlation between objective knowledge and skills on GICT practices*

H_7 *There is a significant correlation between objective knowledge and aspiration on GICT practices*

Meanwhile, the relationship between Y_1, Y_2 and Y_3 was also investigated using the Pearson Coefficient. The findings showed that the hypothesis H_8, H_9 and H_{10} which is shown below can be **accepted**.

H_8 *There is a significant correlation between attitude and skills on GICT practices*

H_9 *There is a significant correlation between attitude and aspiration on GICT practices*

H_{10} *There is a significant correlation between skills and aspiration on GICT practices*

In fact, the Pearson Coefficient was also investigated for X1(Subjective knowledge) and X_2 (Objective knowledge) as suggested by Brucks, (1985) and Carlson et al., (2009). The relationship shows a value of 0.146 which is considered low to medium range with percentage of variance of 2.13 percent.

Conclusively, this section has answered the first objective of this research that is "To determine the level of GICT awareness among teachers in Malaysia".

6.3 Development of GICT Awareness Framework in Malaysia

The idea of this research other than assessing the GICT awareness is to create the awareness among teachers on green practices. It has been noticed that as the respondents answer the questionnaire, they have come to a point to realize that sustainable practices are important in ICT usage. This is shown by the smaller number of respondents who disagree to the statement "green practices help to reduce electricity usage and lessen CO2 emission".

As the main administrator and coordinator of environmental issues, Ministry of Energy, Science, Technology, Environment and Climate Change (KeTTHA) should play a more salient role in promoting GICT awareness among the public. A well-designed programme to promote awareness and cultivate good green practices in

technology such as ICT should be organized. Creating councils and committees to steer the green agenda should be seriously looked into by the ministry.

As the main milestone creators of a nation, teachers should be made compulsory to attend webinars, courses or seminars that advocate sustainable practices before handling ICT equipment. This can eventually create the cascading effect to fabricate a society that is responsible towards preserving the environment by all means.

Moreover, a well-planned syllabus for computer literacy which also integrates green practices should be constructed. In addition, adding a new subject in the first 3 year of the secondary education such as Green Environment Practices could generate a society that has great values for environmental sustainability. Creating awareness should start at the early stage in education for it to be an attitude with aspiration.

Figure 6.7 shows the framework on how to infiltrate GICT ideas in the society. The projection of the framework is an outcome from the response from the teachers in the open-ended question and from extensive research on journals. The Government as the highest authority should manage the planning, monitoring and enforcement through empowering the private sector and NGOs to create programmes for teachers to inflate the ideas. Students on the other hand gets the knowledge from the teachers via subjects or a partial syllabus in a subject. In this manner, the future society or the public apprehends the importance of green practices in ICT which in return helps in sustainability of the environment.

Sustainability should be deeply rooted in all aspects of the country's administration. It isn't a target to be achieved but should be a part of our daily lives because sustainability should be seen as the future of any nation right from the air we breathe, food we eat and the physical environment we live in.

The challenge for the government in harnessing sustainability in all endeavours is creating the awareness among the citizens. Continued and consistent efforts should be taken to educate the public to simulate green initiatives in their daily activities.

This diagram (Figure 6.7) can be further explained as in Figure 6.8. The responsibilities for each entity are elaborated as a detailed framework to create awareness on GICT practices among teachers, students and the public generally. This framework can be a guide for any administrator to govern their portfolio towards creating awareness and adoption of green practices especially in ICT.

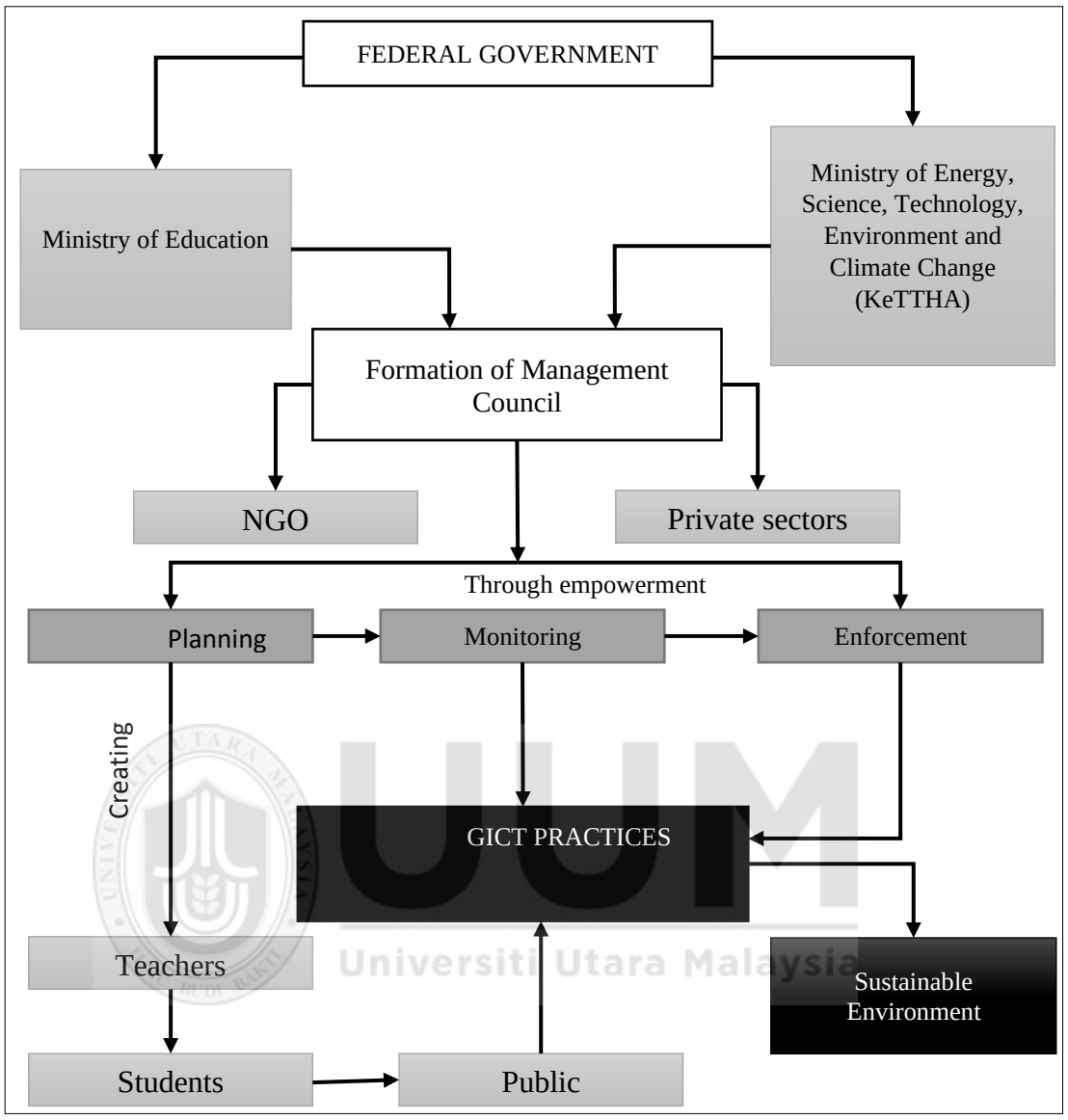

Figure 6.7: ***Empowering GICT Idea for a Sustainable Environment Framework***

Source: Authors Construct, 2021

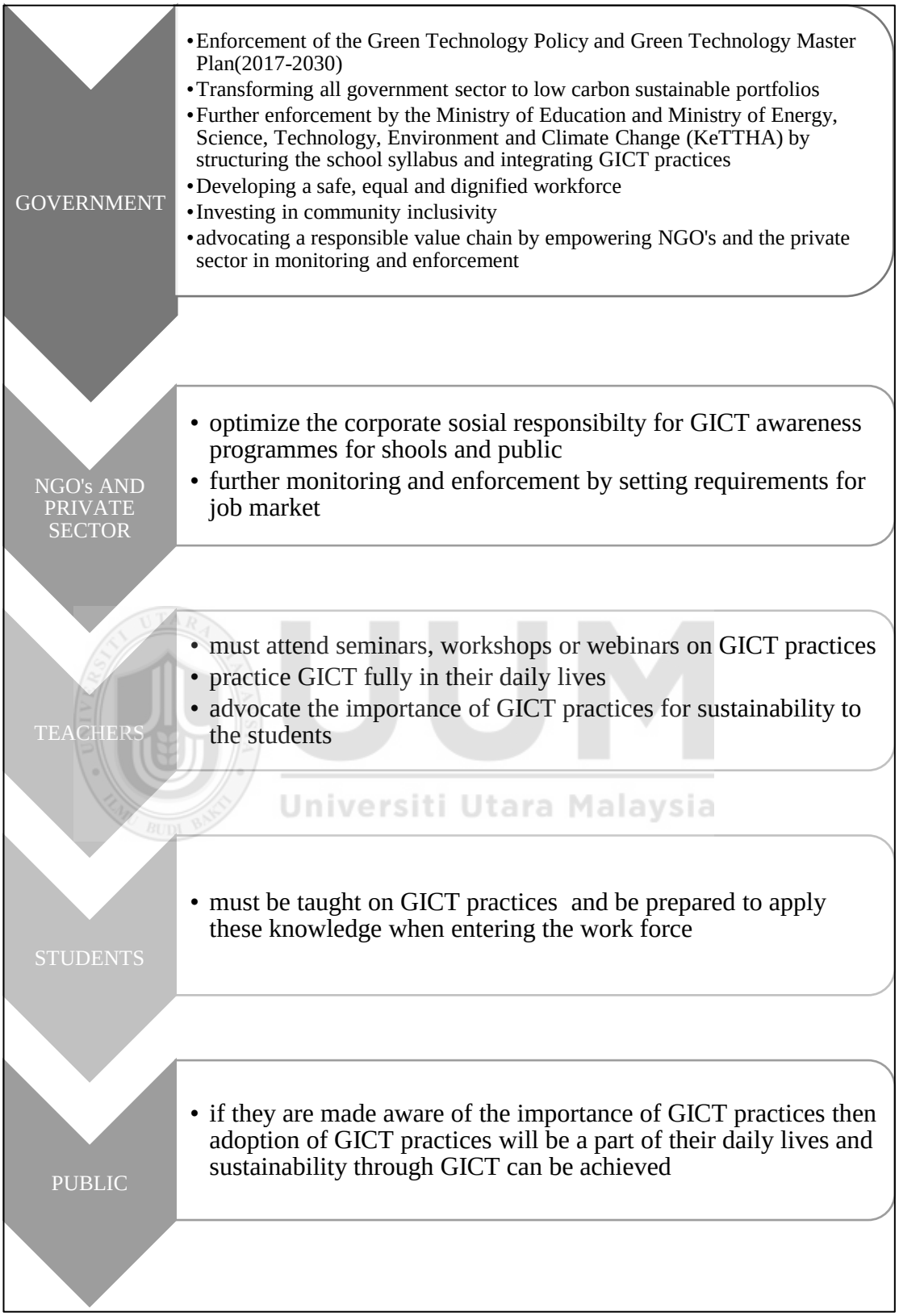

Figure 6.8: ***GICT Awareness and Adoption Framework***
Source: Author's Contruct, 2022.

Wherelse, the theoretical and conceptual framework for this study was created based on a number of models and studies such as Bennet and Rockwell (1995), Molla (2008), SaniaKhan et al. (2011), Bokolo and Mazlina (2016), Sarita et al. (2018) and Hankel et al. (2019).

In this study, while the mediating factors that contribute to the awareness of GICT practices are attitude, skill and aspiration, the outcome from the survey has highlighted that governance and policy are two vital factors that contributes to the awareness in GICT. This is shown in Figure 6.8 below.

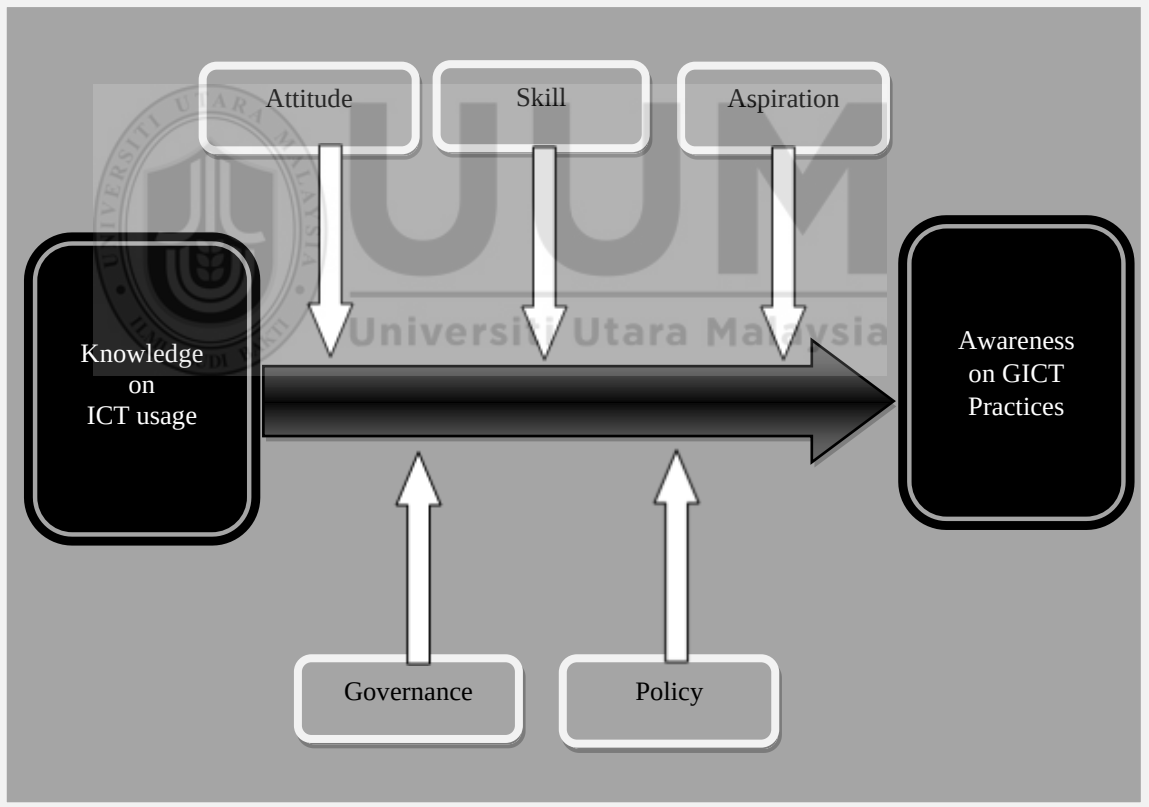

Figure 6.8: ***The mediating factors that contribute to GICT awareness***

Source: Authors Construct,2021

Although, knowledge, attitude, skill and aspiration have been noted to be vital in ascertaining the awareness by Bennett and Rockwell (1995), governance and government policy plays an equally vital role in assuring that people are aware of green practices especially in ICT usage. Leiserowitz (2007) stated government policies and governance play an important part in environmental awareness among citizens. Moreover, government policy and proper governance will enhance innovation activities both directly and indirectly according to Guo et al. (2018).

Conclusively, formulation of attractive policies and government is as important as developing knowledge, attitude, skill and aspiration in creating awareness on GICT practices.

6.3 Summary of the Chapter

The GICT perspectives have been reviewed among the 1008 teachers in this section. ICT is a critical technology which could provide the intelligence to manage even lessen the impact of the most imminent threat to our existence, the global warming. Since only 2-3 % of the global carbon footprint is caused by the ICT infrastructures, then there is another 97% which can be put to useful practices to hinder the problems caused. Awareness is an important key in addressing this challenges that we face in managing the ICT structures for better solutions for sustainability. In the next chapter, issues in practicing GICT and recommendations are given for the continuity of this idea in future researches.

CHAPTER SEVEN

DISCUSSIONS ON ISSUES AND SUGGESTIONS IN GICT IMPLEMENTATION AND CONCLUSION

7.1 Introduction

Worldwide efforts are being taken to address the environmental performance and tackling global warming where ICT can play a salient part. Ever since it was reported that ICT is a contributor of greenhouse gases and global warming, governments have introduced initiatives to encounter the dangers posed by ICT especially in energy use. In fact, focus have given to GICT practices for an improvement in the environmental performances.

7.2 Worldwide efforts on GICT practices and its barriers

The world became aware of climate change after the Kyoto protocol came into force in 16th February, 2005. In short, Kyoto Protocol operationalizes the United Nations Framework Convention on Climate Change. Subsequently, Gartner (2008) reported about the carbon emission of ICT infrastructures which lead to the revamp of ideas on ICT management to minimize and tackle environmental impacts and energy usage.

Large scale programmes and initiatives were taken by governments across the globe to enhance GICT practices in our daily lives (Reimsbach, 2009). According to Reimsbach (2009), these programmes and initiatives follow three criteria's that is:

a. Direct or enabling effects, as in tackling the direct effects of environmental impacts of ICTs or using GICT to minimize the environmental impacts across socioeconomic activities.
b. Giving particular emphasis on all environmental impact categories such as global warming due to primary energy use, land use toxicity, ozone layer depletion, non-energy resource depletion, biodiversity and water use.
c. Life cycle phase which involves policies focusing on goods and services. Here the move is to stimulate ICT applications more resourcefully in non ICT sectors in the aspect of manufacturing, distribution or use of goods in.

According to Kavita and Sameer (2015), literally there were efforts taken in China, India and other countries to develop green schools or in the higher education institutions but constraints hampered the effort.

Their study showed the following as barriers identified in implementing GICT in higher education institutions.

i. Inadequate fundings and support from the administrators
ii. Inadequate participation from the students, staffs and faculties
iii. Unconcern about environment culture
iv. Lack of GICT awareness
v. Inadequate trainning and education on green perspectives
vi. ICT impacts on the environment is considered insignificant

vii. Government has failed to post strict regulations and constant monitoring

viii. Lack of good procurement practice at education institutes

ix. Inadequate Research and Development programmes for GICT

Table 7.1 shows the GICT strategies taken by nations across the globe to tackle the effects of ICT towards the environment.

Table 7.1: ***GICT strategies taken by nations across the globe***

Country	Strategies
United Kingdom	Green ICT Delivery group Each government sector is made responsible for applying and establishing GICT in their procurement and daily work
United States	the National Association of State CIOs (NASCIO) has created a Green IT Video Working Group (formerly Greening of IT Working Group) in order to co-ordinate the Green ICT-related efforts of state CIOs
Japan	Japan‟s New Action Plan towards a Global Zero Waste Society
Australia	smart metering for improving monitoring and forecasting of households‟ energy consumption. The forecast is mainly used to optimise energy generation
Germany	“Flagship project” E-Energy under the Action Plan “Germany: Green IT Pioneer” also aims at optimising energy supply through ICT-based systems.
Korea	Intelligent Transportation Systems (ITS), a Global Positioning System (GPS)-based application as part of its New Growth Engine of the Broadcasting and Communications Industry to reduce traffic congestion.
European Commision	Intelligent energy distribution networks through its Intelligent Energy - Europe (IEE) programme The EC has adopted two directives targeting the disposal of ICTs: The Directive on the restriction of the use of certain hazardous substances in electrical

	and electronic equipment (ROHS) and Directive on waste electrical and electronic equipment (WEEE)

Source: Reimsbach, 2009

A study by Ferdous (2018) added that lack of updated knowledge on rapid changes of the technology, lack of motivation among individuals, lack of proper planning for GICT, indifferent attitude towards updating knowledge in GICT in workshops and shortage of trained or skilled manpower are the hurdles in GICT practices. Moreover, Monika et al. (2017) stated that GICT is quite costly and some computers which are green in hardware are considered as underpowered.

Conclusively, the fast-changing technology can hamper GICT practices. And governance, implementation and monitoring by the administrators is vital in deciding whether an organisation implements GICT and motivate individuals towards sustainable development in the technology.

7.3 Tackling Issues in Implementing GICT Practices among Teachers in Malaysia

In spite of all the attention given to integrating ICT in teaching and learning processes in schools, the aspect of cultivating knowledge on sustainably managing ICT or GICT has been left unattended (Rabiatul Adawiah and Mohd Shukri, 2018). Moreover, in the Malaysian context, there is a lack of collaboration between the initiatives of National ICT Policy and the National Green Technology Policy. The National Green Technology Policy was initiated by Ministry of Energy, Green

Technology and Water (KeTTHA) in 2009. This has been clearly discussed in the section of problem statement of this study.

One of the main issues that inhibits the implementation of green practices among teachers is the insufficient involvement of the government. Without proper planning, monitoring and enforcement any policies cannot be implemented fruitfully. Whilst we have a well decorated National Green Technology Policy, the infiltration of the planning, monitoring and enforcement is not clear in the public sectors in Malaysia. This statement is also supported by the findings of this study in the open-ended question whereby a prominent number of respondents feel that government should play a more salient part in making sure the GICT practices are well administered.

Another barrier to green practices of ICT among teachers is the incompetent attitude towards going green. The finding of this study shows that many teachers are not aware of basic GICT practices such as energy saving modes and labels, optimizing paper usage for printing and e-waste.

Bei Bei et al. (2020) advocated that environmental responsibility is an essential factor in any organization to adapt to green practices. When one has the feel of responsibility towards environmental sustainability, they have the tendency to show via their behaviour which becomes an attitude. Education plays a very vital role in moulding a responsible citizen towards the needs of the nation. This statement was also supported by Nizam and Vilhi (2018); Murugesan (2008) and many others, who

advocated that education plays a very important role in creating awareness on GICT practices.

Computer Program in Education (KDP) was introduced in 1992 as a pilot project in 60 secondary schools. This was the terminus a quo to the Computer Literacy program among secondary school students. These schools were equipped with a computer lab with a server which allows access to 20 computers for the students with one unit for the constructing teacher. This attempt by the government was to educate children on computer literacy in order to be technologically equipped with computer skills and programming to create human capital who are competent for the work force in future.

However, this program does not advocate green practices in ICT. The only intrusion of GICT is as e-waste which is a part of the science curriculum in the learning on issues pertaining to the environment.

The policy makers should foresee those proper measures are taken to overcome environmental issues. ICT has not been taken into account as a serious problem to the environment. Clear projection should be made by government on the ICT expansion in the country in the preceding years to come and what would be the impact on the environment.

This point has been advocated by the respondents in the open-ended question as well. A prominent number of teachers cum respondents feel that they have not been

well informed about green practices in ICT and that the government should take immediate and precautious measure by introducing GICT as a subject or partially in a subject to create awareness since young. They stressed that even the teachers should be given proper workshops or seminars regarding the green practices in ICT which is discussed in the next section.

Colin (2017) stressed that education is a necessary method to advocate the intelligent use of ICT towards sustainability. By ways of educating users on how the ICT can be enabler in reducing the carbon emission or saving energy, sustainable practices in ICT can be attained. There are various ways in which ICT can be of eminent use in sustainable development. The sustainable development in ICT can be attained by the following approaches.

I. Government initiatives in recycling computer waste
II. Internal communication campaign on good practice materials
III. Reducing volumes of unnecessary prints
IV. Optimizing media utilization
V. Development of teleconferencing
VI. Reducing number of employees trips
VII. Implementation of virtualization of servers and workstations
VIII. The use of green products with low energy consumption

Albert at al. (2017) concluded that GICT plays an imminent role as one that can reduce the environmental impact of ICT itself, thus contribute significantly to sustainable development.

Planning and implementation of policies are very vital in ensuring that GICT practices are followed by every individual. A well decorated policy or framework is useless if there are no enforcements to uphold the policy. Moreover, the need to go green in ICT is crucial since, the country is heading towards a digitalized nation and work force must apprehend the importance of GICT practices to minimize the detrimental effects of computers and its infrastructures.

7.4 GICT in future studies

This study has collected vital data on the aspect of knowledge, attitude, skill and aspiration of teachers in Malaysia on GICT practices generally. These data could be used to further include various provincial control variables that could give a better understanding on the present GICT practices in Malaysia.

Private school teachers and managements were not involved in this study. So, there is room for research to do a comparative study between public and private schools. In fact, a study that compares the awareness of GICT practices in the education sector between the Peninsular Malaysia and East Malaysia is also viable to get an insight on GICT awareness. Comparative study can also be done with boarding school teachers and international school teachers.

Nevertheless, studies can also be conducted on the planning, monitoring and enforcement by the government on GICT practices. A study just focusing on the government policies, planning, implementation and monitoring is vital work to

ensure that the policy does not remain decorated on papers. This could generate ideas and initiatives that should be taken by the administrators to make GICT awareness a national agenda.

In this study though effort was taken to obtain information on the planning, implementation and monitoring, it was futile. A number of 35 emails was sent to the 14-education department and ICT personnel in Malaysia's Natural disaster Management Agency under the Prime Ministers Department (NADMA) and Ministry of Energy, Science, Technology, Environment and Climate Change (KeTTHA), but none of the personnel answered the online google form. This could only mean that there is **no action taken on implementation and governance of GICT practices done in the country at present.** This is a viable field for one who wishes to further study on this topic

As said by Molla (2008), the adoption of GICT depended on five most critical areas which are attitude, policy, practice, technology and governance. While attitude refers to the extend an individual is interested and concern about the environment, knowledge about GICT and skill is also vital for an individual to persevere in green practices. But generally, the government policy and strategies are an essential ingredient in GICT practices. Initiatives taken by the government in advocating, planning, implementing ang monitoring is what makes the idea of GICT penetrate the society. Proper management and governance are an important ingredient in making sure that GICT practices are carried out among the citizens in general.

Moreover, the aspect of e-waste for instance was not looked into in depth. There still rises a question on how the teachers actually dispose their ICT equipment. That aspect was not explored. In this study, initiative was taken only to identify the subjective knowledge among teachers on e-waste.

Inclusively, future studies on the ways the community handle ICT disposals can give a clearer idea on the society's awareness on GICT practices.

7.5 Limitation of the study

Since this research was done amidst of the covid-19 pandemic, there were limitations faced by the author. There was restriction movement ban for everyone, which only allows the researcher to collect data via sending online questionnaire which could be accessed using a QR scan code. Emails were sent to 1260 school requesting for 5 teachers from the school to answer the questionnaire but due to the movement control order, the schools were closed, and the request was not responded comprehensively. Only 1008 teachers responded by answering the questionnaire. This is small setback in this research.

Moreover, an open-ended questionnaire was also sent out through 35 emails to the 14-state education department and IT personnel in Malaysia's Natural disaster Management Agency under the Prime Ministers Department (NADMA) and Ministry of Energy, Science, Technology, Environment and Climate Change (KeTTHA). Surprisingly, none of the officials answered the questionnaire. The items

are in Appendix XII. This is another hindrance in deriving to a conclusion on how well is the GICT implementation and monitoring in the country.

7.6 Conclusion

Researchers have stressed their concern over the climate change globally. Climate change is considered the most important challenge that the world faces today. In the recent decade, studies have shown that greenhouse gases emission has accelerated tremendously especially in the developing countries. Computers and other ICT infrastructures have been named as a significant contributors of greenhouse gases. Study by Gartner (2008) revealed that ICT has its portion of 2-3% in the whole carbon footprint. Greenhouse gases such as the carbon dioxide has been known to be dangerous and very harmful to all living entities in our environment (Abdullahi Bello,2015: Sekaran,2008).

This is caused by the large draw of electricity and consumption by the computers and data centres. Carbon dioxide emission is caused by the usage of fossil fuels in electricity generation. Moreover, computers and other ICT infrastructure are also a major problem to the environment when disposed in landfills as e-waste. They leachate dangerous heavy metals such as mercury, lead and cadmium into the environment which are capable of causing serious deficiencies to the people and other living beings in the environment. These elements can seep into the underground water and become serious pollutants in our food chain.

ICT equipment's such computer also poses great danger in the process of manufacturing where toxic chemicals are released in assembling the computer parts while soldering and fire production.

GICT was introduced to combat all these negative effects of ICT and its infrastructures. GICT proposes innovative ways to safeguard the environment such as using thin client screens, energy saving modes and labels, optimizing paper usage for printing and recycling computers and its components to avoid it in becoming dangerous e-wastes.

This study was conducted among teachers in Malaysia since they play a salient role in the imparting knowledge to the future generation. This study validated that knowledge, attitude, skill and aspiration are the components that determine the awareness of an individual on GICT. Pearson Coefficient was calculated for each variable and the values show that the objectives of this study have been achieved and all the hypothesis proven. Moreover, a standard linear regression was also formulated that shows that the model fits the dependent and independent variable. T-test in this study showed that there is small difference in the aspect of knowledge between genders but no significant difference in the aspect of awareness.

The barriers in implementing GICT and measures that need to be taken was also enlisted with a hope that this study will be an eye opener for the policy makers and the public in general.

It is a great aspiration of the author that all parties such as individuals, public at large and NGO's focus on green practices in ICT and it would help the policy makers in framing policies and strategies for GICT which could bring benefits towards a sustainable development in the country. Any efforts towards creating awareness on promoting energy conservation among the society should be done in a long-term basis. More programs and campaigns should be anticipated by the government for the idea of green practices to infiltrate the society comprehensively.

This study has validated that the level of awareness on GICT practices among teachers in Malaysia is average and imminent measures should be taken to promote the idea GICT practices for a sustainable future.

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APPENDIX I

ASSESSING AWARENESS OF GICT PRACTICES AMONG TEACHERS IN MALAYSIA

This questionnaire is an instrument aimed to create awareness among teachers about GICT. This study was done under the supervision of Associate Professor Dr Zainal Md Zan, UUM. Thank you for taking part in this study.

Instructions to respondents of the study.

1. **This questionnaire aims at studying the objective and subjective Knowledge of GICT**
2. **The questionnaire consists of six parts;**

   Part A: Demographic background

   Part Bi: Questions on subjective knowledge in GICT

   Part Bii: Questions on objective Knowledge in GICT

   Part C: Attitude of teachers in handling the ICT equipment

   Part D: Teacher's skills in handling ICT equipment

   Part E: Aspiration of teachers in practicing green aspects of ICT

CONSTRUCT OF ITEMS FOR THE ONLINE QUESTIONAIRE

Section	Item Label	Description
A. Demographic	D1	Level of children being taught
	D2	The residing state
	D3	Years of experience as a teacher
	D4	Age of respondent
	D5	Gender of respondent

Section	Item Label	Description- Respondents are required to answer how well do you know about the following terms	None	little	moderate	good	Very good
Bi. Subjective Knowledge	SKN1	Green Computing					
	SKN2	Malaysian Green Technology Policy					
	SKN3	E-waste					
	SKN4	Energy Star					
	SKN5	e-PEAT					
	SKN6	Carbon Footprint					
	SKN7	80plus					
Bii. Objective Knowledge			Strongly	Disagree	Not Sure	Agree	Strongly
	OKN1	ICT equipment's are made of dangerous material					
	OKN2	ICT equipment's contributes to global warming					
	OKN 3	ICT equipment's if disposed in landfill excretes dangerous chemical like mercury and lead					
	OKN 4	ICT equipment's that becomes obsolete in a short period of time is the reason for accumulation of e-waste					

	OKN 5	ICT equipment's such as computers if left on throughout the day will use more energy and emit CO2 to the environment.					
	OKN6	Laptops consumes more energy compared to Desktops					
	OKN7	Usage of "Energy Star" equipment's increases energy consumption					
	OKN8	"Screen Saver" saves electricity					
	OKN9	Laser printers consume less electricity than ink printers					
	OKN10	17 inches monitor needs more electricity to function compared to a 14 inches monitor					
	OKN11	Sleep Mode uses the same amount of electricity as Screen Savers					
	OKN12	To "off" the switch and pull out the plug saves more energy than leaving computers in "sleep mode"					
	OKN13	"Cathode Ray Tube" Monitor is more efficient in saving energy					
	OKN14	Usage of Laptop, Smartphone and Tablet is more energy saving and reduces carbon dioxide emission					

Section	**Item Label**	**Description- This section is about the respondents attitude towards GICT**	Strongly Disagree	Disagree	Not Sure	Agree	Strongly Agree
C. Attitude (Adapted from Abdullahi Bello, 2010)	AT1	Willing to use green aspects of ICT even if it is more expensive					
	AT2	Willing to spare time and energy in practicing green aspects of ICT					
	AT3	Voluntarily use paper for printing without wastage					
	AT4	Willing to forgo comfort in the effort to preserve the environment					
	AT5	Practicing green aspects of ICT can help me contribute towards environmental					

		sustainability					
	AT6	Practicing green aspects of ICT does not affect my work					
	AT7	Practicing green aspects of ICT can increase productivity in school					
	AT8	Practicing green aspects of ICT does not take a lot of time					
	AT9	Practicing green aspects of ICT in our daily work is easy					
	AT10	Practicing green aspects of ICT does not need enormous effort					

Section	**Label Item**	**Description- This section is about the respondents skills in GICT**	Strongly Disagree	Disagree	Not Sure	Agree	Strongly Agree
D. Skills	SK1	I use ICT equipment's such as computer in my daily teaching and learning process					
	SK2	I make sure that the computer switch is turned off and plugged from the socket when not in use					
	SK3	I always activate the screen saver when I am not using the computer					
	SK4	I make sure that the computer goes into the hibernate/standby mode if inactive within 5 minutes					
	SK5	I use a small monitor to avoid electricity wastage					
	SK6	I optimize paper usage by printing on both sides or use recycled papers					
	SK7	I always go for grey scale printing to avoid colour wastage					
	SK8	I only off the computer at the end of the working day					

	SK9	I always activate the power management setting on my computer					
	SK10	I make sure the Bluetooth and Wi-Fi is off when not in use					
	SK11	Brightness of the screen in my computer and phone are always low to save energy					

Section	**Item Label**	**Description- This section is about the respondents aspiration towards GICT**	Strongly Disagree	Disagree	Not Sure	Agree	Strongly Agree
E. Aspiration	ASP1	I am aware of the importance of GICT					
	ASP2	GICT practices helps reduce electricity usage and lessen CO2 emission					
	ASP3	I am concern about the GICT practices in sustaining the environment					
	ASP4	Proper usage of ICT equipment's is not a threat to the environment					
	ASP5	Government need to monitor and enforce usage of GICT in order to sustain the environment					
	ASP6	Carbon emission could be reduced in ways such as file sharing, online teaching, digital archive management, video conferencing, distance learning, e-government and e-management					
	ASP7	Education towards voluntariness in GICT should start at the early stage to make way for environmental sustainability					
	ASP8	I am still able to perform well at work by practicing green aspects of ICT					
	ASP9	I am clear about the green aspects of ICT such as computer					
	ASP10	I will apply the green aspects of ICT in future					
	ASP11	I plan to apply the green aspects of ICT always					

APPENDIX II- DATA OF RESPONSES FOR SUBJECTIVE KNOWLEDGE, IN DETAIL

Items	Level of knowledge	Frequency (Percentage)	Mean	Median	Std. deviation
SKN1- Green Computing	1.None	260 (25.8%)	2.23	2.00	0.923
	2.Little	322 (31.9%)			
	3.Moderate	378 (37.5%)			
	4.Good	32 (3.2%)			
	5.Very Good	16(1.6%)			
	Total	1008			
SKN2-Malaysia's Green Technology Policy	1.None	116(11.5%)	2.60	3.00	0.874
	2.Little	288(28.6%)			
	3.Moderate	512(50.8%)			
	4.Good	64(6.3%)			
	5.Very Good	28(2.8%)			
	Total	1008			
SKN3- E-waste	1.None	88(8.7%)	2.71	3.00	0.862
	2.Little	266(26.4%)			
	3.Moderate	540(53.6%)			
	4.Good	80(7.9%)			
	5.Very Good	34(3.4%)			
	Total	1008			
SKN4- Energy Star	1.None	246(24.4%)	2.32	2.00	1.011
	2.Little	320(31.7%)			
	3.Moderate	340(33.7%)			
	4.Good	74(7.3%)			
	5.Very Good	28(2.8%)			
	Total	1008			
SKN5- E-PEAT	1.None	538(53.4%)	1.61	1.00	0.756
	2.Little	348(34.5%)			
	3.Moderate	102(10.1%)			
	4.Good	18(1.8%)			
	5.Very Good	2(0.2%)			
	Total	1008			
SKN6- Carbon Footprint	1.None	326(32.3%)	2.10	2.00	0.977
	2.Little	354(35.1%)			
	3.Moderate	246(24.4%)			
	4.Good	68(6.7%)			
	5.Very Good	14(1.4%)			
	Total	1008			
SKN7- 80plus	1.None	574(56.9%)	1.56	1.00	0.749
	2.Little	328(32.5%)			
	3.Moderate	86(8.5%)			
	4.Good	16(1.6%)			
	5.Very Good	4(0.4%)			
	Total	1008			
Average		**N=1008**	**2.16**	**2.00**	**0.879**

APPENDIX III- DATA OF RESPONSES FOR OBJECTIVE KNOWLEDGE IN DETAIL

Items	Scale	Frequency	Mean	Median	Std. deviation
OKN1- ICT equipment's are made of dangerous material	1.Strongly Disagree 2.Disagree 3.Not sure 4.Agree 5.Strongly Agree Total	36(3.6%) 240(23.8%) 382(37.9%) 308(30.6%) 42(4.2%) 1008	3.08	3.00	0.921
OKN2-ICT equipment's contribute to global warming	1.Strongly Disagree 2.Disagree 3.Not sure 4.Agree 5.Strongly Agree Total	12(1.2%) 170(16.9%) 230(22.8%) 526(52.2%) 70(6.9%) 1008	3.47	4.00	0.893
OKN3-ICT equipment's disposed in landfills excretes dangerous chemical like mercury and lead	1.Strongly Disagree 2.Disagree 3.Not sure 4.Agree 5.Strongly Agree Total	6(0.6%) 46(4.6%) 258(25.6%) 608(60.3%) 90(8.9%) 1008	3.86	4.00	0.762
OKN4-ICT equipment's that becomes obsolete in a short period of time is the reason for accumulation of e-waste	1.Strongly Disagree 2.Disagree 3.Not sure 4.Agree 5.Strongly Agree Total	8(0.8%) 50(5.0%) 174(17.3%) 618(61.3%) 158(15.7%) 1008	3.72	4.00	0.711
OKN5- ICT equipment's such as computers if left on throughout the day will use more energy and emit CO2 to the environment	1.Strongly Disagree 2.Disagree 3.Not sure 4.Agree 5.Strongly Agree Total	4(0.4%) 138(13.7%) 270(26.8%) 518(51.4%) 78(7.7%) 1008	3.52	4.00	0.838
OKN6- Laptops consume more energy compared to desktops	1.Strongly Disagree 2.Disagree 3.Not sure 4.Agree 5.Strongly Agree Total	34(3.4%) 306(30.4%) 410(40.7%) 240(23.8%) 18(1.8%) 1008	2.90	3.00	0.860
OKN7- Usage of "Energy Star" equipment's increases energy consumption	1.Strongly Disagree 2.Disagree 3.Not sure 4.Agree 5.Strongly Agree Total	114(11.3%) 308(30.6%) 416(41.3%) 154(15.3%) 16(1.6%) 1008	2.65	3.00	0.924
OKN8- "Screen	1.Strongly Disagree	24(2.4%)	3.54	4.00	0.886

Saver" saves electricity	2.Disagree 3.Not sure 4.Agree 5.Strongly Agree Total	128(12.7%) 206(20.4%) 580(57.5%) 70(6.9%) 1008			
OKN9- Laser printers consume less electricity than ink printers	1.Strongly Disagree 2.Disagree 3.Not sure 4.Agree 5.Strongly Agree Total	18(1.8%) 159(15.8%) 480(47.6%) 325(32.2%) 26(2.6%) 1008	3.18	3.00	0.789
OKN10- 17 inches monitor needs more electricity to function compared to a 14 inches monitor	1.Strongly Disagree 2.Disagree 3.Not sure 4.Agree 5.Strongly Agree Total	6(0.6%) 136(13.5%) 396(39.3%) 414(41.1%) 56(5.6%) 1008	3.38	3.00	0.807
OKN11- Sleep Mode uses the same amount of electricity as Screen Savers	1.Strongly Disagree 2.Disagree 3.Not sure 4.Agree 5.Strongly Agree Total	50(5.0%) 332(32.9%) 318(31.5%) 294(29.2%) 14(1.4%) 1008	2.89	3.00	0.929
OKN12- To "off" the switch and pull out the plug saves more energy than leaving computers in "sleep mode"	1.Strongly Disagree 2.Disagree 3.Not sure 4.Agree 5.Strongly Agree Total	6(0.6%) 28(2.8%) 70(6.9%) 602(59.7%) 302(30.0%) 1008	4.16	4.00	0.714
OKN13- "Cathode Ray Tube" Monitor is more efficient in saving energy	1.Strongly Disagree 2.Disagree 3.Not sure 4.Agree 5.Strongly Agree Total	58(5.8%) 78(7.7%) 664(65.9%) 186(18.5%) 22(2.2%) 1008	3.04	3.00	0.761
OKN14- Usage of Laptop, Smartphone and Tablet is more energy saving and reduces carbon dioxide emission	1.Strongly Disagree 2.Disagree 3.Not sure 4.Agree 5.Strongly Agree Total	10(1.1%) 104(10.3%) 436(43.3%) 424(42.1%) 34(3.4%) 1008	3.37	3.00	0.752
Average		**N=1008**	**3.34**	**3.43**	**0.825**

APPENDIX IV- DATA OF RESPONSES FOR ATTITUDE IN DETAIL

Item	Scores	Frequency	Mean	Median	Std. Dev.
AT1- I am willing to use green aspects of ICT even if it is more expensive	1.Strongly Disagree 2.Disagree 3.Not sure 4.Agree 5.Strongly Agree TOTAL	12(1.2%) 76(7.5%) 162(16.1%) 660((65.5%) 98(9.7%) 1008	3.75	4.00	0.778
AT2- I am willing to spare time and energy in practicing green aspects of ICT	1.Strongly Disagree 2.Disagree 3.Not sure 4.Agree 5.Strongly Agree TOTAL	4(0.4%) 56(5.6%) 120(11.9%) 746(74.0%) 82(8.1%) 1008	3.84	4.00	0.658
AT3- I voluntarily use paper for printing without wastage	1.Strongly Disagree 2.Disagree 3.Not sure 4.Agree 5.Strongly Agree TOTAL	18(1.8%) 112(11.1%) 66(6.5%) 678(67.3%) 134(13.3%) 1008	3.79	4.00	0.872
AT4- I am willing to forgo comfort in the effort to preserve the environment	1.Strongly Disagree 2.Disagree 3.Not sure 4.Agree 5.Strongly Agree TOTAL	4(0.4%) 54(5.4%) 164(16.3%) 672(66.9%) 114(11.3%) 1008	3.83	4.00	0.706
AT5-Practicing green aspects of ICT can help me contribute towards environmental sustainability	1.Strongly Disagree 2.Disagree 3.Not sure 4.Agree 5.Strongly Agree TOTAL	4(0.4%) 0(0.0%) 56(5.6%) 714(70.8%) 234(23.2%) 1008	4.16	4.00	0.545
AT6-Practicing green aspects of ICT does not affect my work	1.Strongly Disagree 2.Disagree 3.Not sure 4.Agree 5.Strongly Agree TOTAL	8(0.9%) 26(2.4%) 126(12.5%) 670(66.5%) 178(17.7%) 1008	3.98	4.00	0.690
AT7-Practicing green aspects of ICT can increase productivity in school	1.Strongly Disagree 2.Disagree 3.Not sure 4.Agree 5.Strongly Agree TOTAL	4(0.4%) 24(2.6%) 224(22.2%) 618(61.3%) 136(13.5%) 1008	3.85	4.00	0.688
AT8-Practicing green aspects of ICT does not take a lot of time	1.Strongly Disagree 2.Disagree 3.Not sure 4.Agree 5.Strongly Agree	4(0.4%) 36(3.6%) 300(29.8%) 548(54.4%) 120(11.9%)	3.74	4.00	0.726

	TOTAL	1008			
AT9-Practicing green aspects of ICT in our daily work is easy	1.Strongly Disagree 2.Disagree 3.Not sure 4.Agree 5.Strongly Agree TOTAL	4(0.4%) 22(2.2%) 248(24.6%) 624(61.9%) 110(10.9%) 1008	3.81	4.00	0.665
AT10-Practicing green aspects of ICT does not need enormous effort	1.Strongly Disagree 2.Disagree 3.Not sure 4.Agree 5.Strongly Agree TOTAL	6(0.6%) 86(8.5%) 304(30.2%) 544(54.0%) 68(6.7%) 1008	3.58	4.00	0.765
Average		**N= 1008**	**3.83**	**4.00**	**0.709**

APPENDIX V- DATA OF RESPONSES FOR SKILL IN DETAIL

Item	Scores	Frequency	Mean	Median	Std. Dev.
SK1- I use ICT equipment's such as computer in my daily teaching and learning process	1.Strongly Disagree 2.Disagree 3.Not sure 4.Agree 5.Strongly Agree TOTAL	6(0.6%) 58(6.2%) 12(1.3%) 466(50.1%) 388(41.7%) 1008	4.25	4.00	0.821
SK2- I make sure that the computer switch is turned off and unplugged from the socket when not in use	1.Strongly Disagree 2.Disagree 3.Not sure 4.Agree 5.Strongly Agree TOTAL	4(0.4%) 28(3.0%) 18(1.9%) 474(51.0%) 406(43.7%) 1008	4.34	4.00	0.714
SK3- I always activate the screen saver when I am not using the computer	1.Strongly Disagree 2.Disagree 3.Not sure 4.Agree 5.Strongly Agree TOTAL	62(6.7%) 206(22.2%) 76(8.2%) 458(49.2%) 128(13.8%) 1008	3.42	4.00	1.151
SK4- I make sure that the computer goes into the hibernate/ standby mode if inactive within 5 minutes	1.Strongly Disagree 2.Disagree 3.Not sure 4.Agree 5.Strongly Agree TOTAL	8(0.9%) 82(8.8%) 68(7.3%) 618(66.5%) 154(16.6%) 1008	3.89	4.00	0.809
SK5- I use a small monitor to avoid electricity wastage	1.Strongly Disagree 2.Disagree 3.Not sure 4.Agree 5.Strongly Agree TOTAL	14(1.5%) 294(31.6%) 196(21.1%) 372(40.0%) 54(5.8%) 1008	3.15	3.00	0.994
SK6- I optimize paper usage by printing on both sides or use recycled papers	1.Strongly Disagree 2.Disagree 3.Not sure 4.Agree 5.Strongly Agree TOTAL	8(0.9%) 18(1.9%) 38(4.1%) 600(64.5%) 266(28.6%) 1008	4.19	4.00	0.657
SK7- I always go for grey scale printing to avoid colour wastage	1.Strongly Disagree 2.Disagree 3.Not sure 4.Agree 5.Strongly Agree TOTAL	4(0.4%) 112(12.0%) 82(8.8%) 564(60.6%) 168(18.1%) 1008	3.83	4.00	0.878
SK8- I only off the computer at the end of the working day	1.Strongly Disagree 2.Disagree 3.Not sure 4.Agree 5.Strongly Agree TOTAL	228(24.5%) 442(47.5%) 50(5.4%) 168(18.1%) 42(4.5%) 1008	2.31	2.00	1.152

SK9- I always activate the power management setting on my computer	1.Strongly Disagree 2.Disagree 3.Not sure 4.Agree 5.Strongly Agree TOTAL	12(1.3%) 98(10.5%) 280(30.1%) 450(48.4%) 90(9.7%) 1008	3.54	4.00	0.850
SK10- I make sure the Bluetooth and Wi-Fi is off when not in use	1.Strongly Disagree 2.Disagree 3.Not sure 4.Agree 5.Strongly Agree TOTAL	16(1.7%) 118(12.7%) 58(6.2%) 482(51.8%) 256(27.5%) 1008	3.91	4.00	0.987
SK11- Brightness of the screen in my computer and phone are always low to save energy	1.Strongly Disagree 2.Disagree 3.Not sure 4.Agree 5.Strongly Agree TOTAL	10(1.1%) 40(4.3%) 34(3.7%) 568(61.1%) 278(29.9%) 1008	4.13	4.00	0.754
Average		N= 1008	3.67	3.70	0.899

APPENDIX VI- DATA OF RESPONSES FOR ASPIRATION IN DETAIL

Item	Scores	Frequency	Mean	Median	Std. Dev.
ASP1- I am aware of the importance of GICT	1.Strongly Disagree 2.Disagree 3.Not sure 4.Agree 5.Strongly Agree TOTAL	6(0.6%) 20(2.2%) 150(16.1%) 630(67.7%) 124(13.3%) 1008	3.91	4.00	0.653
ASP2- GICT practices help to reduce electricity usage and lessen CO_2 emission	1.Strongly Disagree 2.Disagree 3.Not sure 4.Agree 5.Strongly Agree TOTAL	2(0.2%) 4(0.4%) 74(8.0%) 606(65.2%) 244(26.2%) 1008	4.16	4.00	0.603
ASP3- I am concern about the GICT practices in sustaining the environment	1.Strongly Disagree 2.Disagree 3.Not sure 4.Agree 5.Strongly Agree TOTAL	2(0.2%) 12(1.3%) 96(10.3%) 634(68.2%) 186(20.0%) 1008	4.06	4.00	0.598
ASP4- Proper usage of ICT equipment's is not a threat to the environment	1.Strongly Disagree 2.Disagree 3.Not sure 4.Agree 5.Strongly Agree TOTAL	2(0.2%) 10(1.1%) 60(6.5%) 616(66.2%) 242(26.0%) 1008	4.16	4.00	0.595
ASP5- Government need to monitor and enforce usage of GICT in order to sustain the environment	1.Strongly Disagree 2.Disagree 3.Not sure 4.Agree 5.Strongly Agree TOTAL	2(0.2%) 6(0.6%) 38(4.1%) 570(61.3%) 314(33.8%) 1008	4.28	4.00	0.593
ASP6- Carbon emission could be reduced in ways such as file sharing, online teaching, digital archive management, video conferencing, distance learning, e-government and e-management	1.Strongly Disagree 2.Disagree 3.Not sure 4.Agree 5.Strongly Agree TOTAL	0 (0%) 22(2.4%) 182(19.6%) 518(55.7%) 208(22.4%) 1008	3.99	4.00	0.721
ASP7- Education	1.Strongly Disagree	2(0.2%)	4.01	4.00	0.569

towards voluntariness in GICT should start at the early stage to make way for environmental sustainability	2.Disagree 3.Not sure 4.Agree 5.Strongly Agree TOTAL	4(0.4%) 12813.8%) 650(69.9%) 146(15.7%) 1008			
ASP8- I am still able to perform well at work by practicing green aspects of ICT	1.Strongly Disagree 2.Disagree 3.Not sure 4.Agree 5.Strongly Agree TOTAL	6(0.6%) 34(3.7%) 234(25.2%) 556(59.8%) 100(10.8%) 1008	3.76	4.00	0.719
ASP9- I am clear about the green aspects of ICT such as computer	1.Strongly Disagree 2.Disagree 3.Not sure 4.Agree 5.Strongly Agree TOTAL	4(0.4%) 4(0.4%) 52(5.6%) 610(65.5%) 260(28.0%) 1008	4.19	4.00	0.595
ASP10- I will apply the green aspects of ICT in future	1.Strongly Disagree 2.Disagree 3.Not sure 4.Agree 5.Strongly Agree TOTAL	4(0.4%) 2(0.2%) 62(6.7%) 644(69.2%) 218(23.4%) 1008	4.15	4.00	0.576
ASP11- I plan to apply the green aspects of ICT always	1.Strongly Disagree 2.Disagree 3.Not sure 4.Agree 5.Strongly Agree TOTAL	0(0%) 8(0.9%) 66(7.1%) 642(69.0%) 214(23.0%) 1008	4.13	4.00	0.571
Average		**N=1008**	**4.09**	**4.00**	**0.612**

APPENDIX V11- PEARSON CORRELATION FOR EACH VARIABLE

		SK	OK	AT	SKILL	ASP	KN	AW
SK	**Pearson Correlation**	1	.132**	.339**	.299**	.359**	.721**	.390**
	Sig. (2-tailed)		.000	.000	.000	.000	.000	.000
	N	1008	1008	1008	1008	1008	1008	1008
OK	**Pearson Correlation**	.132**	1	.310**	.408**	.382**	.782**	.431**
	Sig. (2-tailed)	.000		.000	.000	.000	.000	.000
	N	1008	1008	1008	1008	1008	1008	1008
AT	**Pearson Correlation**	.339**	.310**	1	.501**	.686**	.430**	.848**
	Sig. (2-tailed)	.000	.000		.000	.000	.000	.000
	N	1008	1008	1008	1008	1008	1008	1008
SKILL	**Pearson Correlation**	.299**	.408**	.501**	1	.588**	.473**	.820**
	Sig. (2-tailed)	.000	.000	.000		.000	.000	.000
	N	1008	1008	1008	1008	1008	1008	1008
ASP	**Pearson Correlation**	.359**	.382**	.686**	.588**	1	.493**	.891**
	Sig. (2-tailed)	.000	.000	.000	.000		.000	.000
	N	1008	1008	1008	1008	1008	1008	1008
KN	**Pearson Correlation**	.721**	.782**	.430**	.473**	.493**	1	.546**
	Sig. (2-tailed)	.000	.000	.000	.000	.000		.000
	N	1008	1008	1008	1008	1008	1008	1008
AW	**Pearson Correlation**	.390**	.431**	.848**	.820**	.891**	.546**	1
	Sig. (2-tailed)	.000	.000	.000	.000	.000	.000	
	N	1008	1008	1008	1008	1008	1008	1008

APPENDIX VIII: PEARSON CORRELATION BASED ON GENDER

Gender			SK	OK	AT	SKILL	ASP	KN	AW
Male teachers	SK	Pearson Correlation	1	.163**	.328**	.308**	.374**	.737**	.379**
		Sig. (2-tailed)		.004	.000	.000	.000	.000	.000
		N	302	302	302	302	302	302	302
	OK	Pearson Correlation	.163**	1	.447**	.415**	.447**	.787**	.491**
		Sig. (2-tailed)	.004		.000	.000	.000	.000	.000
		N	302	302	302	302	302	302	302
	AT	Pearson Correlation	.328**	.447**	1	.664**	.689**	.511**	.884**
		Sig. (2-tailed)	.000	.000		.000	.000	.000	.000
		N	302	302	302	302	302	302	302
	KN	Pearson Correlation	.737**	.787**	.511**	.477**	.540**	1	.573**
		Sig. (2-tailed)	.000	.000	.000	.000	.000		.000
		N	302	302	302	302	302	302	302
	SKILL	Pearson Correlation	.308**	.415**	.664**	1	.702**	.477**	.887**
		Sig. (2-tailed)	.000	.000	.000		.000	.000	.000
		N	302	302	302	302	302	302	302
	ASP	Pearson Correlation	.374**	.447**	.689**	.702**	1	.540**	.895**
		Sig. (2-tailed)	.000	.000	.000	.000		.000	.000
		N	302	302	302	302	302	302	302
	AW	Pearson Correlation	.379**	.491**	.884**	.887**	.895**	.573**	1
		Sig. (2-tailed)	.000	.000	.000	.000	.000	.000	
		N	302	302	302	302	302	302	302
Female teachers	SK	Pearson Correlation	1	.112**	.350**	.310**	.367**	.704**	.412**
		Sig. (2-tailed)		.003	.000	.000	.000	.000	.000
		N	706	706	706	706	706	706	706
	OK	Pearson Correlation	.112**	1	.226**	.406**	.348**	.785**	.398**
		Sig. (2-tailed)	.003		.000	.000	.000	.000	.000
		N	706	706	706	706	706	706	706
	AT	Pearson Correlation	.350**	.226**	1	.387**	.689**	.380**	.822**
		Sig. (2-tailed)	.000	.000		.000	.000	.000	.000
		N	706	706	706	706	706	706	706
	KN	Pearson Correlation	.704**	.785**	.380**	.484**	.477**	1	.542**
		Sig. (2-tailed)	.000	.000	.000	.000	.000		.000
		N	706	706	706	706	706	706	706
	SKILL	Pearson Correlation	.310**	.406**	.387**	1	.518**	.484**	.774**
		Sig. (2-tailed)	.000	.000	.000		.000	.000	.000
		N	706	706	706	706	706	706	706

	ASP	Pearson Correlation	.367**	.348**	.689**	.518**	1	.477**	.892**
		Sig. (2-tailed)	.000	.000	.000	.000		.000	.000
		N	706	706	706	706	706	706	706
	AW	Pearson Correlation	.412**	.398**	.822**	.774**	.892**	.542**	1
		Sig. (2-tailed)	.000	.000	.000	.000	.000	.000	
		N	706	706	706	706	706	706	706

APPENDIX IX: LETTER OF AUTHORIZATION FOR GICT IMPLEMENTATION

From: Dato' Mohamad Zabidi bin Zainal
Sent: 03 August 2010 12:10
To: ksu; suk; Ketua Jabatan
Cc: Tan Sri Mohd Sidek B. Hassan; Dato' Dr. Nor Aliah Mohd. Zahri; Pn. Rahmah Bt. Ramli
Subject: Garis Panduan Penggunaan ICT Ke Arah ICT Hijau Dalam Perkhidmatan Awam
Importance: High

YBhg./YB Tan Sri/Datuk/Dato'/Tuan/Puan,

Seperti YBhg./YB Tan Sri/Datuk/Dato'/Tuan/Puan sedia maklum, Dasar Teknologi Hijau Negara telah dilancarkan oleh YAB Perdana Menteri pada 24 Julai 2009. Bagi menyokong penggunaan ICT Hijau dalam Perkhidmatan Awam, MAMPU sebagai agensi yang menerajui pemodenan ICT dalam Sektor Awam telah mengambil inisiatif dengan memperkenalkan **Garis Panduan Penggunaan ICT Ke Arah ICT Hijau Dalam Perkhidmatan Awam** bagi menyokong Dasar Teknologi Hijau Negara.

2. YBhg./YB Tan Sri/Datuk/Dato'/Tuan/Puan adalah dipohon untuk mengambil tindakan sewajarnya agar langkah-langkah yang digariskan di dalam garis panduan ini dipatuhi, dilaksanakan dan dipantau sepenuhnya dengan berkesan. Garis panduan ini boleh dimuat turun melalui Portal MAMPU (www.mampu.gov.my).

3. Kerjasama dan keprihatinan YBhg./YB Tan Sri/Datuk/Dato'/Tuan/Puan di dalam melaksanakan perkara ini amatlah dihargai bagi memastikan hasrat dan aspirasi YAB Perdana Menteri ke aras ICT Hijau terlaksana.

Sekian, terima kasih.

(MOHAMAD ZABIDI ZAINAL)
3 Ogos 2010

APPENDIX X: GUIDELINES FOR GICT APPLICATIONS AND IMPLEMENTATIONS

(Attachment to the Instruction Letter of the Director General of MAMPU)

GUIDELINES FOR THE USE OF ICT TOWARDS GREEN ICT IN PUBLIC SERVICES

1. AIM

This guide aims to explain the practice of using ICT equipment towards Green ICT to support the National Green Technology Policy in Public Services.

2. BACKGROUND

(a) The National Green Technology Policy was developed by the Ministry of Energy, Green Technology and Water and launched by YAB Prime Minister on 24 July 2009. This policy states that Green Technology as a driver of national economic growth towards sustainable development. It includes economic, environmental and social elements as outlined in the following five (5) objectives:

(a) Reduce the rate of increase in employment and at the same time increase its contribution to the national economy;

(b) To help growth in the Green Technology industry and increase its contribution to the national economy;

(c) To increase the capacity for innovation in the development of Green Technology and increase competitiveness in Green Technology on the international stage;

(d) To ensure sustainable development and conserve the environment for future generations; and

(e) To increase education and public awareness of Green Technology and encourage widespread use of Green Technology.

(b) The Government through the Second Guidelines of the Tenth Malaysia Plan clarified the need for Government agencies to institutionalize Green Technology

policies and practices.

(c) This shows that the use of Green ICT is a strategic move by the Government to support the Green Technology Policy. This initiative is an effort to deal with current global issues such as environmental pollution, depletion of the ozone layer, global warming and related issues that must be implemented jointly by all Government agencies.

(d) MAMPU as the leading agency for ICT modernization in the Public Sector took the initiative to introduce these guidelines to support the above policies and strategies.

3. DEFINITIONS

Based on the Green Technology Policy, the definitions used are as follows:

(a) Green Technology

Refers to the development and application of products, equipment and systems to conserve the environment and natural resources and minimize or reduce the negative effects of human activities.

(b) Green ICT

Refers to practices in terms of the production, use and disposal of computers, servers and accessories such as monitors, mice, printers and network equipment effectively and efficiently with minimal or no impact on the environment. This aims to reduce the use of hazardous materials, save electricity and extend the lifespan of ICT products.

4. IMPLEMENTATION STAGE

In cultivating best practices for the implementation of Green ICT. There are three (3) main stages that need to be taken into account in Green ICT practices, namely:

(a) Stage of Procurement
The stage where the procurement of ICT products that have the characteristics of Green ICT.

(b) Level of Use of ICT Equipment
The stage where the cultivation of green practices in the use of ICT equipment for daily work uses the principles of reduce (reduce), reuse (reuse) and recycle (recycle).

(c) Stage of Disposal
The stage where the disposal process of products that need to be disposed of according to procedures that take into account environmental conservation.

5. SCOPE OF GUIDELINES

Since the field of ICT is a broad field, these guidelines only outline the scope of ICT products which are:

(a) personal computer;
(b) laptop computers;
(c) printers;
(d) server (server); and
(e) application.

6. STEPS TO USE ICT TOWARD GREEN ICT

6.1 ACQUISITION STAGE

In order to ensure that Green ICT in public sector agencies is implemented consistently, the procurement of ICT products must have the specifications of green ICT characteristics as follows:

(a) Savings in the use of electricity;
(b) Low carbon production;
(c) Low heat production;
(d) Minimal use of toxic substances such as printer ink (ink) and toner;
(e) Components in the product that can be reused; and
(f) ICT products or systems that can improve environmentally friendly performance for non-ICT use such as energy control systems, environmental monitoring systems in buildings and others related.

This ICT product must be recognized as green, eco-friendly, energy star and the relevant from the national or international level.

6.2 LEVEL OF USE

For the cultivation of the use of Green ICT, agencies must implement the following practice measures:

(a) Personal computers and Laptops
(i) Not using or activating a screen saver. This is because the use of the screen saver will use the same amount of energy as the use of the active screen;
(ii) Ensure the monitor is in standby/ hibernate state after 5 minutes of inactivity;
(iii) Ensure power management facilities for personal computers and
(iv) Make sure the computer is closed and the switch is off and unplug the computer from the electrical socket when not used for a period of time long. This is to avoid electric current still active in the wiring system through the plug computers that are not turned off and unplugged;

(v) Replacing the Cathode Ray Tube (CRT) monitor with a Liquid Crystal Display

(LCD) monitor. This is because the use of LCD can save 30% to 50% electricity compared to CRT;

(vi) Consider the use of the monitor size suitable because the size of the large monitor will use more electricity; and

(vii) Consider the use of Thin Client Technology where it can reduce consumption electricity and maintenance costs.

(b) Printers

(i) Activate the duplex facility and draft mode on the printer as default. This is to save the use of paper and ink of printer;
(ii) Activate the power-saving sleep mode facility on the printer (if any);
(iii) Reducing the number of stand-alone printers with the creation of network printers that can be shared by civil servants;
(iv) Control the relevant documents only for printed;
(v) Consider printing controls on the printernetwork based on user ID;
(vi) Ensure that the use of paper is correct and optimum
(vii) Reducing the use of materials such as ribbons,paper and toner.

(c) Server (Server)

(i) Optimizing server usage with implement the consolidation method through

virtualisation technology;

(ii) Ensure inactive servers its use should be shut down and switch turned off;

(iii) Consider the use of Keyboard, Visual Display Unit, Mouse (KVM) to the servers for reduce the amount of electricity required and the heat produced by the monitor.

(d) Application

(i) Double the use of online services towards reducing the use of paper and

printed materials;

(ii) Improving the use of email facilities to communicate paperless for official purposes only;

(iii) Considering ease of use a new channel for feedback and formal complaint; and

(iv) Improve the development of online applications which replaces the manual work process.

6.3 DISPOSAL STAGE

ICT products that need to be disposed of must follow procedures which is outlined through Treasury Circular Number 5 Year 2007 "Government Movable Asset Management Procedure" and taking into account environmental conservation and green practices whether it can still be used (reuse) and recycled.

7. ROLE AND RESPONSIBILITY OF AGENCY

In the implementation of Green ICT in agencies that can support National Green Technology Policy, agencies must ensure:

(a) The Chief Information Officer (CIO) of the agency shall play an active role in planning, implement and coordinate efforts and measures help the effective implementation of Green ICT in the agency respectively;

(b) Awareness program among service members public must be held so that all members are committed accept, implement and practice technology culture Green in the use of ICT;

(c) Three (3) stages of Green ICT implementation are implemented for all ICT equipment; and

(d) The monitoring of the implementation of Green ICT is done on a regular basis systematic.

8. AMENDMENTS AND UPDATES

These guidelines are subject to revision and amendments from time to time in line with changes technology, application, procedure and legislation.

9. CLOSURE

Agencies must adhere to these guidelines internally implementing the use of ICT towards Green ICT as efforts to support environmental conservation and Policy National Green Technology.

10. FURTHER INFORMATION

Any questions regarding the content of this document can submitted to:

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ICT Policy and Planning Division
Administration Modernization and Management Planning Unit
Malaysia (AFFORDABLE)
Prime Minister's Department
Level 6, Block B2
Federal Government Administration Complex
62502 PUTRAJAYA
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APPENDIX XI

ASSESSING PLANNING, IMPLEMENTATION AND MONITORING OF GICT PRACTICES IN MALAYSIA

This questionnaire is an instrument aimed to find the level of planning, implementation and monitoring about GICT practices in Malaysia. This study was done under the supervision of Associate Professor Dr Zainal Md Zan, UUM. Thank you for taking part in this study.

1. What are the features that must be present during the procurement of ICT products according to the standards set by the government?

   _____

2. What is the procedure for disposing of ICT Products in the government sector in Malaysia?

   _____

   _____

3. How long are the ICT items are stored before disposal?

   _____

4. Who is responsible for the disposal of ICT goods?

5. In your opinion, is the implementation or practice of green ICT strategy at the departmental and school level practiced efficiently? If not why?

6. Do you play an active role in planning, implementing and coordinating the efforts and implementation measures of Green ICT in the Department?

7. What are the programs implemented at the departmental level to implement the practice of Green ICT culture among officers in the department and teachers in schools?

8. Is the monitoring of the implementation of green ICT is carried out by the department or ministry? If so, how?

9. What is your comment on the planning, implementation and monitoring of Green ICT in our country?