

## **AWARENESS OF GREEN TECHNOLOGY AMONG ENGINEERING TECHNOLOGY STUDENTS**

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### **Abstract**

Sustaining biodiversity and clean environment are the main aims of green paradigm. However, past research has shown that green awareness among people especially in the developing and third world countries is low. Hence, the purpose of this case study was to identify the awareness of engineering technology students regarding green technology in one of the public universities in Malaysia. Technology Acceptance Model (TAM) was used as the underpinning theoretical framework. A sample of 40 final-year university students from the Department of Engineering Technology was randomly selected. The study found that even though the majority of the respondents claim that their awareness of green technology is relatively high, the daily application of green technology in their lives is only moderate. Interestingly, in the open-ended section, respondents were asked to state an example of a green technology, one-fourths (25%) of the respondents admitted that they do not know. Further, almost half of the respondents state that Malaysian citizens have rather low awareness of green technology.

Keywords: Engineering technology major, Green technology, Technology Acceptance Model (TAM), University students.

## 1. Introduction

In his book “The World in 2050”, Smith [1] predicts four major forces that will shape the world in 2050 - demography, natural resources, climate, and globalization. With depleting natural resources, the world is looking for viable alternatives in terms of generating renewable energy. United Nations report on Green Technological Transformation [2] asserts that overall assessment on the countries’ policy on the environment is critical. As the earth’s population is expected to reach nine billion people by 2050, it is pertinent to evaluate the pace of productive economic expansion - this growth must be balanced with respect to the human and natural capitals.

Damages from deforestation, excessive carbon emission, toxic and non-biodegradable waste will affect the lives on this planet. To maintain environmental quality, we need clean air, non-toxic water, renewable energy, stable climate, and green waste management. Future generation is expecting a better world for them and sustaining the mother earth must begin with green awareness from the early age. However, literature has shown that awareness of green practices and products among students are only moderate [3]. According to Hassan et al. [4], Lim [5], and Osman et al. [6] students claim to possess knowledge on the environment but their green skills are rather questionable. Another study found that Malaysian public universities students have insufficient knowledge about green technology [7]. Thus, the aim of the study was to investigate green technology awareness and practice among engineering technology students in one of the public universities in Malaysia.

## 2. Background of the Study

The Rio Declaration and Kyoto Protocols are two prominent declarations on the environment besides the Earth Charters. In the nutshell, these world agendas were designed to protect this planet from environmental hazardous activities and to sustain balance development. The countries that signed in must show commitment to implement the declarations and protocols based on green paradigm. As such, green technology, green economy and green lifestyle are on the top priority list of the United Nations’ agenda in order to sustain the mother earth and to reduce global warming. In other words, environmentally clean technology is expected to be created and used at a faster rate. World economy is changing to adopt green economy and higher investment is expected in green sector. Life style, careers, education and training are tailored to accommodate green demands in the future. Renewable energy, green vehicles, non-carbon technology would be created to suppress greenhouse effects.

Green technology is the core technology in the Fourth Industrial Revolution where green digital is used in Artificial Intelligence, autonomous vehicles and robotics. Future technology should be intelligent and environmentally friendly. Green or “clean” technology is unique technology, which is non-detrimental to living things. Green technology is powered by renewable energy and it minimizes any form of waste. With depleting of natural resources as predicted by Smith [1], the aim of green technology is to reduce the consumption of fossil fuels. Carbon-based fuels, carbon dioxide emission and non-biodegradable garbage are the main contributors to earth’s pollution and environmental hazards. The exhaustion of our limited natural resources such as fossil fuels is a significant threat to our sustainable development where the depletion of fossil fuels is eminent by 2050 [8].

Another hazard is non-biodegradable waste that poses enormous menace of world's sustainability. With more than a billion tons of garbage per year, the world is "drowning" with waste dumps and toxic gases [9]. Hence, a sustainable waste management is required and public awareness of 3Rs - Reduce, Reuse and Recycle should be harnessed. In other words, enhancing green education in terms of heightening green awareness, green knowledge and skills of the contemporary youth and the future generation is critical.

### 3. Problem Statement

According to the Malaysian National Professor Council [10], in general, Malaysian students have poor green skills. This is due to the education regarding green technology is limited [11]. Green skills are important especially for engineering technology students so that they could design and invent green devices and green systems in the future. People may be preoccupied with the economic survival than to worry about environmental quality. It is often said that not-so-rich countries focus on the 'development' and those of richer countries pay attention to the 'environment'. Hence, the ways to achieve 'sustainable development' remain ambiguous [12]. According to United Nations [13], the world population will reach 9.6 billion people by 2050, from 7.2 billion today. Thus, if the current modes of consumption continue, the resources of 'two' planet earths may be required to sustain the population in 2050.

According to Upton [14], global population is increasing fairly rapid especially in the developing countries and in urban environments where problems of waste and pollution are intensifying. Food production may be able to keep pace but not the distribution. There are increasing problems getting access to clean water or safe freshwater. Energy use is rising and with it the emission of greenhouse gases is influencing the world's temperature rising and climate change. Acid rain is a growing problem. Global forests continue to shrink due to deforestation and open burning of the forests in some poorer countries. In fact, we are at the critical moment in the global environment. A global green revolution is needed to save the planet earth. The starting point must begin with the young generation. In Malaysia, several empirical studies have shown green practice among Malaysians are still low [15, 16]. Thus, it is pertinent to conduct this research to identify green awareness and practice among engineering technology students. The theoretical framework underpinning this study was based on Davis' Technological Acceptance Model (1989) [17]. This model explains about users' perception on usability of a technology. The model comprises elements such as (a) perceived usefulness (PU) and (b) perceived ease-of-use (PEOU). This model is an extension to the theory of reasoned action (TRA) by Ajzen and Fishbein. This theory assumes some forms of intentions to act.

### 4. Methodology

The research design used in this study was a single site with multiple cases. A sample of 40 final-year students from a population of 74 final-year engineering technology students from one public university was selected randomly. A set of questionnaires was constructed based on the research objectives and the conceptual framework. The 5-point Likert scale questionnaire (1=Strongly Disagree; 2=Disagree; 3=Uncertain; 4=Agree; 5=Strongly Agree) was validated by a panel of experts in the field and also

in a pilot test. Green awareness and practice of prospective engineering technologists were measured in this empirical research.

## 5. Results

The results section begins with the demographic information of the respondents ( $n=40$ ). Table 1 shows that the majority (75%) of the respondents were females and only 25% were male students. In this study, more females were selected from certain fields such as food technology where majority of the students were females. In terms of age group, most (67.5%) of the respondents were between 25 to 30 years old. About one-thirds (32.5%) were aged between 20 - 24 years old. Socio- economic status (SES) of the respondents shows the majority (85%) from low to middle-w income categories.

**Table 1. Demographic variables.**

Variables	Frequency ( <i>f</i> )	Percentage (%)
<b>Gender</b>		
Male	10	25.0
Female	30	75.0
<b>Age</b>		
20 - 24 years old	13	32.5
25 - 30 years old	27	67.5
<b>Estimated Monthly Household Income</b>		
Low (MYR 1,000 and below)	18	45.0
Middle Low (MYR 1,001 - MYR 3,000)	16	40.0
Middle High (MYR 3,001 - MYR 6,000)	5	12.5
High (MYR 6,001- MYR 10,000)	1	2.5

With respect to the awareness of green technology (see Table 2), in general, the respondents have positive attitude toward green technology ( $M=4.28$ ;  $SD=0.67$ ). They strongly agreed that green technology was important ( $M=4.53$ ;  $SD=0.68$ ) and it could enhance their quality of life ( $M=4.38$ ;  $SD=0.63$ ). They knew very well that planting trees will help reduce greenhouse effect ( $M=4.63$ ;  $SD=0.67$ ) and it could stimulate economic growth ( $M=4.38$ ;  $SD=0.71$ ). They plan to use green technology ( $M=4.25$ ;  $SD=0.71$ ) and they were aware that they need to enhance their knowledge about green technology ( $M=4.45$ ;  $SD=0.64$ ).

**Table 2. Awareness of green technology.**

Items	<i>M</i>	<i>SD</i>
1 I believe green technology is important	4.53	0.68
2 Planting trees will help reduce greenhouse effect	4.63	0.67
3 By using green technology, it will beneficial for my health	4.63	0.67
4 Green technology will generate better economic growth	4.38	0.71
5 I need to enhance my knowledge on green technology	4.45	0.64
6 I plan to use green technology in my future workplace	4.25	0.71
7 I believe green technology will enhance my quality of life	4.38	0.63
Total average	4.28	0.67

Theoretically, the respondents admitted that they have high awareness of green technology. However, in practice, their awareness in using green technology showed polarized responses as the means were getting lower and the standard deviations were getting higher (see Table 3). In general, the respondents were slightly agreed ( $M=3.55$ ;  $SD=1.03$ ) that they used green technology in their daily lives. Specifically, the respondents believe that they use green technology to sustain healthy environment ( $M=3.88$ ;  $SD=0.79$ ). They also agreed that they separate the rubbish ( $M=3.65$ ;  $SD=1.23$ ) and practice recycling at home and the workplace ( $M=3.78$ ;  $SD=1.03$ ). However, the respondents were unsure whether they use organic materials ( $M=3.10$ ;  $SD=1.15$ ) or stop buying CFC-contained sprays ( $M=3.20$ ;  $SD=1.07$ ) to protect the environment. As mentioned earlier, the high standard deviations for most of the items in this section shows variability of the responses.

**Table 3. Usage of green technology.**

	Items	<i>M</i>	<i>SD</i>
8	I use green technology to create healthy environment	3.88	0.79
9	I use organic material to reduce usage of chemical in my daily life	3.10	1.15
10	I stop buying spray that contains CFC because CFC is harmful to the ozone layer.	3.20	1.07
11	I bought stuff that can be recycled or made from recycled materials	3.70	0.91
12	I separate rubbish into categories such as papers, plastic, bottles and cans for recycling purposes	3.65	1.23
13	I practice recycling in my home and workplace	3.78	1.03
	<b>Total average</b>	<b>3.55</b>	<b>1.03</b>

Tables 4 and 5 illustrate the students' attitudes on the environment and the practice of recycling waste. As expected, both categories portray high means that reflect the positive attitudes of the respondents toward protecting the environment and recycling the wastes. Table 4 shows that the respondents believe that green technology will reduce global warming ( $M=4.30$ ;  $SD=0.82$ ) and they plan to use green technology in their future workplace ( $M=4.10$ ;  $SD=0.74$ ). They strongly agreed they had planted trees ( $M=4.25$ ;  $SD=0.74$ ) but slightly agreed that they had join the environmental campaign ( $M=3.53$ ;  $SD=0.74$ ). In terms of recycling wastes (see Table 5), the respondents claim that they used recycled papers ( $M=4.10$ ;  $SD=1.00$ ) and disposed toxic materials properly ( $M=4.10$ ;  $SD=0.81$ ). Also, they strongly agreed that they never throw rubbish to the drains or rivers ( $M=4.40$ ;  $SD=0.59$ ) and used water cautiously so that the water was not wasted ( $M=4.45$ ;  $SD=0.64$ ).

**Table 4. Environment.**

	Items	<i>M</i>	<i>SD</i>
19	I believe green technology will reduce global warming	4.30	0.82
20	I plan to use green technology at my future workplace	4.10	0.74
21	I plant trees in my compound to protect the environment	4.25	0.74
22	I join environmental campaign to use green technology	3.53	0.74
	<b>Total average</b>	<b>4.10</b>	<b>0.70</b>

Tables 6 show the results of open-ended items. In identifying environmental pollutants, most respondents pointed to toxic gases from automobiles and industrial gases ( $f=30$ ) followed by dumpster ( $f=27$ ), toxic wastes ( $f=17$ ) and open burning ( $f=16$ ). When asked qualitatively about the level of green technology awareness of Malaysians, the respondents rated moderate to low levels.

**Table 5. Recycling wastes.**

	Items	<i>M</i>	<i>SD</i>
23	I use recycled papers	4.10	1.00
24	I properly dispose toxic chemicals	4.10	0.81
25	I never throw rubbish into drain or river	4.40	0.59
26	I use water minimally in order not to waste this precious resource	4.45	0.64
<b>Total average</b>		<b>4.25</b>	<b>1.12</b>

**Table 6. Environmental pollutants.**

Pollutants ( $n=40$ )	Frequency ( $f$ )
Toxic gases from automobiles and factories	30
Rubbish	27
Toxic wastes	17
Open burning	16

Final section of the open-ended items queried about the respondents' knowledge on specific green technology and the suggestions to enhance the awareness of green technology among Malaysians. The specific green technology that the respondents familiar with. Surprisingly, one-fourths of the respondents (25%) could not give any specific example. Others provide popular examples of environmentally friendly strategies such as recycling, planting trees, use paper bags (instead of plastics) but these are not necessarily categorized as green technology. Specific green technology mentioned by few respondents includes using hybrid car, hydroponic, and solar panels. This shows the shallowness of the respondents' knowledge on green technology. The respondents recommended approaches to promote greater awareness of green technology at their future workplace. Most of the respondents suggest green campaign ( $f=39$ ) followed by planting greeneries ( $f=32$ ) and put in place recycling program ( $f=28$ ). Perhaps a unique response is the idea of introducing Green Technology Competition as suggested by some respondents.

## 6. Discussion, Conclusion and Recommendations

The sample comprised final-year undergraduate students mostly aged between 25 to 30 years old and coming from low to middle-income families. No significant differences were detected regarding their perceptions on green technology across demographic variables. They seemed to be in consensus with regard to the critical issues raised in this study. Data have shown that, in general, the respondents have positive attitude toward green technology. They strongly agreed that green technology was essential and it could improve their quality of life. Literature has shown that 'development' and 'environment' could be two opposite sides of a coin [12]. If a country put high emphasis on development, it may 'sacrifice' the environment. Hence, United Nations report [2] suggests that instead of seeing

development and sustainability as two opposites, it is more appropriate to see them as complimentary and mutually supportive imperatives. This may become possible if the whole world agrees to embrace low-carbon, resource-efficient and to adopt green economic model.

However, when it comes to practice in using green technology, the respondents gave polarized responses. Therefore, it is vital to nurture green skills including employability skills for engineering students [16, 18]. In practice, the respondents were hardly agreed that they used green technology in their daily lives. Nonetheless, they believe that green technology will reduce global warming and they plan to use green technology in their future workplace. They have planted trees but not very often join the environmental campaigns. Malaysian government has launched the 'love our rivers' campaign since 1993 [19]. This campaign was designed to protect the rivers and to sustain the water quality of the rivers.

Based on the findings of the study, we could conclude that green values and thinking must be inculcate among young generation through green education using varied strategies including Problem-Based Learning [20, 21]. Integrated and collaborative strategies must be put in place [22, 23]. The government should also play proactive role in encouraging Malaysian citizens and businesses to use green technologies. Green technology policy and law should be implemented to curb environmentally degrading activities. In addition, implementing green curriculum at all levels of education (e.g., schools, colleges and universities) must be made compulsory. Proper training should also be given to technical professionals, in general, and technical/technology teachers, in particular, to use green technologies in their classes or workshops, and the adoption of green values and thinking as the new paradigm with slogan such as 'saves the world'. Last but not least, everyone must play an active role to promote and use green technology, whenever possible, in order to see greener future.

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