

## Focussing on recycling attitudes of engineering students at UiTM Shah Alam - towards zero discharge

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**Abstract.** The generation of municipal solid waste (MSW) in Malaysia over the past 10 years has increased by 95 percent due to rapid development in the urban areas. 16.76 million tonne of waste is expected to be generated by Malaysian in the year 2020. Presently, there are about 70 percent of waste produced reported to be collected and 95 percent of it are disposed in landfills with only 5 percent left are being recycled. A 40 percent reduction of waste disposed to landfill by year 2020, through recycling and intermediate treatments such as waste to energy, composting and material recovery is very much needed as opening new landfills are not socially attractive. It clearly shows the awareness in reducing waste through recycling is still at infancy among Malaysians. Hence, a proper solid waste management should be enhanced through education among youngsters to ensure an integrated solid waste management towards zero discharge is achievable. The purpose of the research is two-fold. Firstly, to determine the recycling practices awareness among engineering students through manual and on-line survey. Secondly, a study on the effectiveness of recycling bins at the engineering students' centre. The data collected were analyzed using statistical analysis. Results show that there is significant relationship ( $p < 0.05$ ) between gender and knowledge on recycling using Chi square test. However, there is an insignificant relationship ( $p > 0.05$ ) between knowledge and awareness of students towards recycling using partial correlation. Nevertheless, it is important to note that recycling practices through the provision of well-designed recycling bins and continuous education will ensure a sound society upholding a Zero Discharge attitude in the future.

### 1. Introduction

Malaysia presently is experiencing rapid growth of economy and urban transformation since the last decade. With respect to this, the amount and types of solid waste have increased gradually corresponding to the economic growth and improving living standard. Solid waste is one of the major environmental problems faced by most municipalities in Malaysia [1]. The generated amount of solid waste increases from 17,000 per day to 19,100 tons in 2005, an average of 0.8 kilogram per capita per day [2]. From the statistics obtained, it is expected that in year 2020, the amount of solid waste generated is 30,000 tons per day [1]. The waste in Malaysia consists of 45% food waste, 23% plastic, 7% paper and 6% iron. It is approximated that 95-97% of waste collected is taken to landfill for disposals. Meanwhile, the remaining waste is diverted to recyclers or being dumped illegally [1].

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Solid waste management program is one of the greatest challenges to achieve institutional sustainability [3]. There are few methods of handling municipal waste which are reduce, reuse, recover, treatment and disposal to the landfills. In order to achieve an effective solid waste management, the society should be educated and preferably students are the first target. One of the methods to reduce waste generated is through recycling. The waste management in the campus can be initiated from the effective recycling program that is being implemented by the university [4]. Recycling can be defined as a recovery process of waste from used products through their reuse in which it may be used for other purposes or for their original purpose [5]. A successful recycling programme is affected by few factors which are the technology, participation of public, the development and maintenance of environmentally responsible behaviour [6].

In 1987, the Action Plan for a Beautiful and Clean Malaysia (ABC Plan) was implemented which aims to minimize the waste generated but unfortunately, there was no legal and fiscal instrument to regulate the plan which leads to the first and second recycling program in 1993 and 2000. Ever since, National Recycling Day has become an annual event in Malaysia celebrated on every November 11<sup>th</sup> [4]. Nevertheless, based on the world recycling rate data in 2015, Malaysia holds the fifth lowest rank in the world where the recycling rate is at 17.5% [8] which is unimpressive compared to her neighbour, Singapore which holds the top rank where 59% of the Singaporean practices recycling. To date, the awareness of the recycling practices is still lacking and targeting 22% in the year 2020 [9]. Table 1 represents the methods of waste disposal in Malaysia in year 2002, 2006 and the targeted year of 2020 of waste disposal [10]. There are six treatment of waste disposal comprising of recycling, composting, incineration, inert landfill, sanitary landfill and other disposal sites. Back in year 2002 and 2006, the most popular method of disposal is by treating the waste to other disposal sites. Other disposal sites refer to open dumpsites which have illegal dumping or have accumulated a huge quantity of waste. However, Malaysia has targeted to reduce to zero percent of waste being sent to other disposal sites in 2020. Instead, sanitary landfill has been targeted to have the highest percentage followed by recycling and incineration in year 2020. To emphasise the importance of waste segregation, the government has imposed the “Waste Segregation Bill” effective 1<sup>st</sup> September 2016 to homeowners and fines to be imposed to those who ignore the call.

**Table 1.** Method of waste disposal in Malaysia.

Treatment Methods	Percentage		
	2002	2006	2020 (Targeted)
Recycling	5.0	5.5	22.0
Composting	0.0	1.0	8.0
Incineration	0.0	0.0	16.8
Inert landfill	0.0	3.2	9.1
Sanitary landfill	5.0	30.9	44.1
Other disposal sites	90.0	59.4	0.0
Total	100.0	100.0	100.0

It is crucial to start educating the young ones about the importance and benefits of recycling as well as encouraging them to participate in recycling to care for the environment. It is believed that the current and future waste generators will respect and conserve natural resources through education by making informed waste prevention choices [11]. Hence the authors wish to emphasise that University Teknologi Mara (UiTM) with a total number of students of more than 150,000 and being the biggest university in Malaysia, plays a vital role to subscribe to waste management education to be embedded in all the fields she offers. UiTM Shah Alam is the biggest branch and has a total population of some 42,000 students where 25% of them study engineering. Although a recycling campaign was organized

by the facility department of the university in year 2013-2014, where recycle bins were placed at the centre of engineering building, the lack of response and support from the students made the effort seemed futile. Thus, continuous education on the importance of recycling practice among the students is required to be done and provision of recycling bins at the students' centres are the main focus of this research. Issues regarding the operational maintenance and placement of recycling bins at selected location were not particularly attended to, but, these were in no way jeopardise the clear intention of why sound waste management particularly recycling should be performed by the students.

## **2. Experimental procedure and methodology**

The study used questionnaires to elicit responses, with specific focus on awareness and behaviour of recycling among students and effectiveness of recycling bins at engineering students' centre. Engineering students are being used in the study because they contribute to 25% of total population of students in UiTM Shah Alam. The following method of data collection was selected in order to fulfil the objectives of the research.

The students' centres are located at the beautifully designed Kompleks Kejuruteraan Sultan Abdul Halim which comprises of two tower buildings that houses the lecturers' rooms and five blocks of lecture halls, tutorial rooms and laboratories. The students' centres for the civil engineering students are located at level 5 of Block 1, for mechanical engineering is located at Level 3 of Block 3, and for both the electrical engineering and chemical engineering students centres located at Block 4 and 5 respectively. Besides these locations, students seating area are also available at the base of the tower buildings close to the library. The study is being conducted at the students' centre/ lecture venues since it is the strategic and the most frequent place for the students to conduct group discussion or self-study. Thus, indirectly, the behaviours of students towards sustaining recycling practices can easily being observed.

The respondents are randomly selected from all the four branch of engineering fields. However, it is to be noted there are limitations while conducting the research. Limitations are factors than cannot be controlled by the researcher meanwhile, delimitations are restrictions that the researcher deliberately imposes on the study to narrow the scope. The first limitation of the study was that some of the respondents received may well be of the same respondents but at the same time there are those approached that do not want to continue to participate in the survey conducted after the first or second survey. Another crucial limitation is the respondents' degree of honesty when filling out the questionnaire. In this case, the respondents would answer the questions based on what they think is the right ones or selection when the fact is it opposes to what they actually do.

There are three (3) phases of questionnaires delivered gradually to fulfil the objectives to study the awareness and perceptions of engineering students towards recycling practices as well as to determine the effectiveness of recycling bins provided in the campus. In the first phase of questionnaire, the questions asked focuses on the waste management in the campus and to identify the awareness of respondents on recycling practices. It was conducted in November 2016. Besides the questionnaires, to complement the survey, there are five (5) recycling bins being placed at the students' centres previously described. These recycling bins were supplied at the faculty at the beginning of Phase 2. Hence, the second phase of the questionnaire that was conducted on March 2017 were aimed to study the effectiveness of the new recycling bins at engineering students' centres. The final phase of questionnaires in May 2017 seeks further respondents understanding on how waste segregation helps to conserve the environment. A total of 1129 respondents were received from all sets of questionnaires. The data collected is then analyzed using statistical analysis (Minitab) to determine the significant of the selected variables.

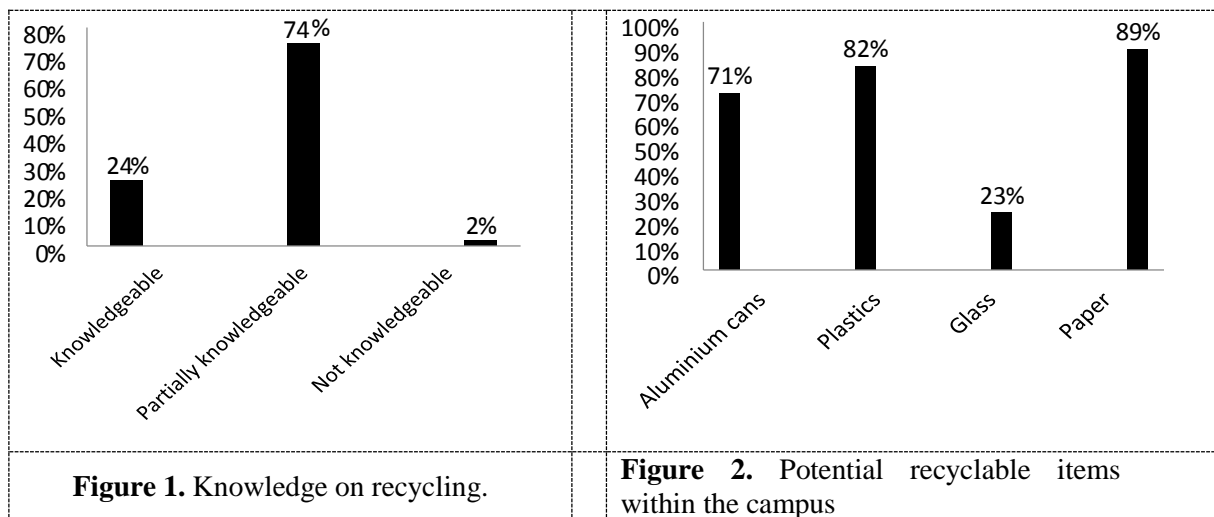
## **3. Results and Discussion**

The questionnaires were conducted in stages with a total of 1129 respondents. Table 2 shows the demographic data of the students involved in the first and second phase of the study. No demographic data was needed in the third phase of the questionnaire since it only focuses on how waste segregation

helps to conserve the environment. In the first phase, the questions asked focused on the awareness of respondents on the knowledge and awareness of recycling at the faculty. The questions were purposely asked to determine the knowledge of respondents towards recycling practices and to determine if they are aware on the environmental issues surround their place of study.

**Table 2.** Demographic data.

Demographics data	Percentage
Gender	
Male	54%
Female	45%
Age	
19-21	18%
22-24	74%
25-27	7%
>27	1%
Field of engineering	
Electrical	21%
Chemical	44%
Civil	18%
Mechanical	17%



Regarding the knowledge of recycling among the students, most of the respondents are partially knowledgeable about recycling, 24% are knowledgeable and a minority of 2% knows nothing at all (figure 1). A statistical analysis was done using partial correlation between respondents' knowledge and the awareness level towards recycling. From the analysis obtained, it was found that an insignificant relationship of ( $p > 0.05$ ) with a correlation of 0.81 was obtained. It has shown that there is no significant relationship between knowledge and awareness level. A Chi Square Test was conducted which is associated with gender and the knowledge on recycling. From the statistical analysis obtained, the Pearson Chi Square, gives a p-value less than significance level ( $p < 0.05$ ). Thus, it is concluded that there is a relationship between gender and knowledge on recycling. Specifically, this approach is appropriate because the sampling method consists of simple random sampling.

To complement the survey, a waste composition study was performed to know what are the general items of the waste discarded by the students. As the research is focussing on recyclable materials, the waste is categorised only as plastics, paper, food waste, aluminium cans and those that are of

multicomponent such as battery, cartridge ink, motherboard or any electrical circuit and wires are termed as miscellaneous (table 3). However, it must be noted that the results intend to show the typical composition of students' as generators at the university taken at specific time and days of the week during the period of study. Besides, other waste composition such as textile, rubber and metals are not included.

**Table 3.** Waste composition at faculties of engineering, UiTM.

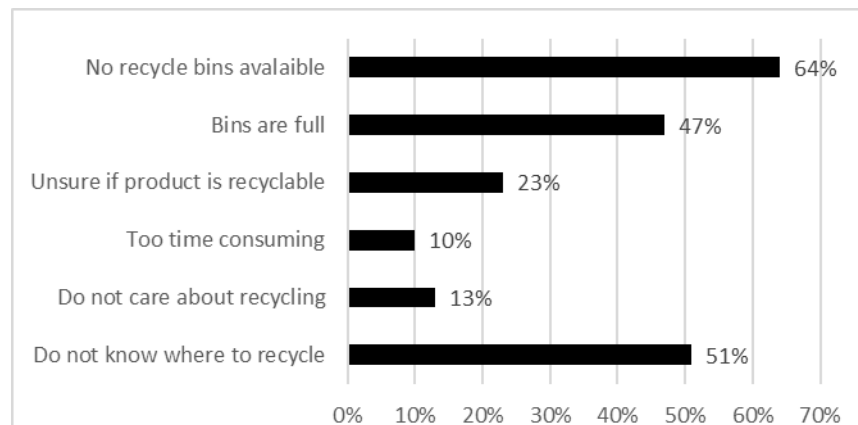
<div> <div>Date/ Day</div> <div>Composition of Waste</div> </div>	24/4/17 Mon	3/5/17 Wed	8/5/17 Mon	15/5/17 Mon	22/5/17 Mon
Paper	15.20	20.91	26.50	30.26	25.26
Plastic	34.80	27.71	29.85	26.24	28.81
Aluminium Can	1.82	0.71	1.70	1.78	1.30
Food Waste	28.04	30.35	34.09	30.42	29.97
Miscellaneous	14.10	15.23	19.18	16.80	13.99
Total	94.26	94.91	111.32	105.50	99.33

As can be observed in table 3 the waste collected varies between 94 – 111 kg depending on the students' activities or presence at the centres. The waste collected on Monday 8/5/17 is the highest because it was the start of the examination week where many students are present at the centres. This results also serve as the basis for the question posed related to the potential recyclable items within the campus. The purpose of the question asked was to identify if the respondents are aware on the potential of recycling activities at their surroundings. From the results as depicted in figure 2, the respondents agreed that the most potential items to be recycled are paper followed by plastics, aluminium cans and glass. This confirmed the earlier observation made (figure 2) whereby a large proportion of the waste generated at complex of engineering can be recycled or is potentially recyclable. In fact, the program for segregation and recycling is feasible in the faculty. It is noteworthy that the results obtained is similar to the study conducted in Campus Mexicali I of the Autonomous University of Baja California (UABC) where paper represents the largest percentage of recyclable waste in the faculty [12]. Pearson correlation factor was conducted for age of respondents and their awareness on potential recyclable items at the faculty. It was found that the p-value is more than the significant level ( $p > 0.05$ ). This shows that correlations between the two variables are statistically insignificant. So, there is in conclusive evidence about the significant of the association between variables.

On the question about what might cause them not to practice recycling, variety of reasons was given. As shown in figure 3, the major excuse is on the availability of the recycling bins. This also suggests that there is still recycling potential among them. Because of the absence of recycling bins, the students throw their rubbish in the available bins provided. However, 47% of the respondents said that the bins are full, 23% are unsure if the products are recyclable, 13% do not even bother to care about recycling and only 10% believe that recycling is too consuming.

In the second phase of questionnaire, the questions asked related to the effectiveness of recycling bins in the faculty. As previously mentioned, in year 2013/2014, recycling bins placed at the library lobby seating area provided by the facility department of the university. Due to lack of support from the students, the recycling bins are left ignored by the students. Therefore, as mentioned earlier, there are five (5) new recycling bins placed at the complex of engineering as the alternative, were made and placed at each engineering centres as shown in figure 4 during phase 2 of the study. This approach was made to encourage the engineering students to practice recycling in the environment of study. As can be observed in figure 5, 91% of respondents are aware on the existence of the bins and a minority of 9% are not aware. The recycling bins provided are mainly for the segregation of aluminium cans,

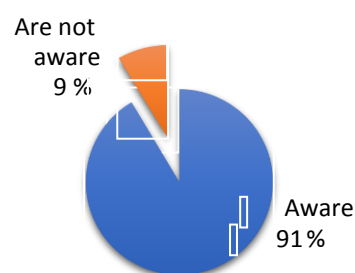
plastic bottles and papers. These are clearly specified on the recycling. However, they are unable to differentiate and understand what the objectives of the placement of the bins. Even with a clear signage, the students are unable to perform the act of recycling properly. This strongly recommends, the education on recycling is very important to increase the students' awareness on recycling in future.



**Figure 3.** Obstacles preventing students from recycling.



**Figure 4.** Recycling bins at engineering complex.

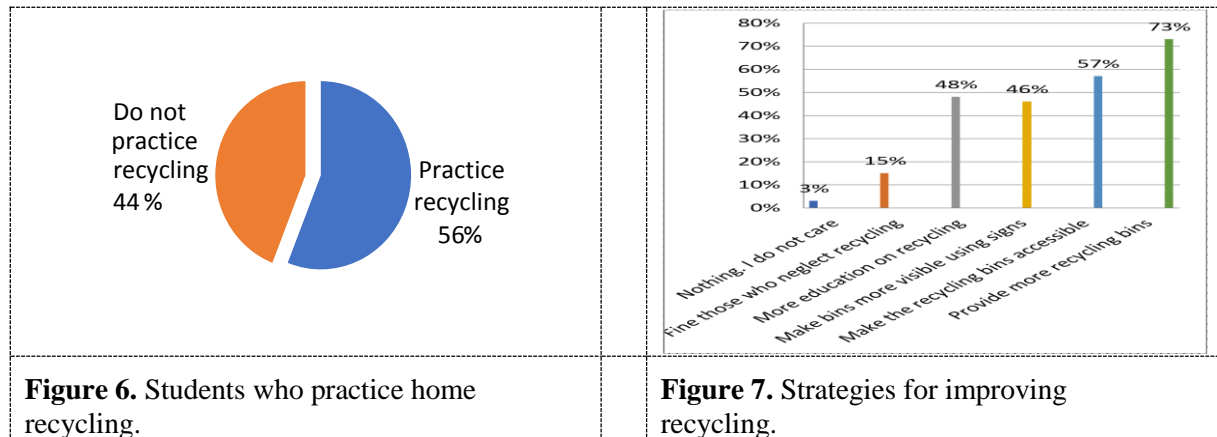


**Figure 5.** Awareness on the existing recycling bins in the campus.

Recycling is good for the environment in the sense that old waste products of no use are then converted into same new products. In order to encourage students to recycle more, education should start at home. On the question whether, recycling is continued at home, from the survey conducted, 56% of respondents practice recycling at home and 44% respondents do not recycle at home (figure 6). The result also indicated that 38% of female practice recycling and only 18% of the male do. This result agrees with the findings conducted in Dalhousie University in which the statistical calculation of t-tests is not statistically significant and female tend to practice recycling more compared to male. The sustainability of the waste management should be enhanced through higher educational institution [13]. Strategies on how to improve recycling should be implemented among youngsters. The results show that 73% respondents suggested to provide more recycling bins and make them accessible (57%) followed by education on recycling (48%), visible signage (46%) and impose fine on those who neglect recycling (15%) (figure 7). This result agrees to the study conducted in the University of the West Indies, Cave Hill Campus, Barbados where the data suggested that signage and the accessibility



of recycling bins are the potential key strategies that could be used to increase awareness about recycling.



Recycling helps to reduce the amount of waste being sent to the landfill in which it helps to conserve raw materials and protects natural habitats for the future. In the last phase of questionnaire distribution, the questions delivered focused on how waste segregation helps to conserve the environment. From table 4, majority of 52%, said they will start practice waste segregation in everyday life. Also, most of the respondents want to take advantage of the concept of waste to wealth (W2W) that converts waste into profitable end products. The results finally capture respondents' awareness on the importance of conserving the environment and shows positive attitudes towards the ideas.

**Table 4.** Opinions on contribution to the conservation of environment.

Respondents opinions on contribution to the conservation of the environment	% of respondents
I will start practicing waste segregation in everyday life	52
I will help in promoting the importance of waste segregation	27
I will promote recycling products	22
I would be more interested to know about recyclable items	24
I want to aspire to be entrepreneurs from recycled products	12
I want to take advantage of the concept of waste to wealth (W2W) that converts waste into profitable end products	39

#### 4. Conclusion

The research conducted among engineering students focus on the knowledge and awareness of recycling practices. The results obtained shows that the students' awareness and knowledge on recycling are unfavourable at the beginning. Since the research has shown that most of the students' knowledge on waste segregation are still low, it reflects the urgency to educate all students on zero waste management. Most of the students believe that the obstacles that prevent them to recycle are due to the absence of recycling bins or the waste bins are full. Results shows that there is significant relationship ( $p < 0.05$ ) between gender and knowledge on recycling using Chi square test and gives an insignificant relationship ( $p > 0.05$ ) between knowledge and awareness of students towards recycling using partial correlation. As the recycling facilities (recycling bins) are provided, majority of students are aware on the existence of the new recycling bins. It was also observed that waste segregation at home are also been practised more by the female than the male students. Hopefully, with the new existing facilities provided in the faculty (and many more are needed), these will enable to help increase the awareness of students towards the importance of waste segregation. Further, the authors

felt the study is most rewarding when a major portion showed their willingness to continue participation in conserving the environment and even more exciting that a small percentage would become eco-entrepreneurs in the future. As an overall conclusion, it is necessary to develop students' attitude and willingness through providing a firm understanding on the importance to conserve the environment and to practice recycling to prevent problems related to solid waste management in order to guarantee a sustainable future in the country.

### Acknowledgement

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