

ASSESSING THE LEVEL OF KNOWLEDGE AND PRACTICES OF WASTE MANAGEMENT AMONG SECONDARY SCHOOL STUDENTS

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ABSTRACT

This study investigates the knowledge and practices of waste management among secondary school students. A survey was conducted among 258 students from a secondary school in the Perak Tengah District who were given questionnaires each to complete which included items to assess students' understanding of the principles of Reduce, Reuse, and Recycle (3R) as well as their actual implementation of these practices. However, after screening all the questionnaire forms, 233 forms were analysed and 25 forms were found to be incomplete due to unanswered questions. The level of knowledge and practices were identified by ternary partitions (low/moderate/high) of the mean score. The partitioning value was determined by the five-point scale, with the highest value being 5.00, and it is divided into three levels: low (mean=1.00-2.33), medium (mean=2.34-3.67), and high (mean=3.68-5.00). Results indicate a high level of awareness and comprehension of 3R concepts among the students with an overall mean of 3.9, which demonstrates strong knowledge in this regard. This study reveals that a significant number of the students actively engage in recycling efforts and adopt good practices of waste management in their daily lives with an overall mean of 3.7. However, areas for improvement were identified,



particularly in terms of reducing and reusing materials. These findings underscore the importance of ongoing education and awareness initiatives to promote environmentally responsible behaviours among the younger generation. Improving waste management can be achieved by incorporating lessons on responsible consumption and production (SDG No. 12) into the curriculum. This approach encourages students to adopt waste-reducing practices.

Keywords: 3R, Education, Environment, School student, Waste management

INTRODUCTION

Solid waste management (SWM) is a crucial environmental concern that profoundly affects public health, ecological balance, and sustainable development (Debrah et al., 2021). The management of waste is commonly carried out through collection, transport, storage, processing, recovery, and disposal. The disposal method must be able to minimise harmful environmental effects. Therefore, waste should be managed according to the waste management hierarchy, which includes Reduce, Reuse, Recycle, Recovery, and Disposal. The most desired practices of waste management are the top three in the hierarchy: Reduce, Reuse, and Recycle, commonly known as the '3Rs'.

Implementing sustainable SWM practices is vital for reducing the negative environmental impacts of waste and fostering resource conservation (Idul, 2023). While extensive research has been conducted on SWM in municipal and industrial contexts, there is an increasing need to focus on educational institutions, particularly secondary schools, as they are pivotal in cultivating environmental consciousness among young people (Minghua et al., 2009; Mkhonto & Mnguni, 2021). Secondary schools are not only significant waste generators but also serve as crucial platforms for instilling efficient waste management practices in future generations. Educating students about SWM can lead to long-term behavioural changes that support environmental sustainability. Structured environmental awareness activities can have a profound impact on students, fostering an enduring appreciation for the environment from an early age (Rahaman & Abdul Rahim, 2021).

The extent of knowledge and the actual practices of SWM in secondary schools remain underexplored (Rada et al., 2016; Ifegbesan, 2021). Adequate knowledge of solid waste management is important to minimise waste generated (Wibowo et al., 2017). Knowledge is defined as the capacity to acquire, retain, and use information; a blend of understanding, experience, wisdom, and skills (Rahaman & Abdul Rahim, 2021). Educational institutions should continuously educate and spread awareness about good Solid Waste Management (SWM) practices. Students' comprehension of littering and proper waste management is intrinsically linked to their capacity to adopt concepts and behavioural patterns associated with environmental sustainability. Poor recycling practices among school students could be improved through educational activities (Rada et al., 2016). Expanding their knowledge in this domain will significantly enhance their environmental awareness and attitudes (Owojori et al., 2022). Training and awareness-raising activities in zero waste implementation are very important at each level of the waste management hierarchy, especially the 3Rs, which require detailed planning (Hanedar et al., 2021).

The educational institutions are responsible for integrating environmental concerns into school curricula, focusing on waste management principles like segregation at source, reduction, recycling, reuse, and composting. This curricula will promote environmental awareness and action among students, which will, in turn, raise awareness of SWM practices among the general public (Comighud & Lalamonan, 2020). Children should be taught the principles of recycling at an appropriate age, as those who regularly recycle at school are likely to adopt these habits at home and share them with their family members (Neves et al 2023). This early education fosters a culture of environmental responsibility and sustainability that can have long-lasting effects on future generations. Therefore, waste management implementation in educational institutions, particularly secondary schools, is crucial to instil environmental consciousness into students and staff. Schools are like small versions of society, where good practices can be introduced and practised at an impressionable age. Comprehensive waste management strategies encompass waste reduction, segregation, recycling, and proper disposal, all of which contribute to minimising environmental impact (Comighud & Lalamonan, 2020). Previous research shows that students exhibit knowledge regarding the significance of recycling programs, however, they fail to

translate this awareness into a practical application (Ayodeji, 2010). In addition, students have a positive view of environmental sustainability but they lack participation in green activities (Bashirun et al., 2019). Ultimately, lack of implementation of acquired knowledge could begin at home, and then carried out to school premises as well as beyond which is into other outdoor environments (Min & Mapa, 2021).

Integrating waste management principles into the curriculum not only enhances students' understanding of environmental issues but also cultivates a sense of responsibility towards waste reduction and resource conservation (Comighud & Lalamonan, 2020). In addition, encouragement from the educational institution, especially teachers, is important to ensure segregation, separation and green activities are successful (Mustafa et al., 2022). Teachers play a crucial role in instilling environmental values and promoting sustainable behaviours among students. Implementing a waste management system with a zero-waste strategy is a key component of the management policy for sustainable waste management in schools (Saglam & Aydin 2024). Recycling is an urgent requirement in sustainable waste management (Wang et al., 2020). However, public awareness of recycling and its influencing factors were seldom systematically analysed (Wang et al., 2020).

Environmental education within schools should offer students and teachers opportunities to participate in actions and behaviours that contribute positively to creating a more sustainable school environment (Ifegbesan, 2021). Therefore, this study aims to address this gap by assessing the current state of knowledge and practice of solid waste management, which focuses on reduce, reuse, and recycling (3R) in secondary schools. By evaluating both the level of knowledge and implementation of 3R among students, this study seeks to identify areas for improvement and provide recommendations for enhancing waste management practices within educational institutions.

METHODOLOGY

For this study, the researcher employed a quantitative survey method using a validated self-administered questionnaire form for data collection. The questionnaire was designed to assess the level of students' knowledge and

practice on waste management at school. A secondary school in the Perak Tengah District was chosen as the location for this study. The respondents were the Form 1 and 2 students who attended a talk on waste management organised by the school. The talk was conducted for afternoon session students only. This school operates with both morning and afternoon sessions, with the lower forms (Form 1 and 2) attending in the afternoon. Since education starts at an early age, these lower forms students have been chosen as the respondents for this study. The questionnaire was distributed before the talk began to identify the students' baseline understanding of waste management at school, and a total of 258 completed forms were collected. In addition, the distribution of the questionnaire before the talk will ensure the validity of responses and help mitigate any potential bias in the participants' responses that might arise after being influenced by the content of the talk (Rahaman & Abdul Rahim, 2021). The purpose and method of the study were explained to the students and teachers to obtain their consent.

The questionnaire utilised in this study comprises three sections. Part A gathers respondent information, including gender and race. Part B focuses on students' knowledge of 3R (reduce, reuse and recycle), while Part C delves into students' practices of 3R at school and their daily life. The results of the questionnaire were evaluated, and the data were then analysed by using statistical statistics. However, after screening all the completed forms, 25 forms were found to be incomplete due to unanswered questions and were therefore excluded from the analysis. This study analysed only 233 forms.

The level of knowledge and waste management practices studied were analysed using frequency count, percentage, mean and standard deviation. This analysis is commonly used to assess knowledge levels (Ifegbesan, 2010; Rahaman & Abdul Rahim, 2021; Min & Mapa, 2021). Responses to the questionnaire were pooled and scored. Nominal values were assigned to the items according to scales. Questions on knowledge and practices of waste management had an assigned score of 1-5 for Strongly Disagree; Not Agree; Uncertain; Agree and Strongly Agree.

In order to statistically determine the level of knowledge and practices, ternary partitions (low/moderate/high) were used. The partitioning value was determined by the five-point scale, with the highest value being 5.00, and is

divided into three levels: low (mean=1.00-2.33), medium (mean=2.34-3.67), and high (mean=3.68-5.00). (Lapammu & Mahamod 2018; Rahaman & Abu Rahim, 2021). The interpretation level analysis was derived from the five-point values divided into three levels as provided in Table 1 (Lapammu & Mahamod 2018; Rahaman & Abu Rahim, 2021). The mean scores obtained for each statement were referred to within this range for the interpretation of levels. For the purpose of data interpretation, mean values of 3.68 and above were considered to indicate high knowledge or practices, while values below 2.33 were regarded as implying low knowledge or practices.

Table 1. Interpretation of Mean

Mean range	Interpretation
1.00 – 2.33	Low
2.34 – 3.67	Moderate
3.68 – 5.00	High

Source: Lapammu & Mahamod (2018); Rahaman & Abu Rahim, (2021)

RESULTS AND DISCUSSION

Respondent Background

All the respondents in this study were Form 1 and Form 2 students aged 13 and 14 years old. They were the participants of a waste management talk organised by the school. As secondary school typically begins at the age of 13, it is important to educate the youngest students about the significance of environmental issues as it also positively influences the behaviour of their families (Rada et al., 2016).

The demographic data on the respondent background is presented in Table 2. Majority of the respondents or 134 (58%) were female and there were 99 (42%) male respondents. The majority of respondents were Malay, or 232 (99.6%), with one respondent from another race (0.4%).

Table 2. Respondent Background

Demographic Background	Frequency (n)	Percentage (%)
Gender		
Male	99	42%
Female	134	58%
Race		
Malay	232	99.6%
Chinese	0	0%
Indian	0	0%
Others	1	0.4%

Source: Author

Level of Knowledge in 3R

Reduce, Reuse, and Recycle, commonly known as 3R, are at the top of the waste management hierarchy and are highly desirable. The students' knowledge of the 3Rs in this study was assessed using 10 items presented to the respondents to evaluate their understanding of the concept. The analysed data regarding the respondents' understanding is presented in Table 3. The analysis shows that six out of 10 items recorded high mean scores, while only four items recorded moderate mean scores.

The first item that recorded a high mean score was “3R refers to Reduce, Reuse, Recycle” (SD=4.2, Mean=4.7), and the second item was “Recycling aims to reduce solid waste generation” (SP=3.6, Mean=4.0). Third item was “I am knowledgeable about recycling practices” (SP=3.6, Mean=4.3). Fourth item was “I know the types of solid waste that can be recycled” (SP=3.4, Mean=3.8). Fifth item was “I am aware of the presence of recycling bins in schools” (SP=3.8, Mean=4.2). The last item was “Recycling aims to reduce the amount of waste sent to landfills” (SP=3.7, Mean=4.1).

The findings suggest that students have a high level of knowledge about “3R”, as reflected in the mean scores recorded in the analysis (Overall mean=3.9). However, their level of knowledge was more focused on Recycling which is one of the three R's. The term "3R" (reduction, reuse, and recycling) is well-known and understood among the students, indicating that it is a common concept across various levels of education

and not unfamiliar to the general public. Raising mass awareness about the impact of waste disposal practices is important from the beginning of school education (Licy et al.,2013).

Introducing or integrating waste management concepts and themes into environmental education and school curricula at all levels will not only enhance students' understanding of waste management but also has the potential to positively influence their waste management behaviours and practices (Ifegbesan, 2021). Given the current level of understanding among the school's students found in this study, waste management at school could be enhanced and improved. The lack of environmental education in most developing countries is due to weaknesses in the practical environmental curricula, which leaves teachers ill-prepared to address contemporary environmental issues for sustainable development and cleaner production (Debrah et al 2021). The practical environmental curricula may contribute to three Sustainable Development Goals: SDG No. 4 (Quality Education), SDG No. 11 (Sustainable Cities and Communities), and SDG No. 12 (Responsible Consumption and Production). By integrating these goals into the curriculum, students can develop a deeper understanding of the interconnectedness of education, urban sustainability, and responsible consumption.

Table 3. Level of Knowledge In Waste Management

No	Item	Frequency (%)					Std Dev	Mean	Mean Score
		SD	D	U	A	SA			
1.	3R refers to Reduce, Reuse, Recycle.	1 (0.4%)	1 (0.4%)	8 (3.4%)	46 (19.7%)	177 (76.0%)	4.2	4.7	High
2.	I have been involved in the 3R awareness campaign	18 (7.7%)	40 (17.2%)	90 (38.6%)	61 (26.2%)	24 (10.3%)	2.8	3.1	Mod
3	I know practices to reduce solid waste generation	5 (2.1%)	21 (9.0%)	90 (38.6%)	96 (41.2%)	21 (9.0%)	3.0	3.5	Mod
4	I know the types of solid waste that can be recycled	8 (3.4%)	23 (9.9%)	65 (27.9%)	99 (42.5%)	38 (16.3%)	3.2	3.6	Mod

5	I know methods for separating solid waste for 3R	7 (3.0%)	17 (7.3%)	82 (35.2%)	87 (37.3%)	40 (40%)	3.2	3.6	Mod
6	Recycling aims to reduce solid waste generation	3 (1.3%)	10 (4.3%)	47 (20.2%)	96 (41.2%)	77 (33.0%)	3.6	4.0	High
7	I am knowledgeable about recycling practices	2 (0.9%)	4 (1.7%)	20 (8.6%)	102 (43.8%)	105 (45.1%)	3.8	4.3	High
8	I know the types of solid waste that can be recycled	2 (0.9%)	13 (5.6%)	69 (29.6%)	83 (35.6%)	66 (28.3%)	3.4	3.8	High
9	I am aware of the presence of recycling bins in schools	3 (1.3%)	4 (1.7%)	36 (15.5%)	90 (38.6%)	100 (42.9%)	3.8	4.2	High
10	Recycling aims to reduce the amount of waste sent to landfills	6 (2.6%)	6 (2.6%)	40 (17.2%)	84 (36.1%)	97 (41.6%)	3.7	4.1	High
Overall Mean							3.9	High	

Notes: SD-Strongly Disagree; D-Disagree; U-Uncertain; A-Agree; SD-Strongly Agree. Mod=Moderate
Source: Author

Level of Practice in 3R

The level of practice of 3R by school students is shown in Table 4, where a total of 10 items were presented to the respondents. Based on the standard deviation and mean score, the majority of respondents have a high level of 3R practices. This can be seen from the overall mean scores, 3.7. The obtained scores indicate that 5 items recorded high mean scores, 4 items recorded moderate mean scores, and 1 item received a low mean score.

The item with a low mean score was “I dispose of solid waste in only one trash bin even though there are recycling bins nearby” (SP=2.7, Mean=2.9). Even though only 1 item was considered to have low practices by the respondents, it is important to highlight this item. To promote waste separation through training and awareness, it is essential to reduce the number of garbage bins where all waste is disposed of together (Hanedar et al., 2021). The low practice of waste sorting may be attributed to the presence of bins lacking clear instructions or having no instructions at all,

resulting in frequent incorrect waste separation (Rada et al., 2016). Garbage bins should be placed separately from recycle bins, especially in classrooms, to avoid confusion. The correct location of recycling bins is one of the most important considerations (Hanedar et al., 2021). The awareness of the 3Rs among those involved is demonstrated by waste separation activities becoming routine at school, at home, and in the community (Rada et al., 2024). Determining strategies for implementing waste separation at its source is crucial to ensure the efficiency of the process (Hanedar et al., 2021).

The institutional waste generated on school grounds consists mainly of biodegradable food waste and paper waste (Ifegbesan, 2021). However, this study found that the item “I bring my own meals to school to reduce plastic use” (SP=3.2, Mean=3.5) and “I use my own containers to pack food bought from the store” (SP=3.0, Mean=3.3) were interpreted as moderate practice. These indicate that students lack awareness and knowledge about this environmentally friendly alternative method (Ifegbesan, 2021). Hence, fostering awareness and teaching new behaviours to school children is paramount, with the hope that this will eventually cultivate a positive attitude toward food waste disposal and, ultimately contribute to a more ethical self. (Bathmanathan et al., 2023). School students should be educated about their environmentally unfriendly practices and equipped with strategies to address them, while also promoting environmentally friendly practices

Table 4. Level of Practices In 3R

No	Item	Frequency (%)					Std Dev	Mean	Mean Score
		SD	D	U	A	SA			
1	I separate solid waste for 3R	8 (3.4%)	24 (10.3%)	67 (28.8%)	92 (39.5%)	42 (18.0%)	3.2	3.6	Mod
2	I bring my own meals to school to reduce plastic use	12 (5.2%)	32 (13.7%)	53 (22.7%)	91 (39.1%)	45 (19.3%)	3.2	3.5	Mod
3	I use my own containers to pack food bought from the store	12 (5.2%)	47 (20.2%)	61 (26.2%)	77 (33.0%)	36 (15.5%)	3.0	3.3	Mod
4	I use both sides of the paper when writing and printing	3 (1.3%)	11 (4.7%)	44 (18.9%)	95 (40.8%)	80 (34.3%)	3.6	4.0	High

5	I make crafts using recycled materials	6 (2.6%)	34 (14.6%)	58 (24.9%)	87 (37.3%)	48 (20.6%)	3.2	3.6	Mod
6	I reuse plastic containers to store items	2 (0.9%)	10 (4.3%)	35 (15.0%)	104 (44.3%)	82 (35.2%)	3.7	4.1	High
7	I use reusable bags to carry items purchased from the store	8 (3.4%)	13 (5.6%)	47 (20.2%)	71 (30.5%)	94 (40.3%)	3.6	4.0	High
8	I practise recycling in my daily life	5 (2.1%)	19 (8.2%)	70 (30.0%)	93 (39.9%)	46 (19.7%)	3.3	3.7	High
9	I dispose of solid waste according to the colour of the recycling bins	4 (1.7%)	17 (7.3%)	49 (21.0%)	94 (40.3%)	69 (29.6%)	3.5	3.9	High
10	I dispose of solid waste in only one trash bin even though there are recycling bins nearby	36 (15.5%)	54 (23.2%)	69 (29.6%)	43 (18.5%)	31 (13.3%)	2.7	2.9	Low
Overall Mean							3.7	High	

Notes: SD-Strongly Disagree; D-Disagree; U-Uncertain; A-Agree; SD-Strongly Agree. Mod=Moderate
Source: Author

CONCLUSION

The aim of this study was to comprehend the knowledge and practices of waste management among secondary school students in Perak District. The findings indicate that the majority of respondents have a grasp of the concept of waste management. Results also suggest that while students demonstrate a high level of knowledge about recycling, the third "R", there are areas for improvement, particularly in terms of reducing and reusing materials. The analysis indicates that students may need more education and awareness about the importance of reducing material consumption. Therefore, reducing the number of materials used can have a significant impact on waste reduction and environmental sustainability.

There are several strategies that could be implemented at school. Among these strategies are the improvement of waste management by incorporating lessons on responsible consumption and production (SDG No 12) into the curriculum, and encouraging students to adopt practices

that reduce waste, such as using reusable water bottles and bringing their own packed food to school, as well as highlighting real-world examples of successful waste reduction initiatives. Transforming food waste into bio-fertilizers that can be sold to parents is a significant step in reducing waste generated in schools (Bathmanathan et al., 2023). Generating income for institutions through waste recycling and utilising that income for activities aimed at increasing student awareness will enhance the efficiency of sustainable waste practices (Hanedar et al., 2021).

For the second "R", which is reusing materials, the findings also suggest that students may benefit from more information and guidance on reusing materials. Reusing items can extend their lifespan and reduce the need for new resources. Therefore, enhancing students' knowledge in this area could be achieved by providing examples of how everyday items can be repurposed or reused, organising workshops or activities that demonstrate creative ways to reuse materials, and encouraging students to participate in donation drives or second-hand markets to extend the life of products. Teachers' active and ongoing involvement plays a key role in achieving positive outcomes in waste separation at schools. (Rada et al., 2016). By addressing these areas for improvement and providing more comprehensive education on the 3Rs (reduce, reuse, recycle), the school can further enhance students' knowledge and promote good practices of waste management both within the school and in the wider community. The awareness, knowledge, and practices of students are associated with their personal characteristics (Ifegbesan, 2021).

An efficient waste management can be implemented in schools as well as in students' daily lives. Implementing guidelines aimed at improving the management and collection of recyclable waste in schools is essential (Rada et al., 2016). This study offers insights into the knowledge and attitudes of a current group of secondary school students regarding waste management practices, which are valuable for curriculum development in educational programs. However, one limitation of this study is that it only involved students from Forms 1 and 2 (lower forms), who may not fully represent the knowledge and practices of waste management among all secondary school students. The perspectives and behaviors of older students in the upper forms could differ significantly and were not captured in this study. Additionally, the survey was conducted before the talk, which means the

data collected reflects the participants' baseline knowledge and practices without the influence of educational intervention. This precludes the ability to measure any immediate impact the talk may have had on enhancing students' understanding and implementation of 3R principles.

Future research should include a broader range of students and researchers could consider conducting follow-up surveys post-intervention to assess changes in knowledge and behaviour. Conducting an extended study that includes more schools, either privately owned secondary schools or boarding schools, could further enhance the understanding in this area. This broader scope will provide a more comprehensive understanding of waste management knowledge and practices among a wider demographic of secondary school students.

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CONFLICT OF INTEREST

The authors declare no conflict of interest.

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