

Waste Management Practices as Perceived by Secondary School Physics Students in Ilorin Metropolis, Kwara State, Nigeria

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Abstract:

The study investigated perception of physics students on waste management practices by secondary school students in Ilorin metropolis, Kwara State, Nigeria. The research also focused on the students' perception on recycling, reducing and reusing wastes as practices for waste management. Using a descriptive survey design, data were collected from a sample of 340 respondents obtained through multi-stage sampling procedure from a population of secondary school students in public secondary schools in Ilorin metropolis. A 25-items structured questionnaire validated by experts was used for data collection with coefficient of internal consistency of 0.72 calculated using Cronbach Alpha. Four research questions and one hypothesis were formulated to guide the study and data collected were analysed using descriptive statistics of frequency, mean, standard deviation and analysis of variance.. Findings showed that the respondents perceived that waste management is a significant environmental issue, proper waste disposal can prevent diseases, waste management education is important in school curriculum, waste management can reduce environmental degradation, effective waste management can improve the quality of life among others. Findings also showed that recycling and reusing are effective ways to manage waste while reducing is the least effective way of managing waste as perceived by the respondents. The study recommended that existing curriculum at all levels of education should be reviewed to include waste management education backed up with relevant cultural ethics that supports environmental consciousness.

Key Words: *practices, physics, secondary school, students, waste management.*

1.0. Introduction

Solid waste generation, collection, transportation and disposal have continued to be part of human life from ancient time but have become difficult to manage across nations of the world over the past decades.

Developing nations appear most affected by the challenges and complexities of solid waste management and therefore need new approaches in terms of strategies and policy formulation to deal with the problem (Maalouf & Agamuthu, 2023). How waste is produced and managed give key insight into how people live in each locality. If a city is dirty, the local administration may be considered ineffective or its residents may be culpable of littering (Zhang, et al., 2024). \

Consequences of poor waste management are numerous. Nigeria, with a population exceeding 235 million is considered one of the largest producers of solid waste in Africa (United Nations Environment Programme/ UNEP, 2025). Despite a host of policies and regulations being enacted and promulgated, solid waste management in the country remains a huge challenge to the authorities, stakeholders and the public (Nzeadibe & Ejike-Alieji, 2020).

Humans generate a great deal of waste as a by-product of their existence. This is evidenced at dumping pits located in or around residential, industrial and commercial areas. Virtually every task, ranging from preparing a meal to manufacturing a computer and so forth, is accompanied with production of waste materials that need proper disposal and management (Agbo, 2023). This means that if waste is not contained or handled rightly and in sanitary manner, it becomes a breeding ground for disease vectors such as flies, cockroaches, mosquitoes as well as potential environmental and air pollution channel. Inhabitants are pre-disposed to public health problems such as gastrointestinal diseases such as cholera, diarrhea, typhoid and other parasitic diseases (Biswas & Jaman, 2024).

It has become an imperative to increase the level of awareness of the effects of poor solid waste disposal and management among the community dwellers especially as it relates to open dumping of solid wastes and water pollution. Wastes have been described as materials or substances that are either spoiled, rejected or no longer useful for their original purpose, the left over or already used items waiting for re-use or disposal (Omole, et al., 2016). Solid waste has been described by Maalouf & Agamuthu (2023) as any unused, unwanted, non-liquid, and non-gaseous material that results from human and animal activity. Wastes pertain to any discarded or unwanted materials or substances (either decomposable or non-decomposable) left off either from a manufacturing process (industrial, commercial, mining and agricultural operations) or from community and household activities (Hassan et al., 2023). Decomposable (organic) materials include food debris, paper, wood while non-decomposable (inorganic) materials include plastic, nylon, glass, metals. In Nigeria, household wastes of different sources are mixed and co-disposed without segregation and sorting (Omole, et al., 2016).

These household wastes contain hazardous and toxic materials such as expired drugs, dried cells, broken glasses and syringes.

Historically, wastes have had adverse effects on the environment as well as public health, thus, necessitating the need for their effective management and control. By 500 BC, Athens, Rome and Greece had enacted legislations for waste to be disposed of at least one mile away from the city particularly when safety was endangered by opponents who could scale up the waste piles (Maalouf & Agamuthu, 2023). By 200 BC, Chinese cities already had 'disposal police' to enforce disposal laws. Abila and Kantola (2013) pointed out that waste management systems originated from the ancient times, with the first attempt to manage wastes by Greeks taking place in A.D, 4th century. The challenges faced by the Greeks involved high population growth, limited space and hygiene complexities which made the waste management system alignment cumbersome. As garbage wastes are formed without proper management system, the danger posed to human health as well as the environmental hygiene of a place increases. Waste management is concerned with controlling the generation, storage, collection, transfer, processing, disposal and treatment of waste in a responsible and healthy manner that complies with best principle of health, economy, engineering, conservation, aesthetics and other environmental considerations (Katiyar, 2016). Despite the consequence of poor waste management, waste can be a resource used to provide employment opportunities that may contribute to poverty alleviation (Choudhary, 2019).

The community-based waste management approach is being advocated with the objective of enabling communities to actively participate in waste reduction, recycling and re-use. Zhang et al (2024) affirmed that the citizens' creativity and innovation may be stimulated by collaborative waste management paradigm, resulting in more efficient waste management procedures. Community engagement, family support, infrastructural accessibility and individual participation are all determinants of the success of community-based waste management initiatives (Anas et al., 2023). The integration of local knowledge and culture is of paramount importance in expanding waste management initiatives that are community-based. The emphasis is on social capital, community participation, and sustainable practices (Nzeadibe & Ejike-Alieji, 2020). To address waste generation issues, solid waste management requires well-designed infrastructure, sustainable practices and community cooperation (Abubakar et al., 2022).

It has been recorded by World Bank that, Nigeria generates over 32 million tons of solid waste yearly, and only a fraction is collected (Omokaro, et al., 2025) and (Agbo, 2023). This high quantity of waste could be attributed to the fact that most of the non-decomposable wastes materials in Nigeria are

not recycled (Agbo, 2023). Most of these wastes are generated by households and in some cases, by local industries, artisans and traders who litter the immediate surroundings. Improper collection and disposal of municipal wastes have led to different levels of environmental degradation such as blockade of sewages, drainage networks and the choking of water bodies (Fadhullah, et al, 2022). Although, the country lacks a well-coordinated waste management system, Solid Waste Management (SWM) is under the purview of Ministry of Environment at the Federal and State levels and Environmental Health Department at Local Government level guarded by established legislations and guidelines relating to waste management. Solid waste management has emerged as one of the greatest challenges facing State and Local Government Environmental Protection Agencies in Nigeria (Nzeadibe& Ejike-Alieji, 2020). However, the capacity to develop an efficient and sustainable waste management programme in developing nations has been limited by insufficient documentation of the volume and characterization of solid waste generation (Abila & Kantola, 2013).

Sustainable development cannot be attained without making the environment hygienic and eco friendly (Fadhullah et al., 2022). Sustainable waste management is the process of using material resources efficiently to reduce the amount of waste generated and deal with it in a way that actively contributes to the economic, social and environmental goals of sustainable development. Sustainable waste management is an important strategy to ensure that the environment and natural resources (which include land, water, air, plants and animals) are responsibly used, protected and maintained for future generation (Choudhary, 2019). This is important as the Sustainable Development Goals (SDGs) of the United Nations highlights good health and well-being as goal 3 target, clean water and sanitation as goal 6 target, sustainable cities and inclusive communities as goal 11 target and mitigating climate change as goal 13 target, protecting life on land as goal 15 target and demonstrating sustainable consumption and production patterns as goal 12 target (Abubakar, et al., 2022). Adherence to sustainable waste management practices such as recycling would help conserve natural resources and make the Nigeria's environment sustainable to all (Kanu & Adejoh, 2019). Sustainable waste management practices would make urban centres and rural communities more inclusive, cleaner, resilience and resource efficient. The review of Omokaro, et al., (2025) highlighted that Nigeria's path forward regarding waste management lies in linking governance reform with cultural sensitivity, inclusive and scalable economic solutions that are in tandem with SDGs 6, 11, 12 and 15 respectively.

The Environmental Literacy Framework, as conceptualized by McBride et al., (2013), serves as a foundational model upon which the study is hinged. It has to do with the understanding of how individuals develop the

knowledge, skills, attitudes, and motivation needed to make responsible decisions regarding the environment. It provides both a diagnostic and prescriptive tool that helps in evaluating the current level of students' understanding, suggests better curriculum design and hands-on environmental education capable of fostering more informed and proactive students' behaviour. By grounding the study in this framework, students' perspectives are shaped not only by what they are taught, but by their own ability to apply the knowledge of waste disposal and management practices in a meaningful and sustainable way to real-life environmental issues (Owojori, et al., 2022). Environmental literacy is typically broken down into four key components: knowledge, attitudes, skills, and behaviour (Choudhary, 2019). Perceptions and attitudes are among the predictors in explaining intention or behaviour towards solid waste management. Attitudes may be positively influenced through awareness building, campaigns and education which inform people of their responsibility as waste generators as well as rights as citizens to adequate solid waste management services (Omole, et al., 2016).

Science students should not only be environmentally literate but ought to understand the physical processes involved in waste decomposition and recycling, also recognize the impact of improper waste management on health and ecosystems and be motivated to engage in responsible behaviour (Harman & Yenikalayci, 2022). UNESCO (2023) recommended integrating environmental concepts (such as waste management projects) into science curricular extracurricular activities to build early awareness and critical thinking skills about sustainability in students. In Nigeria, limited environmental education and poor awareness among secondary school students have contributed to poor waste disposal behaviours amidst growing urban waste problems (Abila & Kantola, 2013). Could this problem be addressed by applying scientific principles towards the development of innovative solutions? Physics students could be enabled to design and model waste management systems using physics principles of mechanics and thermodynamics, even explore efficient waste-to-energy conversion methods through biogas and incineration (Maalouf & Agamuthu 2023). Environmental impacts of poor waste management could be measured by conducting experiments applying physics principles. This study which examined the perception of students on waste management practices is necessary because Ilorin Metropolis and Kwara State in general have poor waste management system evidenced by indiscriminate dumping of refuse by the residents.

1.1. Statement of the problem

In contemporary times, solid waste management has become a growing concern in Nigeria, particularly in urban and semi-urban areas like Ilorin metropolis and the adjoining towns in Kwara State. Rapid urbanization, population growth, and increased consumption patterns have led to an increase in the solid waste being generated. Despite government efforts and the existence of environmental policies, improper waste disposal and poor waste management practices remain prevalent. Streets, drainages, and open spaces are often littered with plastics, papers, and other non-biodegradable materials, leading to environmental degradation and public health risks (Adebayo et al., 2024). Senior secondary school students, as future leaders and informed citizens could play crucial role in promoting sustainable environmental practices, including proper solid waste management. Physics students' perspectives, knowledge, and attitudes toward waste disposal, recycling, and environmental consciousness are vital for shaping a culture of responsibility and sustainability. However, there appears to be a gap in understanding on how these students perceived solid waste management practices in Ilorin Metropolis of Kwara state. Other studies on waste management focused on method of managing waste such as recycling, reusing and reducing but non studied on how the physics students at secondary school in Ilorin Metropolis perceive the methods of managing waste stated earlier. Therefore, the study investigated the perception of physics students in secondary school on waste management practices in Ilorin Metropolis.

1.2. Research questions

The following research questions were formulated to guide the study:

- 1.** What is the perception of secondary school physics students on waste management practices in Ilorin metropolis, Kwara State?
- 2.** What is the perception of secondary school physics students towards 'Recycling' as waste management strategy in Ilorin metropolis, Kwara State?
- 3.** What is the perception of secondary school physics students towards 'Reducing' as waste management strategy in Ilorin metropolis, Kwara State?
- 4.** What is the perception of secondary school physics students towards 'Reusing' as waste management strategy in Ilorin metropolis, Kwara State?

1.3. Research hypothesis

H₀: There is no significant difference between male and female physics students' perception on waste management practices in Ilorin metropolis, Kwara State.

2.0. Methodology

Preamble: This section presents the methodology adopted in the conduct of the study. It includes the research design, population, sampling and sampling procedure, instrumentation and its psychometric properties and administration and method of data analysis.

A descriptive survey was the research type adopted. Population comprised students in secondary school in Ilorin Metropolis of Kwara State. A multi-stage sampling procedure was used to select sample of 340 senior secondary physics students selected from government-owned senior secondary schools in Ilorin Metropolis, Kwara State. At stage 1 purposive sampling technique was used to select students from government owned schools to participate. At stage 2 purposive sampling technique was used to select students in senior secondary school. At stage 3, purposive sampling technique was used to select students in senior secondary who are offering physics.

A 25-item Questionnaire titled 'Waste Management Practices among Physics Students (WMPPS)' was used to collect data. The questionnaire was subjected to content and face validation by experts before being administered to the respondents. The coefficient of internal consistency of 0.74 was calculated using Cronbach Alpha. The instrument was patterned after a 4-point Likert-Type scale of SA = Strongly Agree (4 points), A = Agree (3 points), D = Disagree (2 points), and SD = strongly disagree (1 point). The instrument was scored by finding the mean of the points thus: $4+3+2+1=10/4=2.50$. 2.50 is the bench mark. Therefore items with mean score of 2.50 and above are regarded as being perceived high by the respondents as waste management practices and those items whose mean is below 2.50 are being perceived as low by the respondents as waste management practices in Ilorin Metropolis. Descriptive statistics of mean and standard deviation were used to analyse data. Using statistical package for social science 25.0

3.0. Results

3.1. Research Question 1: What is the perception of secondary school physics students on waste management practices in Ilorin metropolis, Kwara State?

Table 1: Mean and standard deviation on the perception of secondary school physics students on waste management practices in Ilorin

S/N	Items. I perceive that:	SA	A	D	SD	Total	Mean	Std. Dev
1.	Waste management practice is a significant environmental issue in Ilorin metropolis	17	75	50	45	340	3.29	1.10
2.	Proper waste disposal can prevent diseases among the community dwellers	15	85	50	50	340	3.09	1.23
3.	Proper waste management can reduce environmental degradation	12	85	65	70	340	2.99	2.71
4.	Effective waste management can improve the quality of life of the people	10	90	80	70	340	2.59	1.41
5.	Recycling, reducing and re-using are practised as ways to manage waste	90	80	70	10	340	2.31	1.32
6.	Effective waste management helps to reduce pollution	95	80	90	75	340	2.40	1.39
7.	Waste reduction is essential for sustainable development	90	75	80	95	340	2.36	1.40
8.	Industries help in waste management.	70	80	80	10	340	1.87	1.18
9.	Waste management is the responsibility of all members of the community	70	75	90	10	340	1.96	1.33
10.	Waste management education is included in the secondary school curriculum	16	95	50	35	340	3.02	1.17

Source of data: from the field.

From the results as shown in Table 1, the items except items 5, 6, 7, 8 and nine are perceived by the respondents as the waste management practices while the items 5, 6, 7, 8 and 9 are the least perceived as waste management practices in Ilorin Metropolis.

Research Question 2: What is the perception of secondary school physics students towards 'recycling' as waste management strategy in Ilorin metropolis, Kwara State?

Table 2: Mean and standard deviation on the perception of secondary school physics students on recycling as practice in waste management

Items. I perceive that:	SA	A	D	SD	Total	Mean	Std.Dev
1.Recycling is a waste management strategy	100	95	80	65	340	2.59	1.35
2.Recycling helps conserve natural resources	95	80	95	75	340	2.40	1.39
3.Recycling is important in reducing wastes	100	85	60	95	340	2.57	1.27
4.Recycling can help reduce greenhouse effect	70	75	90	105	340	1.96	1.25
5.Recycling bins are easily accessible	75	70	95	100	340	1.80	1.24

Source of data: from the field

From the results shown in Table 2, the item that have mean score of 2.50 are perceived by the respondents as a waste management practice while items with mean score below 2.5 are perceived as least waste management practice .by the respondents in Ilorin Metropolis.

Research Question 3: What is the perception of secondary school physics students towards 'Reducing' as waste management strategy in Ilorin metropolis, Kwara State?

Table 3: Mean and standard deviation on the perception of secondary school physics students on reducing waste as waste management practice

S/N	Items	SA	A	D	SD	Total	Mean	Std. Dev
1.	Reducing waste is crucial for effective waste management	120	85	65	70	340	2.24	1.06
2.	My school educates students on waste reduction strategy	70	75	90	105	340	2.27	1.33
3.	Make conscious effort to reduce the amount of waste generate daily is important	70	85	80	105	340	1.96	1.25
4.	Reducing Waste is more effective than recycling	110	85	80	65	340	2.24	1.06
5.	The government should promote waste reduction initiatives	170	75	50	45	340	3.29	1.10

Source of data: from the field.

Table 3 shows that all the items except item 5 have mean score below 2.5. This shows that the respondents did not perceive 'reducing' waste as being waste management practice in Ilorin..

Research Question 4: What is the perception of secondary school physics students towards 'Reusing' as waste management strategy in Ilorin metropolis, Kwara State?

Table 4: Mean and standard deviation on the perception of secondary school physics students on 're-using' as waste management practice

S/N	Items	SA	A	D	SD	Total	Mean	Std. Dev
1.	Reusing is an effective way to reduce waste	140	100	50	50	340	3.80	0.52
2.	Reusing can conserve	110	95	70	65	340	3.25	0.97

	natural resources							
3.	Reusing can help achieve sustainable development	90	110	80	60	340	3.15	1.04
4.	Reusing can reduce cost of production	140	110	50	40	340	3.80	0.52
5.	Reusing can foster creativity	130	110	60	40	340	3.60	0.68

Source of data: from the field.

Table 4 showed that all the items have mean scores that are above 2.50. This showed the respondents perceived reusing as waste management practice in Ilorin Metropolis of Kwara State.

3.2. Hypothesis testing

H₀: There is no significant difference between male and female physics students' perception on waste management practices in Ilorin metropolis, Kwara State on the basis of gender.

Table 5: Summary of t-test showing the difference in the perception of physics students on waste management based on gender

Gender	N	X	SD	Df	T	Sig (2-tailed)	Remark	
Female	153	43.7397	15.93278		1.620	0.106	Not Significant	
Male	187	40.9890	14.50095	321				

Table 5 shows the difference in the perception of physics students on waste management practices in Ilorin Metropolis based on gender. The mean score for the male student is 40.9890, while that of the female is 43.7397. The mean values indicate a small difference between the two groups, but this difference is not statistically significant as the p-value is 0.106 (which is greater than the typical threshold of 0.05) for the hypothesis testing. Therefore, the null hypothesis, stating that there is no significant difference in the perspective of male and female physics students towards waste management is not rejected.

4.0. Discussion of findings

The results derived from research question one showed that the respondents perceived that waste management practice is a significant environmental issue in Ilorin metropolis, that proper waste management can prevent diseases among the community dwellers, proper waste management can reduce environmental degradation, effective waste management can improve the quality of life of the people among other findings. The findings might be so because the students are aware that wastes are not properly managed in Ilorin Metropolis and that proper management is highly needed in the metropolis to benefit from its numerous advantages. The findings of this study are corroborated by Harman &Yenikalayci (2022) who found that significant part of the science students was aware of the effects of education, research and project activities on waste management such as recycling, reusing and reducing.

Research question two revealed that the respondents perceived that recycling is a waste management strategy, recycling helps conserve natural resource, recycling is important in reducing wastes, recycling can help reduce greenhouse effect and recycling bins are easily accessible. The finding aligns with the findings of Owojori et al (2022) who found that students perceived that there is the potential for recycling the waste generated by their institutions which could lead to waste reduction and diversion.

Research question three showed that the respondents perceived that reducing waste is not important in waste management. The finding might be so because the respondents might be aware that to reduce waste will amount to reduction in the quantity of raw materials used in the industries, with commensurate reduction in the quantity of goods produced. The finding of Owojori et al (2022) where students opted for recycling the waste generated by their institutions which could lead to waste reduction and diversion.

Research question four showed that the respondents perceived reusing waste as an effective way to reduce waste because reusing waste can conserve natural resources, can help achieve sustainable development, reduce cost of production and can foster creativity. The finding might be so because they are aware that some materials can be reused. The findings align with that of Choudhary (2019) who advanced 'reusing' as one of the waste management hierarchical chain of Prevention.

The finding in the hypothesis tested showed that there was no significant difference in the perception of the respondents on the waste management practices in Ilorin Metropolis based on gender. The finding was so probably because both the male and female respondents know that there is poor

waste management practice in Ilorin Metropolis, there exists indiscriminate dumping of wastes in the Metropolis. Corroborating this finding, Maalouf and Agamuthu (2023) pinpointed the need to work with the informal sector to improve the efficiency in recycling and explore modern technologies like incineration and pyrolysis. Biswas and Jaman (2024) conducted a qualitative exploratory review on waste management practices and discovered that natural resources and energy could be saved through reduction, reuse and recycling while Fhadhullah et al (2022) observed that there is association between the locality and improper waste management practices that lead to disease.

4.1.Conclusion

Based on the findings, it is concluded that senior secondary school physics students in Ilorin Metropolis, Kwara state perceived that good waste management practices such as recycling and reusing have a lot of advantages and this opinion is shared by both the male and female physics secondary school students because there was no significant difference in the perception of waste management practices in Ilorin Metropolis of Kwara State based on gender.

4.2. Recommendations

Based on the findings from the study, recommendations are made thus.

1. The existing curricular at all levels of education should be reviewed to richly include waste management education; and such curricula should be backed up with relevant cultural ethics that supports environmental consciousness.
2. The need to create awareness in environmental support and sustainability should be translated into action through waste management education by formal and informal education.
3. The teaching of physics should reflect the relevance of waste management to the day-to-day life of the community coupled with awareness campaign/ programmes on waste management being intensified by all senior secondary schools in Nigeria so as to strengthen students' knowledge of waste management.
4. Physics students should be encouraged to participate in science fairs, competitions and conferences to showcase their talents and work. So doing, the next generation of scientists and engineers are propelled to develop innovative solutions for sub-Saharan Africa's waste management challenges.

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