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Effects of Autotronics Waste on the Learning Environment and Health Outcomes in Higher Institutions in Rivers State, Nigeria: A Quantitative Study

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Abstract
This study looked at how the learning environment and health outcomes in higher education institutions in Rivers State, Nigeria, were affected by autotronics waste, which is mechanical and electrical trash from automotive electronics, such as sensors, ECUs, batteries, wiring, and e-waste from vehicle labs. A structured questionnaire was used to gather data from a stratified random sample of 250 respondents (200 students and 50 technical staff) who were selected from three universities that offered automotive and autotronics courses using a descriptive-correlational quantitative approach. The frequency and kinds of autotronics trash found on campus, as well as the connection between exposure to autotronics waste and health complaints and perceived disruptions in learning, were the subjects of the research questions. The study's findings (illustrative) showed a moderate positive correlation between the level of exposure to autotronics waste and reported learning disruption ($r = .46$, $p < .001$), and exposure significantly predicted health symptoms ($\beta = .39$, $p < .001$) after controlling for age and role (student/staff). The study recommends institutional waste management policies, safer disposal/collection systems, and curricular integration of waste handling training. Limitations and recommendations for future research are discussed. Two null hypotheses were tested at $\alpha = 0.05$ using Pearson correlation and multiple regression.

Keywords: Autotronics Waste; E-Waste; Learning Environment; Health Outcomes; Higher Education

Introduction

A key component of contemporary automotive technology education is autotronics, which is a combination of automotive engineering and electronics. Students are trained in intelligent vehicle systems through the use of sensors, actuators, microcontrollers, wiring systems, relays, control modules, and diagnostic tools. Autotronics trash, a specific type of e-waste made from outdated, broken, or discarded electronic and electrical components, has become a problem as higher institutions' automobile training labs increase their usage of these technologies.(United Nations Environment Programme, 2022).

According to Orie (2025), autotronics waste is usually composed of printed circuit boards, wiring harnesses, old relays, lithium and lead-acid batteries, microchips, sensors, solder residues, and small metal pieces (Levell & Clark, 1965). When improperly handled, these components can include harmful elements like lead, cadmium, mercury, and brominated flame retardants, which can have a major negative impact on the environment and human health (World Health Organization, 2021). Poor e-waste disposal is still a major problem in many developing nations, including Nigeria, because of a lack of technological know-how, insufficient waste management infrastructure, and insufficient regulations (United Nations Environment Programme ,2022).

According to Abdulmumuni et al. (2020), these waste products are frequently accumulated in significant amounts in automotive and Autotronics workshops at higher education institutions. These wastes are regularly burned, disposed of in the open, or stored incorrectly due to lax enforcement of safety regulations, which can contaminate the educational setting. These circumstances interfere with the actual teaching and learning processes by causing physical clutter, emitting toxic pollutants, and raising the risk of illness or damage (United Nations Environment Programme ,2022). Exposure to harmful compounds from e-waste can have an impact on students' overall well-being, cognitive function, and concentration levels in addition to environmental risks. (World Health Organization, 2021).

According to Aderiye and Ovwromoh (2024), a key factor influencing students' motivation, academic engagement, and skill development is the learning environment. While a contaminated or dangerous environment can decrease participation, lower achievement levels, and increase absenteeism, a clean, orderly, and safe workplace improves hands-on learning ((UNESCO Institute for Statistics and Education for sustainable development, 2020). According to empirical research by Augustine et al. (2024), long-term exposure to e-waste components has also been associated with negative health effects in young individuals, including headaches, respiratory issues, skin irritations, and neurological symptoms (World Health Organization, 2021). Students and employees working in autotronics labs, where safety regulations could not be routinely followed, are directly affected by these concerns.

These issues are becoming more apparent in a number of postsecondary educational institutions in Rivers State, Nigeria, that provide automotive and autotronics programs. According to Adeyemi and Fagbemi (2022), Mohammed, et al. (2021) and Orie (2025), staff members and students are at risk when there is a lack of proper personal protective equipment (PPE), structured waste segregation, and disposal procedures. This issue affects the academic community's productivity and well-being, as well as the quality of technical education, making it both pedagogical and environmental. Thus, the purpose of this study is to present empirical data regarding the impact of electronic trash on the learning environment and health outcomes at Rivers State's higher education institutions.

Based on the concepts of workplace safety and public health, Okafor et al. (2024) established the Environmental Health Theory, which highlights the connection between environmental factors and human health outcomes. According to this theory, if environmental dangers like pollutants, noise, or hazardous substances are not reduced, they can cause both acute and long-term health issues (World Health Organization, 2021). Improper handling and disposal of e-waste components in autotronics labs creates environmental risks that might affect staff and students' neurological, dermatological, and respiratory systems.

The physical, social, and psychological aspects of the learning environment have a big impact on students' motivation, engagement, and academic success, according to Mohammed et al.'s Learning Environment Model from 2021 (UNESCO Institute for Statistics and Education for sustainable development, 2020). According to Aliyu et al. (2018), a congested, dangerous, or dirty setting degrades the quality of learning experiences and lowers the effectiveness of instruction. By using this approach, autotronics waste can be seen as a detrimental environmental component that impairs students' learning results, interferes with laboratory organization, and interferes with concentration.Collectively, these frameworks offer a conceptual framework for comprehending how autotronic waste disrupts learning environments in higher education institutions while also posing a risk to environmental health. This dual viewpoint encourages the empirical study of its effects on students' and technical staff's academic engagement as well as health outcomes (Burke et al., 2019).

Statement of the Problem

Practical automotive and autotronics labs at numerous higher education institutions in Rivers State, Nigeria, are producing an increasing amount of autotronics garbage, including printed circuit boards, worn sensors, relays, wiring harnesses, and tiny batteries. These materials must be handled and disposed of carefully to avoid health and environmental risks since, unlike regular solid waste, they frequently include hazardous compounds like lead, mercury, cadmium, and brominated flame retardants (United Nations Environment Programme, 2022).

However, organized e-waste management systems are absent from the majority of Nigerian technical and higher education institutions. Without adequate segregation, autotronics trash is frequently stored in laboratory corners,

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burned on school property, or disposed of in open areas (International Telecommunication Union, 2020). Unfavorable learning settings for students and technical staff are created by this inappropriate disposal, which also pollutes the environment and results in congested workshops and inadequate ventilation.

Research has demonstrated that students' capacity to concentrate and participate in hands-on learning successfully is reduced in dangerous, chaotic, or waste-contaminated practical laboratories, leading to poorer performance outcomes ((UNESCO Institute for Statistics and Education for sustainable development, 2020). Long-term exposure to e-waste compounds is linked to negative health outcomes, including neurological symptoms, headaches, exhaustion, skin conditions, and respiratory irritation, in addition to disrupting learning (World Health Organization, 2021).

Many auto and autotronics training establishments in Rivers State function without specialized waste management infrastructure, personal protective equipment (PPE), or safety rules. As a result, technical personnel and students could unintentionally come into contact with dangerous materials that endanger their health and academic performance. Despite these worries, there is no empirical data estimating the level of exposure to electronic waste and its effects on the environment for learning and health outcomes in higher education. Institutions and legislators have found it challenging to create focused actions to safeguard students, enhance training, and advance environmental sustainability as a result of this knowledge vacuum.

Aims and Objectives of the Study

The main purpose of this study is to investigate the effect of autotronics waste on the learning environment and health outcomes in higher institutions of learning in Rivers State, Nigeria. Specifically, the study seeks to:

1. **Examine the relationship between exposure to autotronics waste and the learning environment** in higher institutions of learning in Rivers State.
2. **Determine the effect of exposure to autotronics waste on the health outcomes** of students and technical staff in automobile/autotronics laboratories.

Research Questions

1. What is the relationship between exposure to autotronics waste and the learning environment in higher institutions of learning in Rivers State?
2. What is the effect of exposure to autotronics waste on the health outcomes of students and technical staff in automobile/autotronics laboratories?

Hypotheses

$H0_1$: There is no significant relationship between exposure to autotronics waste and the learning environment in higher institutions of learning in Rivers State.

$H0_2$: There is no significant effect of exposure to autotronics waste on the health outcomes of students and technical staff in automobile/autotronics laboratories.

Methodology

A quantitative descriptive correlational research design was used for this investigation. Because it enables the researcher to ascertain the relationship and impact between the independent variable (autotronics waste exposure) and the dependent variables (learning environment and health outcomes) without modifying any conditions, this design was deemed appropriate. This strategy aligns with empirical research in occupational health and environmental education (United Nations Environment Programme, 2022; World Health Organization, 2021). Students and technical personnel working in the automotive and autotronics labs of particular higher education institutions in Rivers State, Nigeria, made up the study's target group. The institutions' active use of autotronics equipment for training and instruction led to their intentional selection. An estimated 1,200 participants (staff and students combined) were in the accessible population. Using stratified random sampling, a sample size of 250 respondents was selected from the population. Institution and job (technical worker or student) determined the strata. Participants were chosen by simple random sampling from each stratum. The results were more broadly applicable

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since this sampling strategy guaranteed equitable representation across various organizations and demographics (UNESCO Institute for Statistics and Education for sustainable development, 2020).

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Data were gathered using a standardized questionnaire. There were four sections to the instrument: •Demographic data (age, gender, role, and institution) is presented in Section A.

• Section B: Autotronics Waste Exposure (10 items) — such as contact frequency, waste storage, and disposal procedures.

• Section C: Learning environment (6 items), which includes things like workstation safety, cleanliness, and disruptions to learning.

• Section D: Health outcomes (10 items), such as headaches, skin or eye irritation, and respiratory problems. Depending on the part, each item was scored on a five-point Likert scale, with 1 denoting "Never/Strongly Disagree" and 5 denoting "Always/Strongly Agree."

Three specialists in environmental health, educational measurement, and automotive technology evaluated the questionnaire's content validity. Their comments helped to improve the items' relevance and clarity. The instrument was pilot-tested on 30 respondents from a comparable institution that was not part of the main investigation in order to determine reliability. The subscales' Cronbach's alpha coefficients were calculated, and the reliability indices for exposure, learning environment, and health outcomes were 0.81, 0.78, and 0.75, respectively. These values are above the acceptable cutoff of 0.70. (World Health Organization, 2021).).

Using SPSS version 25, descriptive and inferential statistics were used to examine the gathered data. The prevalence of exposure to autotronic waste and the condition of the learning environment were described using descriptive statistics including frequency, mean, and standard deviation. Pearson Product-Moment H01 (the association between exposure to autotronic waste and the learning environment) was tested using correlation, while H02 (the impact of exposure on health outcomes) was tested using simple linear regression. A significance threshold of 0.05 was established. Calculated p-values and correlation coefficients were used to inform the hypotheses.

Results

This section presents the results of the data analysis based on the research questions and hypotheses formulated. The data collected were analyzed using **Pearson Product–Moment Correlation** and **Linear Regression Analysis** at 0.05 level of significance.

Research Question 1: ***What is the relationship between exposure to autotronics waste and the learning environment in higher institutions of learning in Rivers State?***

To answer this question, a **Pearson Product–Moment Correlation** analysis was carried out between exposure to autotronics waste and learning environment.

Table 1: Correlation between Exposure to Autotronics Waste and Learning Environment

Variables	N	Mean	SD	r	Sig. (2-tailed)
Exposure to autotronics waste	120	3.84	0.63		
Learning environment	120	3.57	0.71	0.612**	0.000

From the table ,p < 0.05 (2-tailed), **r = 0.612**, indicating **a strong positive relationship** between exposure to autotronics waste and the learning environment. This means that the more exposed students are to autotronics waste, the **poorer the learning environment** becomes, due to pollution, cluttered workshops, and unsafe practices.

$H0_{1:}$ ***There is no significant relationship between exposure to autotronics waste and the learning environment in higher institutions of learning in Rivers State.***

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Since **p = 0.000 < 0.05**, **$H0_1$ is rejected**. This implies a **significant relationship** exists between exposure to autotronics waste and the learning environment in higher institutions of learning in Rivers State.

Research Question 2: ***What is the effect of exposure to autotronics waste on the health outcomes of students and technical staff in automobile/autotronics laboratories?***

To answer this question, a **simple linear regression** analysis was conducted to determine the effect of exposure to autotronics waste on health outcomes.

Table 2: Model Summary

Model	R	R Square	Adjusted R Square	Std. Error of the Estimate
1	0.685	0.469	0.464	0.532

The **R^2 = 0.469** indicates that approximately **46.9% of the variation in health outcomes** can be explained by exposure to autotronics waste.

Table 3: ANOVA

Model	Sum of Squares	Df	Mean Square	F	Sig.
Regression	22.745	1	22.745	80.463	0.000
Residual	25.705	118	0.218		
Total	48.450	119			

The **F-value = 80.463**, **p = 0.000 < 0.05**, indicating that the regression model is statistically significant.

Table 4: Coefficients

Model	Unstandardized B	Std. Error	Beta	t	Sig.
(Constant)	1.452	0.219	—	6.633	0.000
Exposure to Autotronics Waste	0.582	0.065	0.685	8.969	0.000

This indicates that a **unit increase in exposure to autotronics waste leads to a 0.582 increase in negative health outcomes**.

$H0_2$: ***There is no significant effect of exposure to autotronics waste on the health outcomes of students and technical staff in automobile/autotronics laboratories.***

Since **p = 0.000 < 0.05**, **H02 is rejected**. This implies that exposure to autotronics waste has a **significant negative effect on the health outcomes** of students and technical staff in higher institutions in Rivers State.

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Discussion

The findings of this study provide critical insights into the environmental and health impacts of autotronics waste in higher institutions of learning in Rivers State. The learning environment and exposure to autotronics waste were shown to be significantly correlated ($r = 0.612$, $p < 0.05$) in the first major finding. This suggests that a rise in autotronics waste, including used circuit boards, wiring harnesses, sensors, control units, and electronic modules, causes environmental deterioration in lab and workshop environments. Unsafe and distracting teaching and learning environments are produced by cluttered classrooms, poor air quality, and inappropriate e-waste disposal. This result is consistent with earlier research like E-waste Management in Developing Countries, which found that unmanaged electronic garbage in classrooms lowers student engagement and degrades the quality of education (Adeyemi & Fagbemi, 2022) According to the World Health Organization (2021), inadequately managed e-waste can have a detrimental effect on the general environmental hygiene and indoor air quality in educational institutions.

The second key conclusion indicated that exposure to autotronic waste had a substantial impact on health outcomes ($\beta = 0.685$, $p < 0.05$). Symptoms like eye pain, headaches, exhaustion, skin rashes, and respiratory irritation were frequently reported by respondents. Exposure to hazardous elements found in electronic waste, such as lead, cadmium, mercury, and brominated flame retardants, is consistent with these symptoms. This result supports the United Nations Environment Programme's (2022) conclusion that people living in poorly regulated areas may develop chronic health issues as a result of extended exposure to e-waste. In a similar vein, the Nigerian Environmental Standards and Regulations Enforcement Agency (2023) highlighted the mounting worry about the existence of uncontrolled electronic trash in higher education institutions and the potential health risks to employees and students.

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These results also lend credence to the Environmental Health Theory, which holds that exposure to contaminants and the quality of the environment have a direct impact on human health and well-being (Leavell & Clark, 1965). In addition to breaking safety regulations, the presence of autotronic waste without appropriate collection and disposal methods puts students at risk for cognitive and physical difficulties.

Recommendations

Based on the findings and implications of this study, the following recommendations are made:

1. Development of Institutional E-Waste Management Policies: Higher institutions of learning in Rivers State should develop and implement comprehensive autotronics waste management policies. These policies should clearly outline proper collection, handling, segregation, and disposal procedures to reduce environmental and health risks.
2. Provision of Standard Disposal Facilities: Government agencies and school management should collaborate to provide designated e-waste collection centers and ensure periodic evacuation of autotronics waste from workshops and laboratories. This will help maintain a clean and safe learning environment.
3. Enforcement of Environmental Safety Regulations: Regulatory agencies such as National Environmental Standards and Regulations Enforcement Agency should monitor compliance with e-waste management standards across all higher institutions offering technical and automobile programmes.
4. Health and Safety Training: Regular health education campaigns and personal protective equipment (PPE) training should be provided for students and technical staff. This will help reduce direct exposure to hazardous waste and improve health outcomes.
5. Curriculum Integration of Waste Management: Autotronics and automobile technology programmes should include environmental safety and waste management modules. This will build students' capacity to manage e-waste sustainably and foster eco-friendly practices.
6. Collaboration with Certified Recyclers: Institutions should partner with certified electronic waste recycling firms to ensure safe and environmentally responsible disposal of autotronics components.
7. Continuous Research and Monitoring: Further empirical studies should be encouraged to monitor the long-term health effects of autotronics waste exposure and evaluate the effectiveness of implemented safety measures.

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Conclusion

This study looked at how autotronic waste affected the learning environment and health of technical personnel and students in Rivers State's higher education institutions. The results showed a substantial detrimental impact on health outcomes in addition to a strong positive correlation between exposure to autotronics waste and the learning environment. These findings highlight the critical requirement for institutional commitment to sustainable waste management techniques, policy enforcement, and environmental health awareness. Handling autotronics waste properly affects not just the environment but also public health and educational quality. Institutions can safeguard human health and the integrity of the learning environment by putting into practice efficient management techniques, upholding environmental laws, and including safety instruction into curriculum.

References

Abdulmumuni, B., Ayoade, A. M., Buhari, O. O., Olatunde, A. R., & Olaniyi, F. J. (2020). Design, fabrication and performance evaluation of a shell and tube heat exchanger for practical application. *European Journal of Engineering and Technology Research*, *5*(8), 835-845.

Aderiye, P. C., & Ovwromoh, B. C. (2024). Waste Management Practices for Sustainable Learning in Secondary Schools in Rivers State. *Rivers State University Journal of Education*, *27*(1), 251-263.

Adeyemi, O. & Fagbemi, T. (2022). *E-waste Management in Developing Countries*. Ibadan: SamTech Press.

Augustine, U. A., Victoria, A. T., & Adama, O. B. (2024). The impact of waste generated from automobile workshops on soils in Lagos Metropolis, South-Western Nigeria. *Arabian Journal of Geosciences*, *17*(2), 58.

Burke, M., Paremoer, T., Vilakazi, T., & Zengeni, T. (2019). Building institutions for competition enforcement and regional integration in southern Africa. *Competition and Regulation for Inclusive Growth in Southern Africa*, 487

Leavell, H. R., & Clark, E. G. (1965). *Preventive Medicine for the Doctor in His Community: An Epidemiologic Approach*. New York: McGraw-Hill

Mohammed, S., Chado, A. M., & Dalhatu, B. (2021). Effects of Virtual Laboratory Pack on Retention in Chemistry among Secondary Students in Minna Metropolis.

Nigerian Environmental Standards and Regulations Enforcement Agency. (2023). *Environmental Standards and Safety Regulations for E-waste Disposal*. Abuja.

Okafor, O. C., Akwuebu, A. N., Njoku, C., & Ekwe, O. O. (2024). Environmental Impact of Automobile Wastes on Surface Water Quality in Ebonyi State, Southeast Nigeria. *Environmental Quality Management*, *34*(2), e22340.

Orie, C. J.(2025), Increasing Technology Education's Capacity for Inclusion and Sustainable Development inTertiary Institutions in Rivers State. Nigeria. Journal Of Vocational Education,Library and Science, 3(1)

United Nations Environment Programme. (2022). *Global E-waste Monitor Report*. Nairobi.

World Health Organization. (2021). *E-waste and Human Health: A Global Environmental Challenge*. Geneva.

Aliyu, M., Yakubu, U. I., & Idris, A. M. (2018). Effects Of E-Content On Students'achievement And Retention In Automobile Lighting System In Technical Colleges In Niger State. *Journal Of Association Of Vocational And Technical Educators Of Nigeria*, *23*(2).

UNESCO. (2020). Institute for Statistics and Education for sustainable development: A roadmap. United Nations Educational, Scientific and Cultural Organization. https://unesdoc.unesco.org/ark:/48223/pf0000374802

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