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Effect Of Health Education On Environmental Pollution Cognition Among Secondary School Students In Emohua L.G.A

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ABSTRACT
This study investigated the effect of health education on environmental pollution cognition among secondary school students in Emohua L.G.A**,** Rivers State. The study was a quasi-experimental study and data for the study was obtained from a sample size of 100 students drawn from the population of 81,343 secondary school students living in Emohua L.G.A, Rivers State using multistage sampling procedure. A validated self-structured questionnaire titled "Environmental Pollution Cognition Questionnaire (EPCQ) with a reliability index of 0.89 was used for data collection. The data collected was analyzed using the Statistical Package for Social Sciences version 25 employing both descriptive and inferential statistics of percentage, mean, Standard Deviation, paired-sample t-test and ANCOVA. The study found that health education had a significant effect on environmental pollution cognition among the students in Rivers State ($P<0.05$), Health education had a significant effect on environmental pollution cognition among students' in Rivers State based on age ($P<0.05$) and no significant effect based on gender ($P>0.05$). Based on the findings of the study, it was concluded that health education had a positive and statistical significant effect on environmental pollution cognition with variations in the effectiveness of the intervention based on demographic factors such as age and gender. Finally the study recommended among others that Rivers State Secondary School Management Board should collaborate with local authorities, environmental agencies, and non-governmental organizations to create a multi-faceted approach to environmental education to address environmental pollution.
Keywords: Health Education, Environmental Pollution, Cognition

INTRODUCTION
Environmental pollution is an escalating global issue, with significant implications for human health, biodiversity, and the sustainability of our ecosystems. The increasing levels of air, water, and soil pollution have adverse effects on public health, contributing to respiratory and cardiovascular diseases, and impacting overall quality of life (World Health Organization, 2018).
Environmental pollution is the introduction of harmful substances or pollutants into the environment, resulting in adverse effects on living organisms and ecosystems (Scheurer & Cofalla, 2016). It is a complex issue that stems from various human activities, including industrial processes, transportation, agriculture, and waste disposal. Environmental pollution can come in various forms, including air pollution, water pollution, and soil pollution, and exposure to these pollutants can have long-term effects on cognitive development, academic performance, and overall well-being.

Air pollution, in particular, has been linked to cognitive impairments in children and secondary school student. A recent study by Zhang et al. (2022) found that exposure to high levels of air pollution during adolescence was associated with lower academic performance and cognitive function. The study followed a cohort of 2,708 Chinese adolescents and found that those who lived in areas with higher levels of air pollution had lower scores on cognitive tests, including tests of working memory, attention, and executive function.

Water pollution can also have significant impacts on cognitive development. A study by Xu et al. (2021) found that exposure to lead in drinking water was associated with lower IQ scores in children and adolescents. The study followed a cohort of 1,450 Chinese children and found that those who had higher levels of lead in their drinking water had lower scores on tests of cognitive function, including tests of memory, attention, and processing speed.

Soil pollution is another source of environmental pollution that can impact cognitive development. A study by Roy et al. (2021) found that exposure to heavy metals in soil was associated with lower cognitive scores in children and adolescents. The study followed a cohort of 1,000 Indian children and found that those who lived in areas with higher levels of heavy metals in the soil had lower scores on tests of cognitive function, including tests of memory, attention, and processing speed. Heavy metals, such as lead and mercury, are commonly found in soil and can be absorbed into the body through ingestion or inhalation. Exposure to these heavy metals can cause damage to brain cells, disrupt neurotransmitter signaling, and impair cognitive function (Grandjean & Landrigan, 2020). The effects of heavy metal exposure can be especially pronounced in children and adolescents, as their brains are still developing and are more vulnerable to environmental toxins.

Environmental pollution has detrimental impacts on human health, ranging from respiratory and cardiovascular diseases to developmental disorders and cancer (Landrigan et al., 2018). It also disrupts ecological systems, leading to biodiversity loss and ecosystem degradation (Fischer et al., 2020). The degree of environmental pollution in Nigeria, including Rivers State, is significant, as evidenced by available statistics.

According to the World Health Organization (WHO), Nigeria ranks among the countries with the highest levels of air pollution globally, with an estimated 150,000 premature deaths annually attributed to air pollution-related causes (WHO, 2018). Industrial emissions, vehicular pollution, and power generation contribute to high levels of air pollutants, posing risks to human health and well-being (Bodo, & Gimah, 2018; Whyte et al., 2020)). Additionally, water pollution is a major concern, particularly in the Niger Delta region, where Rivers State is located. Oil exploration and production activities have resulted in numerous oil spills, leading to the contamination of water bodies, destruction of ecosystems, and negative impacts on the health and livelihoods of local communities (Elzwayie et al., 2017). Furthermore, inadequate waste management practices contribute to land pollution, with open dumping, improper waste disposal, and burning of solid waste being prevalent issues (Yakubu, 2017). These statistics highlight the significant degree of environmental pollution in Nigeria, emphasizing the urgent need for comprehensive measures to address the sources and impacts of pollution and promote sustainable practices for the protection of human health and the environment.

The understanding, awareness, knowledge, beliefs, and attitudes regarding environmental pollution as stated by Zhang et al (2018) is very essential. This encompasses the recognition of the causes, sources, impacts, and consequences of pollution on human health and the environment. Research has shown that individuals' cognition of environmental pollution significantly influences their attitudes and behaviours towards pollution prevention and environmental conservation (Paul & Bhat, 2016).

Cognition refers to the mental processes involved in acquiring, processing, and interpreting information from the environment (Reber & Reber, 2021). In the context of this study, cognition refers to how students perceive, understand, and interpret information related to environmental pollution. It encompasses their awareness, knowledge, beliefs, attitudes, and understanding of the causes, consequences, and preventive measures associated with environmental pollution. The concept of environmental pollution cognition refers to the mental processes involved in understanding, perceiving, and responding to environmental pollution. Environmental pollution cognition is critical for developing

effective strategies to mitigate the effects of pollution on human health and the environment (Kalayci, 2020).

Enhancing environmental pollution cognition among secondary school student is essential for promoting responsible behaviours and fostering a sense of environmental stewardship. It has been argued that good knowledge, positive attitude and belief enhances positive health promoting behaviour (Hamilton-Ekeke, 2023).

In Emohua Local Government Area (L.G.A.) of Rivers State, Nigeria, environmental pollution is a pressing concern. The region faces significant environmental challenges due to industrial activities, urbanization, and inadequate waste management practices (Nwankwoala & Amadi, 2013). There is a pressing need to enhance the environmental pollution cognition of secondary school students in this area, equipping them with the knowledge and skills necessary to contribute to pollution prevention and environmental sustainability.

Health education serves as an effective tool for improving environmental cognition among students. It encompasses a comprehensive approach that includes knowledge dissemination, skill development, and attitude formation towards health and environmental issues. Studies have shown that health education programs can significantly improve students' understanding of environmental pollution and its health implications (Karami & Larijani, 2015). By integrating environmental topics into health education curricula, educators can foster a holistic understanding of the interconnectedness between health and the environment. According to Liao, Lu, and Teng, (2016), environmental education can play a crucial role in improving environmental pollution cognition. Education can provide individuals with the knowledge and skills necessary to understand the causes and effects of pollution and develop effective strategies to mitigate its impact. Environmental education can also help to promote environmental awareness and encourage individuals to take action to reduce pollution levels.

Secondary school students, who are at a critical stage of cognitive development, are ideal targets for educational interventions aimed at enhancing environmental cognition. Research has demonstrated that early education on environmental issues can lead to long-term positive behaviors and attitudes towards the environment (Otto, 2019). Secondary school students, as a vulnerable population, are particularly susceptible to the adverse effects of environmental pollution due to their physiological, psychological, and behavioral characteristics (World Health Organization, 2016). Addressing environmental pollution cognition and promoting sustainable practices among students is crucial for ensuring a healthier and more sustainable future.

The study was guided by Albert Bandura's Social Cognitive Theory (SCT) and Health Belief Model (HBM) that enhanced its framework and provided a comprehensive understanding of the impact of health education on environmental cognition. Social Cognitive Theory (SCT) emphasizes the role of observational learning, imitation, and modeling in behavior change. According to SCT, individuals acquire and maintain behaviors through observing others, with the environment, behavior, and cognition all playing interrelated roles (Bandura, 1986). In the context of this study, SCT suggests that health education programs that model positive environmental behaviors and provide opportunities for students to observe and practice these behaviors can significantly enhance their environmental cognition and practices. The Health Belief Model (HBM) is used to explain and predict health-related behaviors by focusing on the attitudes and beliefs of individuals. The model suggests that individuals are more likely to engage in health-promoting behaviors if they perceive a higher susceptibility to a health issue, recognize the severity of the issue, believe in the benefits of taking action, and identify fewer barriers to taking that action (Rosenstock, 1974). Applying HBM to this study, health education can be tailored to enhance students' perceptions of the risks and impacts of environmental pollution, thereby motivating them to adopt preventive practices.

Demographic variables such as age and gender play a crucial role in influencing environmental pollution cognition among secondary school students. Age is the number of years an individual have lived from birth. Age is among the possible correlates of mental health practice. It is a significant factor in cognitive development and environmental awareness. Younger students are in different developmental stages compared to older students, which affects how they perceive and process environmental information.

Piaget's stages of cognitive development suggest that as children grow older, their ability to understand complex concepts, such as environmental pollution, improves (Ahmad et al., 2016, Piaget, 1952). Studies have shown that older students typically demonstrate higher levels of environmental knowledge and are more likely to engage in pro-environmental behaviors (Barraza & Walford, 2002).

Research has shown that gender differences also impact environmental cognition. A study by Vicente-Molina, Fernández-Sainz and Izagirre-Olaizola, (2018) indicated that females often display higher levels of environmental concern and are more likely to engage in environmentally responsible behaviors than males. Females are more likely to express worry about climate change, pollution, and habitat destruction (Stefanski et al., 2020). This heightened environmental concern often translates into a stronger emotional connection to nature and a desire to protect it (Zeidler et al., 2021). Females are more inclined to express empathy towards wildlife and ecosystems, viewing them as valuable and worthy of preservation (Bryant, 2017). This could be due to socialization processes that emphasize empathy and care in females, leading to a greater concern for environmental issues (Musitu-Ferrer et al., 2019).

The primary objective of this study was to determine the effect of health education on students' knowledge and understanding of environmental pollution, its causes and effects. By assessing the current level of environmental cognition among these students, the study seeks to identify gaps and areas for improvement, ultimately contributing to the development of targeted educational interventions. Understanding the impact of health education on environmental cognition is crucial for developing effective strategies to combat environmental pollution. This research provided valuable insights into the efficacy of health education programs in promoting environmental awareness and responsible behaviors among secondary school students in Emohua L.G.A.

Research Questions

The following research questions were raised and answered to guide the study:

1. What is the effect of health education on environmental pollution cognition among secondary school students in Emohua L.G.A?
2. What is the effect of health education on environmental pollution cognition among secondary school students in Emohua L.G.A based on age?
3. What is the effect of health education on environmental pollution cognition among secondary school students in Emohua L.G.A based on gender?

Hypotheses

The following hypotheses were postulate and tested at .05 level of significance

1. Health education has no significant effect on the environmental pollution cognition of secondary school students in Emohua L.G.A.
2. Health education has no significant effect on the environmental pollution cognition of secondary school students in Emohua L.G.A based on age.
3. Health education has no significant effect on the environmental pollution cognition of secondary school students in Emohua L.G.A based on gender.

METHODOLOGY

Quasi-experimental non-randomized pre-test, post-test control group design was adopted for this study. Hence, the study involved two groups, one experimental group and one control group. The sample for this study was one hundred (100) students drawn from the population of eighty one thousand, three hundred and forty three (81,343) students living in Emohua L.G.A., Rivers State using multistage sampling procedures which included simple random sampling technique and systematic sampling technique.

The instrument for data collection was a validated self-structured questionnaire titled “Environmental Pollution Cognition Questionnaire (EPCQ)” with a reliability index of 0.89 structured in a “True or False” and 4point likert formats. The questionnaire had two sections A and B. The section A was dedicated to gathering demographic information while section B gathered data on the students’ environmental pollution cognition. The cognition aspect covered: knowledge and attitude. The researcher obtained permission from the Principal of the three sampled schools for the study through an official letter signed by the Head of Department of Health Promotion, Environmental and Safety Education. Before the

commencement of the treatment and administration of the research instruments, the researcher had an orientation and familiarization talk with teachers in those schools selected on the instructional strategies, since they served as research assistants.

Thereafter, pretest was administered to both the experimental and control groups before the commencement of treatment to establish the entry behaviour. After the pretest; the intervention was administered on the experimental groups (Group A and B) for a period of six (6) weeks respectively while a random placebo (a random health talk that do not have the content of the intervention) was administered on the control group. The treatments was facilitated by regular physical and health education teachers (research assistants) in those schools. Each lesson period in the experimental schools lasted 40 minutes (a period). The intervention administration lasted for one month and two weeks. Two weeks after the intervention administration, the researcher administered the post test on both treatment groups and control group. The questionnaire was retrieved at the spot.

The completed copies of the questionnaire were collated, coded and analyzed using the statistical package of social sciences (SPSS) version 25. Descriptive statistics of mean and standard deviation were used to answer the research questions while inferential statistics of Z-test and Analysis of Covariance (ANCOVA) were used to test the hypothesis at .05 alpha level.

RESULTS

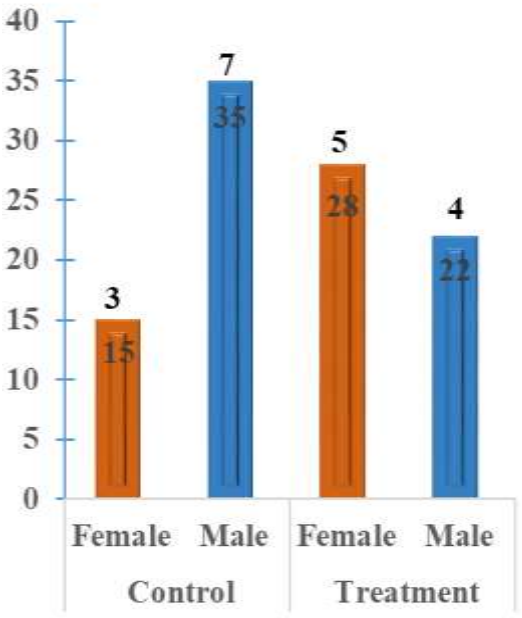

Fig 1: Gender of Respondents

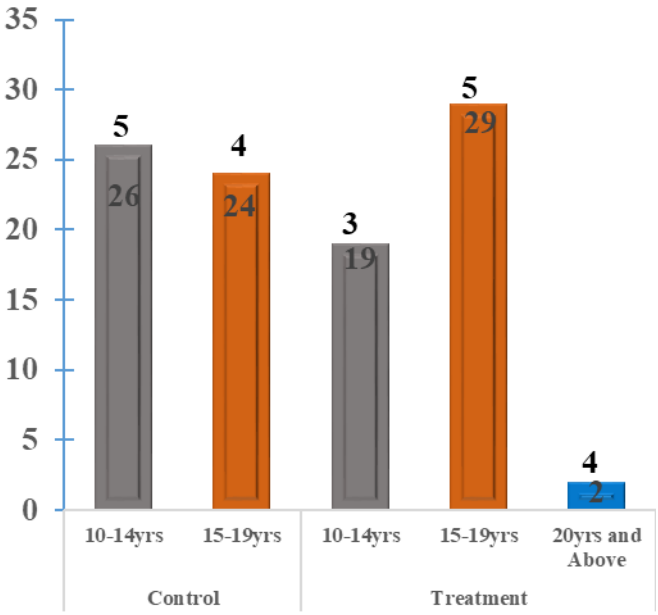

Fig 2: Age of Respondents

Figure 1 illustrates the distribution of study participants by gender. The study findings revealed that within the control group, 15 participants (30%) were female, while 35 participants (70%) were male. In contrast, within the treatment group, 28 participants (56%) were female, and 22 participants (44%) were male.

Fig 2 presents the age distribution of the study participants. In the control group, 26 participants (52%) fell within the age range of 10-14 years, 24 participants (48%) were in the 15-19 years range, and none of the participants were aged 20 years and above. On the other hand, in the treatment group, 19 participants

(48%) were in the age range of 10-14 years, 29 participants (58%) fell within the 15-19 years range, and 2 participants (4%) were aged 20 years and above.

Table 1: Summary of paired sample Z-test on effects of Health education on environmental pollution cognition of secondary school students

	N	Mean	SD	Df	Z-cal	Z-crit.	P. val	Decision
Pre-test Cognition	50	57.2	2.700	49	22.95	2.009	0.003	H_0 Rejected*
Post-test Cognition	50	73.5	4.194					

*Partial Eta^2 = 0.159

Table 1 revealed that for the Pre-test cognition, the mean cognition score before the health education intervention is 57.2, with a standard deviation of 2.700 while the mean cognition score after the health education intervention is 73.5, with a standard deviation of 4.194. The paired sample t-test shows a highly significant difference between pre-test and post-test cognition scores (Z.cal = 22.95, P = 0.003). The effect size, measured by the partial eta square, is 0.159. This indicates a positive level effect, suggesting that health education explains a substantial proportion of the variance in the participants' cognition about environmental pollution. Based on the statistical analysis, the null hypothesis (Ho) stating that health education has no significant effect on students' environmental pollution cognition is rejected. This implies that the health education intervention had a significant impact on improving the participants' cognition about environmental pollution.

Table 2: Summary of ANCOVA analysis on effect of Health education on environmental pollution cognition of secondary school students based on age

Dependent Variable: Post-test level of students' environmental pollution cognition

Source	**Type III Sum of Squares**	**df**	**Mean Square**	**F**	**Sig.**	**Partial Eta Squared**
Corrected Model	235.081[a]	3	78.360	1.749	.002	.273
Intercept	174.969	1	174.969	12.837	.001	.218
Comparing Group (Control)	67.215	1	67.215	4.931	.031	.097
Age	**101.202**	**2**	**50.601**	**3.712**	**.032**	**.139**
Error	626.999	46	13.630			
Total	11696.000	50				
Corrected Total	862.080	49				

* R Squared = .273 (Adjusted R Squared = .225)

The results presented in Table 2 revealed that the overall model was statistically significant (F = 1.749, P = .002), and it explained a significant portion of the variance in the post-test level of students' environmental pollution cognition (R-squared = .273). The main effects of age (F = 3.712, P = .032), were found to be significant, indicating that age had an effects on the post-test level of the participants environmental pollution cognition.

Furthermore, the result showed that the Eta^2 was 0.139 this implied that health education had 13.9% effect on the students' environmental cognition based on age.

Table 3: Summary of ANCOVA analysis on effect of Health education on environmental pollution cognition of secondary school students based on gender

Dependent Variable: Post-test level of students' environmental pollution cognition

Source	Type III Sum of Squares	df	Mean Square	F	Sig.	Partial Eta Squared
Corrected Model	143.186[a]	2	71.593	4.681	.014	.166
Intercept	253.743	1	253.743	16.589	.000	.261
Comparing Group (Control)	125.186	1	125.186	8.184	.006	.148
Gender	**9.307**	**1**	**9.307**	**.609**	**.439**	**.013**
Error	718.894	47	15.296			
Total	11696.000	50				
Corrected Total	862.080	49				

* R Squared = .166 (Adjusted R Squared = .131)

The results presented in Table 3 revealed that the overall model was statistically significant (F = 4.681, p = .014), and it explained a little significant portion of the variance in the post-test level of on students' environmental pollution cognition (R-squared = .166). The main effects of gender (F = 0.609, p = .439), were found not to be significant, indicating that gender had no significant effects on the post-test level of the participants environmental pollution cognition.

DISCUSSION

The comprehensive analysis of the impact of health education on environmental pollution cognition among secondary school students in Rivers State, as summarized in Table 4.1, presents compelling findings. The results reveal a substantial 16.3% increase in students' cognition, with correct responses escalating from 57.2% in the pre-test to 73.5% in the post-test.

The results in table 4.7 also showed that there was a significant difference in the participants cognition level between the pre-test and post-test for the treatment group. Also, the z-test analysis revealed a statistically significant effect (see Table 4.7) with health education intervention contributing to 15.9% improvement in the cognition level among the students. Therefore, it can be concluded that health education has a significant positive effect on cognition in the treatment group, while no significant effect was observed in the control group.

The study's outcomes highlight a discernible improvement in students' knowledge concerning environmental pollution and knowledge is acknowledged as both a catalyst and a resource for cognitive improvement, serving as the foundational material for cognitive processes, refining abilities, and fostering the development of higher-order thinking skills. The findings of this study corresponded with the finding of many researchers whose study pointed out that the health education programme utilized was effective in improving the participants' knowledge with significant improvements in their knowledge and boost their cognitive level on environmental health and help them interact with the environment.

Chen et al. (2016) study to evaluate the effects of an environmental health education program on the knowledge, attitude, and practices of parents of preschool children in China; Al-Sharif et al. (2015), study to evaluate the effectiveness of an environmental health education program in improving knowledge and practices of secondary school students in Saudi Arabia; Dai, et al (2015) study to investigate the effects of an environmental health education intervention on knowledge and practices among rural students in Western China; and Kirenga and Okot-Nwang (2014) study to assess the effectiveness of an environmental health education program in improving knowledge and practice of school children in Uganda, corresponded with the findings of this study as their study revealed that environmental health education program was effective in improving the knowledge, with significant improvements in their knowledge related to environmental health. Oyinloye, Adetunji, and Adejumo (2020) conducted a study to determine the effect of environmental education on the knowledge of secondary school students on land pollution in Lagos, Nigeria also found that the environmental education program had a significant

effect on the knowledge. This findings was also similar to the findings of Kim, et al (2016) and this coincides with the findings of this study.

Furthermore, the study draws parallel findings with other research endeavors, including Eneanya et al. (2020) and El-Gilany et al. (2014) studies on effects of health education on the knowledge of solid waste management among secondary school students which revealed that health education intervention had a significant effect on the knowledge of solid waste management among the intervention group compared to the control group. This is similar to Lwanga-Ntale et al. (2019) study to determine the effect of a health education intervention on the knowledge of solid waste management in a rural community in Uganda and also comparable to Mbabazi et al. (2018) study in Uganda which found that the mean knowledge score increased significantly from 5.3 at baseline to 7.8 at the end of the intervention ($p < 0.001$). In the same vein, Moghaddam Tabrizi et al. (2014) study which evaluated the impact of a school-based environmental health education intervention on the knowledge, highlighted that after the intervention, the mean scores for knowledge significantly increased compared to the pre-intervention scores specifically, in the knowledge regarding the effects of environmental pollution on human health.

The findings of Tsai et al. (2019) study on utilizing school-based health education program to increase knowledge related to particulate matter air pollution among middle school students in Taiwan also corresponded with findings of this study as their findings showed that the health education program significantly increased the intervention group's knowledge of particulate matter air pollution, its health effects, and ways to reduce exposure. Gu et al. (2021) study on investigated the effectiveness of an educational intervention on knowledge related to air pollution among students in urban and rural areas of China in the same vein coincided with the findings of this study as they revealed that educational intervention significantly improved the knowledge related to air pollution among the intervention group, compared to the control group. Additionally, Shalini, Govindaraju, and Mageshwaran, (2018) also found that health education intervention was effective in improving students' knowledge about air pollution and this was similar to the finding of Yao et al. (2021).

Hossain et al (2020) study on effects of a health education program on environmental pollution among school students in Bangladesh also revealed that health education significantly improved students' knowledge about environmental pollution. These studies collectively emphasize the positive impact of health education interventions on knowledge and cognition, specifically highlighting improvements in understanding environmental issues, solid waste management, air pollution, and related health effects.

The study also found that health education had a significant effect on environmental pollution cognition among students in Rivers State based on age and no significant effect based on gender. The significant main effects of age ($F = 3.712$, $p = .032$) suggest that age has an impact on the post-test level of students' environmental pollution cognition. The Eta2 value of 0.139 indicates that health education has a 13.9% effect on students' environmental cognition based on age. This emphasizes the positive impact of health education interventions on shaping environmental awareness, especially in the context of different age groups. The non-significant main effects of gender ($F = 0.609$, $p = .439$) imply that, in the context of the study, gender did not have a significant independent impact on the post-test level of students' environmental pollution cognition. The R-squared value of .166 indicates that the model explains about 16.6% of the variance in the post-test level of students' environmental pollution cognition. While this might be considered a modest amount, it is not uncommon in social science research, and it suggests that other factors not included in the model also influence cognition.

This finding is consistent with literature indicating that cognitive development and awareness of environmental issues may vary across age groups and could be attributed to several factors such as developmental differences, varied levels of prior knowledge, educational background, cognitive readiness, cultural and societal factors.

Students of different age groups may be at different stages of cognitive development and cognitive readiness. Younger students might be more receptive to certain educational approaches or interventions, leading to a more pronounced impact on their environmental pollution cognition compared to older peers. Older students might have already been exposed to environmental education or have acquired some level

of knowledge through prior experiences. In contrast, younger students may be more receptive to new information, resulting in a more substantial increase in cognition.

The educational background and experiences of students may vary based on age. Younger students might be more malleable in terms of accepting and internalizing new information, whereas older students may have established cognitive frameworks that are less easily influenced. Societal and cultural factors can influence how different age groups respond to health education interventions. The influence of societal attitudes, educational policies, or community values may vary across age groups, impacting the effectiveness of the intervention.

CONCLUSION

Based on the findings of the study, it was concluded that health education had a positive and statistical significant effect on environmental pollution cognition. Notably, the study identified variations in the effectiveness of the intervention based on demographic factors such as age and gender.

RECOMMENDATIONS

The following were made based on the findings of the study:

1. Environmental health education should be integrated into the standard school curriculum. Incorporating these topics into regular classroom instruction can ensure continuous exposure and reinforcement of key concepts.
2. Rivers State secondary school management board should collaborate with local authorities, environmental agencies, and non-governmental organizations to create a multi-faceted approach to environmental education to address environmental pollution.
3. Rivers State Ministry of Health should endeavour to design a future health education intervention with a focus on tailoring content and delivery methods to address the unique needs and preferences of different age groups and genders.
4. Health education programs addressing environmental pollution should be extended to involve parents, guardians, and the broader community. This will help to create a supportive environment that reinforces the principles learned in the educational interventions.

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