

## Plastic Materials in a Classroom Environment: An Assessment of Nursery Classes in Sokoto State, Nigeria

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### **Abstract:**

*The study assesses the plastic contact with children in the classroom environment in Sokoto schools because plastics contain harmful chemicals that can inflict severe harm on the health and other domains of children. A survey using 330 questionnaires of teacher respondents was carried out. Results were presented in frequency tables. The chi-square test shows that the results are significantly different at  $p < 0.05$ . The order of stated plastics in the classes is food wrappers, writing materials, food containers, clothes, chairs, and shoes. The majority of respondents think that plastics harm pupils and the minority think that they harm the environment. Method of waste disposal in class environment schools reveal, open dumping, and as the methods of disposal. Of the ways suggested to reduce the effects of plastics in nursery classes environment; therewith, mass awareness was the most submitted, then environmental education at schools, and legislation was the least submitted. There are several forms of plastics in children's contact in Sokoto schools and are processed through an inappropriate waste management method. Thus, can exert harm on them as well as affect their growth and development, their rights to healthy food, water, and air, and threaten public health. Environmental education in schools, mass education, and legislation are needed to protect children.*

**Keywords:** Plastic, Nursery Class, School, Health, Pollution, Additives, Hormone Disruptors.

## **I. Introduction**

The major uniqueness of plastics is their three ideal behaviors, viz, the chemical effects seen from plastics have high effect at low doses, there is no avail of the theory of threshold limit; harms happening because of plastics are difficult to measure using scientific principles in often cases; plastics possesses correlation rather than causality in often times (Liboiron, 2015; Hemavathi et al., 2019). A plastic is an assembly that possessed a long chain of smaller units attached to make a larger unit called polymer using certain bonds, all plastic is a polymer, but several polymers are not regarded as plastics. The plastic polymers also have an incorporation of other substances conjoined in the long polymer aggregate; therewith, substances such as flame retardants, desiccants, plasticizers, etc (Liboiron, 2015). However, the other non- monomer units found in the plastic chains are regarded as additives and have weak interaction with the parent unit and are prone to dissociation when matters arise (Liboiron, 2015; Hemavathi et al., 2019).

Nowadays, in every section of affairs and parts of the world plastic is becoming one of the preferred materials the use and applications of plastics are persistently growing and in turn making a huge waste byproduct that there are no effective waste management strategies to control them in often times especially in developing countries (Verma et al., 2016). Plastics are commonly utilized in our everyday life endeavors in a very easier, convenient and appropriate way. In fact, some regarded plastic as the most applicable polymer that turn around the industrial ages of the 19th and 20th century industrial achievements (Hemavathi et al., 2019; Dhairykar et al., 2022). Plastics are soft, cheap, long-lasting capacity, resilience, easy to use, light-weight, and moldable into diverse array of shapes for the advantage of humans on earth (Loishyn et al., 2020). Plastics are used in food containers, bottles, jars, diapers, fabrics, packaging materials, pipes, cars, electronics, toys, bags, tape, medical tubing, facemasks, buckets, tubing, detergent bags, fast food containers, cups etc (Alabi et al., 2019, Sidi & Yahaya, 2022).

However, to various world agencies, and scientist there are huge stemming concerns pertaining the raising production of plastics across the world, because of several reasons that are peculiar to plastics (Awuchi & Awuchi, 2019). First and foremost, plastics are continually made at humongous scales that the world is yet to have ways to appropriately manage especially in developing and undeveloped economies; circa 5 trillion tons waste is made from plastics and shuttled inappropriately into our water bodies consequently polluting them and paving the way for uptake of harmful chemicals by aquatic biota and transmitting them to humans through the food chain and food web (Awuchi & Awuchi, 2019). Waste/ pollution due to plastics are very difficult to clean up in the environment and cost huge amount of money as well, that is why the plastic has been abundant to threaten the mother earth and the inhabitant of the earth. Indeed, plastic property of persistence in the environment confers it with ability to stay in the environment for hundreds and millions years without been degraded by natural ecosystem (Dhairykar et al., 2022).

Equally, plastics have diverse groups of additives that are harmful to the environment, animals, and humans. For example, endocrine disruptors are components of many plastics capable of causing a deleterious effect on the hormone system of the body, consequently inhibiting proper maintenance of constant internal environment in the body or other vital functions (Awuchi & Awuchi, 2019), specifically endocrine disruptors (like phthalates, alkylphenols, bisphenol A, bisphenol S, polychlorinated biphenyls,

polybrominated diphenyl ethers) spur attention deficit, poor learning and cognitive development, cancers, sexual disorders, body deformations, etc (Awuchi & Awuchi, 2019). Other chemicals that are associated with plastics and harmful are many. Parable, flame retardants are toxic, can bioaccumulate, and affect health; persistent organic pollutants affect brain, liver, kidney, spleen, and brain; dioxins are cancer causing agents, and affect endocrine system; ethylbenzene in chronic exposure elicits kidney damage in animals; particulates emitted by burning plastics are agents of heart disease and respiratory problems, and visibility defects; toluene is associated with hypoxia, reversible effects on liver, kidney, and nervous system; sulphur dioxide emitted in the course of burning plastics is associated with eye irritation, and shortness of breath; about hundreds of polycyclic hydrocarbons are emitted in the end of improper burning of plastics that are cancer agents, and harmful to immune and reproductive systems (Alabi et al., 2019; Awuchi & Awuchi, 2019; Sidi & Yahaya, 2022).

Therefore, it is imperative to investigate the contacts of children/ pupils with plastic materials in their classroom environments to quantify the issue, put up some suggestions of safeguarding the health of children against the effects of plastics. Because the biological system of children is weak and still developing, inability of children to take preventive/protective measures, curiosity, and impulsive, the effects due to plastics are bound make profound effects on children pupils. It is pertinent to give children their human right to health and healthy environment through advocacy to policy makers to take appropriate measures to address the situation. Likewise, researchers are needed to make findings to have better understanding of the plastics and children issues, and families are needed to be educated to take right decisions in preventing their wards contact with plastics at schools (Sripada et al., 2022). That is why this study aimed to have an assessment of the plastics in the children's classrooms in Sokoto, an area that was rarely explored.

#### **A. Research Questions**

The research questions for this study are as follows:

- How is the use of plastic materials in pupils' classrooms in Sokoto state, Nigeria?
- How is the perception of teachers on harms of classroom plastics in Sokoto state, Nigeria?
- How is the method of pupils' classrooms plastics in Sokoto state, Nigeria?
- What are the possible ways of reducing the effects of plastics in pupils' classrooms in Sokoto state, Nigeria?

#### **II. Methods**

This study was carried out in Sokoto state, Nigeria. A state that falls in the northwestern region of the country. The Hausa and the Ffulde languages are widely spoken in the area while Islam is the commonly practiced religion in the LGA. A descriptive survey design was used for this study. This design is appropriate for areas where little has been reported and that is the reason that motivated the researcher to investigate the respondents of the study. Accordingly, this study employed quantitative techniques in both the collection and analysis of the data (Nasiru, 2015). The research was planned to study the plastics in contact with pupils in schools in Sokoto state, Nigeria.

**A. Population and Sample**

The population of this study includes all teachers at pupils' classes in Sokoto state, Nigeria. The sample size of 330 was calculated using Raosoft calculator at 5% margin of error, 95% confidence limit, and 40 percent response distribution, and 1600 population size. Thus, the sampling technique was the simple random probability sampling.

**B. Research Instrument**

The instrument for this study was a semi-structured questionnaire designed by the authors. The questionnaire has of five sections, section A carries the demographic characteristics of the respondents, section B carries the questions about the use of plastics in pupils' classes in schools in Sokoto, Nigeria, section C carries questions about the perception of teachers on harms of plastics in pupils classes in schools in Sokoto state, Nigeria, and section D carries questions about the plastic waste management in pupils classes/ schools and solutions to alleviate the problem. An audio recorder was used to record responses wherever applicable.

**C. Data collection and Analysis**

This method used to collect data in this work was using a semi-structured questionnaire, and a simple random probability sampling. The method utilized in the analysis of the data gathered in this work was the interpretation and presentation of data collected using Special Package for Social Sciences (SPSS), frequency distribution tables and  $X^2$  test.

**III. Result and Analysis****Table 1: Demographic characteristics of teachers in nursery classes in Sokoto**

Variable	Frequency	Percentage
<b>Sex</b>		
Male	132	60.0
Female	198	40.0
<b>Religion</b>		
Islam	198	60.0
Christianity	132	40.0
<b>Educational status</b>		
NCE	132	40.0
Degree	198	60.0
<b>Specialization</b>		
Biology	132	40.0
Physics	99	30.0
Engineering	99	30.0

From the table 1, the demographic characteristics of respondents shows 60.0% are males, and 40.0% are females; 60.0% are Christians and 40.0% are Muslims; most of them (60.0%) are bachelor degree holders, and minority are (40.0%) are Nigeria Certificate of Education holders. The specializations of teachers are: biology (40.0%), physics (30.0%), and engineering (30.0%). The teachers were selected because their specializations are related to the issue of plastics that is been researched in this study.

**A. How is the use of plastic materials in pupils' classrooms in Sokoto state, Nigeria?**

**Table 2: Use of plastic materials in a classroom environment in nursery classes in schools in Sokoto state, Nigeria**

Parameters	Frequency	Percentage
Food wrappers	012	36.4
Writing material(pen, cleaner, math set)	60	18.2
Food containers (hot or cold food)	45	13.6
Clothes	38	11.8
Chairs	37	11.5
Shoes	30	9.1

Chi-square test has shown that,  $\chi^2$  value is 102.926, the p-value is  $<0.0001$ . The result is significant at  $p < .05$ . In table 2, the results for various uses of plastics in the classroom environment of pupils were shown. The most stated plastics in the class environment where pupils live are the food wrappers (36.4%), then writing materials (18.2%), then food containers (13.6%), and then clothes (11.8%). Others with least scores are: chairs (11.5%) and shoes (9.1%).

From this study (table 2) it can be seen that the school pupils have to interact with the various plastic materials that in their classes in the course of their learning studies. Learning is important and plastics are very important to help make human life easier because of their applications like these shown by this study; plastic is used as food wrappers, writing materials (eg pen, whiteboard marker), food containers (like water containers), clothes (uniforms), chairs, and shoes. However, there are concerns to the children on due to their interaction with plastics which need to be revisited to protect the health of these pupils. For instance, the plastics of whatsoever form have the ability to leach out its hazardous additives to the surrounding contacts especially when there is a pressure due to heat or sunlight or oxidation or pyrolysis or mechanical tear (Alabi et al., 2019; Gazal & Gheewala, 2020).

Thus, there is potential that the pupils can take in hazardous additives from plastics from food containers (especially when their food is hot in coolers, takeaway, polythene bags, water bottles, soft drink bottles, water containers etc) (Obebe & adamu, 2020). There are several harmful chemicals in the plastic that can seep into foods or water of the pupils and cause harm; like dioxins (disrupt endocrine, affect cognitive ability, affect motor ability, and can elicit cancer (Sidi & Yahaya, 20022); flame retardants (possesses toxicity, bio accumulate in the body); bisphenols (disrupt hormones pathways in animals); phthalates (act as endocrine disruptors, act on androgen, a principal critical in male and female); nonylphenols (act as endocrine disruptors, reduce male fertility, affect survival of juveniles) (Alabi et al., 2019; Awuchi & Awuchi, 2019; Sidi & Yahaya, 20022). Plastics (along with their harmful additives, adhered microbes, adhered chemicals) gets into the body via nose (inhalation of micro/ nanoplastics), ingestion along with food or water; where it can be translocated to various organs, tissues, and cells in the body. On getting to the cells plastics are able to traverse the lipid membrane and possessed reactive oxygen species to stimulate oxidative stress. In the nose or mouth, plastics can also travel to the lung to cause inflammation (Aljaibachi, & Callaghan, 2018; Agberemi, 2020; Gazal & Gheewala, 2020; Ibrahim & Noordin, 2020; Awuchi & Awuchi, 2019; Sampson, 2021; Sidi & Yahaya, 2022).

**B. How is the perception of teachers on harms of classroom plastics in Sokoto state, Nigeria?**

**Table 3: Perception of teachers on plastic materials in a classroom environment in nursery classes in schools in Sokoto state, Nigeria**

Perception	Frequency	Percentage
Harm on the pupils	132	40.0
Harm on the environment	198	60.0
Total	330	100.0

The  $X^2$  test result for table 3 shows a  $x^2$  value of 13.2, p-value is .00028, therefore, the result is significant at  $p < .05$ . Table 3 shows the perception of teachers on plastics in nursery classes, majority (60.0%) assumed that it is harm the pupils, and minority of them (40.0%) assumed that they possessed harm on the environment.

**C. How is the method of pupils' classrooms plastics in Sokoto state, Nigeria?**

**Table 4: Method of disposal of waste plastic materials in a classroom environment in nursery classes in schools in Sokoto state, Nigeria**

Perception	Frequency	Perception
Open dumping	155	46.9
Open burning	175	53.0
Total	330	100.0

Chi-square test has shown  $x^2$  value is 13.2, the p-value is  $< 0.0028$ , the result is significant at  $p < .05$ . In table 4, there is the result showing method of waste disposal in class environment in nursery schools in Sokoto. Therewith, majority (53.0%) opined that open burning, and minority (46.9%) submitted open burning as the method of disposal. This is in agreement with several studies that relate that waste including plastics is an issue that has not being managed properly; large part of the waste is seen conspicuously disposed in many parts of developing cities, many parts of Nigeria, and many parts of Sokoto (Alabi et al., 2019).

Another widely reported method of waste/ plastic disposal in developing countries like Nigeria (Sokoto included) is the improper open burning. To the children in the classroom open burning is a dangerous method that lead to emission of harmful chemicals such as metals, furans, dioxins, particulate, volatile organic compounds etc (Obebe & Adamu, 2020; Maitlo et al., 2022). Additionally, open dumping of plastics affects the environment by encouraging the intake of plastics by plants and animals and getting into the food chain and food web; in turn the humans including children are affected by the effects of plastics present in plants or animals or water (Alabi et al., 2019). Burning of plastics emits hazardous substances such as carbon monoxide, dioxins, ethylbenzene (causes kidney damage in animal study), toluene (causes hypoxia, central nervous system toxicity), polycyclic aromatic hydrocarbons (cause can cancer, reproductive effects in animals) etc (Sidi & Yahaya, 2022).

**D. What are the possible ways of reducing the effects of plastics in pupils' classrooms in Sokoto state, Nigeria?**

**Table 5: Ways of reducing plastic materials effects in a classroom environment in nursery classes in schools in Sokoto state, Nigeria**

Perception	Perception	Frequency
Mass awareness creation	138	41.8

Environmental education at schools	126	38.2
Legislation	66	20.0
Total	330	100.0

Chi-square test has shown  $\chi^2$  value is 27.055, the p-value is  $<0.0001$ , the result is significant at  $p<0.05$ . Table 5 shows the ways suggested by the teachers to reduce the effects of plastic materials in nursery classes environment in Sokoto state, were shown in table 5; therewith, mass awareness was the most submitted (41.8%), then environmental education at schools, and legislation was the least submitted (20.0%).

This finding in table 5 is in tandem with other studies that suggested health education, awareness creation, legislation parts of the methods needed to control the continuing plastic pollution and its effects on humans and environment (Alabi et al., 2019; Sidi & Yahaya, 2022). For example, a study among students on effect of health education on knowledge of students regarding health hazards of plastics from India has shown that health education is a good intervention to reduce effects of plastics among students (Abid et al., 2020).

#### IV. Discussion

Indeed, plastics are versatile modern materials that have been useful in a diverse array of applications in human life. Plastics are also common in schools' environment. However, due to the recent studies that outlined how plastics contain chemicals that are able to traverse from the parent materials to the environment due to pressure of health, sunlight, mechanical tear, etc, and reach the contact environment like humans, food, soil, water, and quasi; and these plastic chemicals can be able to stimulate many adverse health effects on animals or humans, it is pertinent to assess the plastics that children are being in contact in their classroom dealings (Mikolajewska et al., 2022). This study has found that there are plastics in children's classrooms in surveyed schools in Sokoto; for example, as their clothes, writing materials, food containers, shoes, chairs, and others. And the major methods utilized to get rid of them was the open dumping and burning, the inappropriate waste management practices reported by many studies in the state (Ibrahim et al., 2019; Shehu et al., 2020; Sarkingobir et al., 2021; Sidi & Yahaya, 2022).

Presence of plastics in contact with children is capable of causing harms, because the over 140 additives of plastics can travel to the skin, food, water, of the children and get into the body where they can elicit effects like hormone disruption, inflammation, development problem, nervous issues, cancer, among others (Sidi & Yahaya, 2022). Also, the inappropriate waste management method of open burning is able to emit harmful chemicals like dioxin, carbon dioxide, carbon monoxide, hydrogen chloride, butadiene, persistent organic pollutants, etc which can exert harmful effects on the present and future life of the innocent children that deserved to be accorded with healthy environment, healthy food, healthy water, and right to health (Abid et al., 2020). Also, diffusion of plastics into the environment can affect water, soil, air, plants, and animals that are components of children's food chain can affect them (Rist & Harmann, 2017; Zhu et al., 2018; Umar et al., 2022). It is now clear to seek the government to monitor the inclusion of plastics in children's classrooms, and create a wide awareness on the possible harmful side of plastics; because children rapid brain development makes them more prone to effects from additives that can impair brain function and

development, chemicals get into children's body as a result of contact with environment, children eat, drink, and inhale chemicals more than adults (Center for Health, Environment and Justice, 2010; Tachev & Christova-Bagdassarian, 2015; Zeynep, 2016; Rist & Hartmann, 2017; Critchell, K. & Hoogenboom, 2018; Igbo et al., 2018; Mikolajewska et al., 2022; Mubarroroh et al., 2022; Sripada et al., 2022).

## V. Conclusion

Plastics are polymers made from monomers, therewith, the plastic polymer chain contains numerous hazardous additives that under any slight pressure (like sunlight, heat, tear, mechanical stress) can easily release these chemicals of concern into anything/anybody they come in contact. Nevertheless, these plastics have found their ways into usage in some uncountable ways in human endeavor due to their noble properties; therewith in children's classes there are various plastics found. Due to the nature of children, they don't have ability to take measures to safeguard their health from plastic contacts, they have a weak growing body system, they have a long lifecycle to follow and more chances of plastics contact, they have curiosity to touch and explore, and other reasons; this study try to determine the exact types of plastics in contact with children in classrooms in Sokoto state and the methods utilized to handle them because there is possibility to harm children's health as well as public health if care was not taken. The conclusion that can be seen from this study is, there are several forms of plastics in children's contact in Sokoto schools, and are processed through an inappropriate waste management method. Thus, can exert harms on them as well as affect their growth and development, their rights to healthy food, water, air, and threaten public health. There is need for health/ environmental education in schools, and mass education, and legislations to reduce much contact of children with plastics.

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