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"GARBAGE IN, GARBAGE OUT" DISPOSAL OF WASTE: A CONCEPT FOR REVIVING PLASTIC WASTE INTO ART OBJECTS

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ABSTRACT

This study investigated the plastic waste challenges to the environment of some parts of Takoradi Technical University's (TTU) main campus, Effiakuma - new site, Takoradi-Ghana. The study, therefore, explored the concept of Garbage in, Garbage out waste disposal in producing functional art objects (flower vases) from the realization of the plastic waste challenges. Under the qualitative approach, the studio-based inquiry was adopted for the study. The studio data collection was done using personal interviews and direct observation to solicit data from 15 purposively sampled respondents. The sample size for the study consisted of two TTU management staff, five art lecturers, and eight students. The studio data were analyzed using a visual analysis tool and a studio-based production process. This process allowed the study to reflect on the practical explanation of exploring plastic waste in art. The production process of the studio-based practice brought some practicability and viability of plastic waste as a material into art, as was evident in the flower vase produced. The study concluded that art lecturers and student artists on TTU's main campus should focus on the viability of plastic waste as creative materials for art.

Keywords: Art, Environment, Plastic Waste, Studio-Based Inquiry, Takoradi Technical University

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INTRODUCTION

Plastic, over the year, has been used for the benefit of humanity for commercial and domestic purposes. Plastic as a material has also been exploited heavily by society for packaging and material conservation to demonstrate the versatility of plastics (Andrady & Neal, 2009: 1977). The global demand for plastic has contributed immensely to plastic waste in the environment. This situation is due to the mishandling of plastics by some individuals. Solid waste is an issue in the global world, mainly plastic waste. Plastic waste has a slow degradation rate (Alabi et al., 2019: 1). People are used to carrying items of groceries, clothing, and food in plastic or polyethylene bags purchased in stores in Ghana. Plastic bags are used in our everyday lives for carrying food items (Donkor et al., 2021: 71). However, mishandling plastic bags has played a significant role in the littering system in Ghana. The plastic waste situation at Takoradi Technical University's (TTU) main campus has resulted in many detrimental effects, such as landscape disfigurement, pollution, and blockage of river and gutter channels. Plastic waste is a challenge not only on TTU's main campus, but this challenge has become a community, national and global issue. This plastic waste challenge has resulted to the degree that some Governments in Africa have decided to ban the use of plastics (Ujeh, 2021: 2).

Banning plastic bags and developing alternatives is a welcome measure concerning the pressure on the production and use of plastic bags. While the imposition of tax on plastic bags has a positive impact on the preservation of the fertility of farmland, the continued and dominant use of plastic bags would outweigh the benefits of the levy (Ujeh, 2021: 2). Plastic waste management has become one of Ghana's challenges. Research has shown that plastic polymers are difficult to manage. In other scholarly studies, plastic waste is a factor that leads to poor waste management in Ghana because of the higher population density. The production of plastics and plastic products has increased this year and is more significant than any other quantity recorded worldwide. Its output increased in a single year by 13 million tones between 2015 and 2016 (Kehinde et al., 2020: 1). Fifty per cent of plastic products and packaging materials are considered disposable since they are single-use materials (Kehinde et al., 2018: 1086; Kehinde et al., 2020: 1).

Discarded plastics are known to be harmful to human health and the environment (MESTI, 2020: 2; Nyavor-Akporyo et al., 2013: 2177). Because of its non-biodegradable nature, plastic waste causes irreversible environmental harm (Kota et al., 2014: 373). Plastic waste hinders the natural aeration process of the surface of water bodies, chokes municipal sewer lines and stormwater drains, and clogs the bar screens of sewage treatment plants. Plastic waste interferes with various agricultural operations. It prevents the natural recharge of underground water by contributing to visual pollution (World Wildlife Fund-India, 2021: 1). Municipal plastic waste management is concerned with taking different measurements to save landfill capacity and environmental pollution. This effort is directed toward plastic waste that has a slow degradation rate (Noor, 2021: 1; Flynt, 2020: 1; Ampofo, n.d: 3).

Perceiving plastic waste and its environmental pollution, Takoradi Technical University (TTU) has three campuses, namely Effiakuma new site, Butumagyebu and Akatakyi, all suburbs in the Western region of Ghana, for its operations. The Effiakuma new site is the main campus located at Takoradi. The Effiakuma new site main campus houses the Central administration, Faculty of Applied Arts and Technology, Faculty of Applied Sciences, Faculty of Built and Natural Environment, while the Butumagyebu (BU) campus is located at Sekondi houses the Faculty of Business studies. The Akatakyi campus is off the Agona Nkwanta road, which houses the Faculty of Engineering. TTU is a public tertiary education institution (Technical University) established as a Government Technical Institute in 1954 and became part of the State Tertiary Education System later after the passage of the Polytechnic Law of 1992 (PNDCL 321) (TTU, 2021: 6). An Act of Parliament, the Technical University Act 2016 (Act 922), subsequently converted eight of the then ten Polytechnics, including Takoradi Polytechnic, into Technical Universities

after meeting the requirements (TTU, 2021: 6). Notwithstanding, the study focused on the TTU main campus, Effiakuma new site, Takoradi as the study area. On TTU's main campus, preliminary studies (Donkor et al., 2021: 71) show that managing plastic waste is challenging due to lack of technological advancement in recycling plastic waste (Dutta & Choudhury, 2018: 2). Therefore, considering the challenges faced by the University's waste management, plastic waste has become crucial plastic pollution to the environment of some parts of Takoradi Technical University's (TTU) main campus, Effiakuma new site, Takoradi-Ghana. Again, there is the need to explore the concept of Garbage in, Garbage out waste disposal to produce functional art objects (flower vases) from the realization of the plastic waste challenges. The study, therefore, contributes its quota to the University's development of plastic waste management by reviving plastic waste into art. In an attempt, the following research questions were asked:

- What is the plastic waste challenge on TTU's main campus?
- How can plastic waste be explored as an artistic material for functional art objects?

Theoretical Basis

The study adopted the waste disposal concept of 'Garbage in, Garbage out' from Thomson (2009: 32) and Byju (2022: 1) as a process that constitutes the creation of waste through various works to dump waste in landfills for decomposition. As a workability test for solving the environmental issues or problems with long-distance trash transport, Thomson (2009) and Byju (2022) explained that waste and all used kitchen products such as vegetables, fruits, tainted food products, animal waste, used paper, dried leaves, plastics, and other wastes are produced daily. This process is collectively called Garbage (Byju, 2022: 1). The study classifies garbage into Biodegradable wastes (organic) and Non-biodegradable wastes (inorganic). In this sense, unwanted plastics as non-biodegradable wastes become a significant material for the study. This study reflects on Thomson's (2009: 32) Garbage in, Garbage out, the concept of waste disposal as a theoretical account through which the disposed garbage such as plastic waste on TTU's main campus is collected and recycled into art. In other words, the study's expediency on the adopted theory by both Thomson (2009: 32) and Byju (2022: 1) is to revive plastic waste that has been thrown away or regarded as garbage.

Plastics

The physical structure of plastics is a synthetic material manufactured from petroleum and natural gas as raw materials (Brown & Poon, 2016: 1; Wienaah, 2007: 3). Again, Wienaah (2007: 4) states that plastics are made up of large molecules (macromolecules), parts of all materials. The molecular weight of plastics can be between 20,000 and 100,000 mg/L. Plastics can be considered large bead chains in which monomers such as ethylene, propylene, styrene, and vinyl chloride are bound into a polymer chain. Polymers such as polyethylene (PE), polystyrene (PS), and polyvinyl chloride (PVC) are the final products of the polymerization process in which monomers are united. In many instances, only one type of monomer is used to manufacture the material, sometimes two or more. A wide range of products may be produced by melting the base plastic in the form of pellets or powder (Dow, 2021: 1; Wienaah, 2007: 4). Plastics have been developed from natural resources (e.g., gums and shellac) to the chemical modification of resources (e.g., natural rubber, cellulose, collagen, and milk proteins), and finally, to completely synthetic plastics (e.g., Bakelite, epoxy, and PVC).

The first organic polymers (plastics) were bio-derived materials such as eggs and blood proteins. It is believed that Mesoamerican people used natural rubber for their work, such as balls, bands, and figures. The horns of treated livestock served as windows for lanterns in the Middle Ages. Materials that imitated the properties of the horns were developed by treating milk proteins with laundry around 1600 BC. In the 19th century, as chemistry evolved during the Industrial Revolution,

many materials were brought back. The development of plastics accelerated with the discovery of vulcanization to harden natural rubber by Charles Goodyear in 1839 (Trevor, 2019: 1; Nara Loca Abadi, 2020: 1; Zafar, 2020: 1). Plastics as polymers are produced by converting natural products or synthesizing primary chemicals, usually derived from oil, natural gas, or coal. The variability of plastic, either within plastic types or between family types, makes it possible to adapt plastic to specific design and performance requirements. Therefore, some plastics are best suited for some applications, while others are best suited for entirely different applications (American Chemistry Council, 2005).

Melting point and properties of plastics

Kupis (2018) indicates that every plastic has its melting point. Table 1 shows how plastic melts at its degree Celsius. The melting point of plastic waste bottles helps to create functional art objects.

Table 1. Results on the melting point of plastics

Raw materials	Catalysts	Melting point (°C)
Polystyrene	Nil	190
Polypropylene	Nil	120
Polyethylene	Nil	110
Mixed plastic	Nil	185
Mixed plastic	Activated carbon	75
Mixed plastic	Activated carbon + charcoal	75
Mixed plastic	Activated carbon + CaO	70

The chemical process of plastics is classified in their synthesis, such as condensation, polyaddition, and cross-linking (Smith, 2021: 1). The chemical process can also be classified by its physical properties, including hardness, density, tensile strength, thermal resistance, and glass transition temperature. Plastics can additionally be classified by their resistance and reactions to various substances and processes, such as exposure to organic solvents, oxidation, and ionizing radiation. Other classifications of plastics are based on qualities relevant to manufacturing or product design for a particular purpose. Examples include thermoplastics, thermosets, conductive polymers, biodegradable plastics, engineering plastics, and elastomers. Finally, a critical classification of plastics is the degree to which the chemical processes used to make them are reversible or not (Davis, 2020a: 1; Osborne, 2018: 1).

Hazard (Plastic waste)

Regarding environmental and health impacts, it is essential to distinguish between different types of plastics (Wienaah, 2007: 5). Most plastics are found to be non-toxic (PVC is a significant exception). Polyethylene (PE) and polypropylene (PP), for example, are inert materials; however, plastics are not entirely stable. Under the influence of light, heat or mechanical pressure, they may break down and release harmful substances. For example, monomers from which polymers are produced can be released and affect human health. Styrene (used to manufacture polystyrene, PS) and vinyl chloride (used to manufacture PVC) are known to be toxic, and ethylene and propylene can also be problematic. The effects on the environment of plastics also differ depending on the type and quantity of additives used. Certain flame retardants may cause environmental pollution (e.g., bromine emissions). Pigments or colors can contain heavy metals that are very toxic to humans. Chromium (Cr), copper (Cu), cobalt (Co), selenium (Se), lead (Pb), and cadmium (Cd) are frequently used to produce brightly colored plastics. For example, cadmium is used in red, yellow, and orange pigments. In most industrialized countries, these pigments have been legally prohibited. Additives used for heat stabilizers (i.e., chemical compounds that increase the temperature at which decomposition occurs) often contain heavy metals, such as barium (Ba),

tin (Sn), lead, and cadmium, sometimes in combination (Dow, 2021: 1; Daniyan et al., 2017: 1; Ampofo, n.d: 3).

Plastic Art and the Environmental Space

The environmental space has become an art area with the conversion of art and buildings into a space that can effectively contain human activities while being aesthetically pleasing (Donkor et al., 2021: 184; McCreery, 2016: 1; Fanizza, 2016). Plastic is a construction material used for numerous purposes. The use of plastics is non-biodegradable and indestructible for the realization of artworks, such as paneling, flooring, and even furniture. Plastic material can be formulated into different shapes and sizes. The concept and content of plastic waste serve as philosophical motivation for the artists with traditional Adinkra symbols and sayings (Micah et al., 2021: 10; Quoterich, 2021; Adinkra Symbols, 2020; Linnartz, 2020: 1). Plastic has the strengths of water resistance and electric proof. Plastic is a lightweight material compared to other art materials (McCreery, 2016: 2; Klein, 2011: 3). Plastic art involves the physical manipulation of a plastic medium by moulding or modeling sculptures or ceramics (Gunzelmann, 2020: 1). Plastic art has a long history. It has had a synthetic organic resin since its invention (Davis, 2020b: 1). The concept of plastic arts emerged over the 19th century (Visual-cork, 2020: 1). The environmental space concentrates on the overall perspective of space. In integrating plastic waste into the environmental space, the strength of plastic waste can demonstrate conceptual inspiration for exterior and interior spaces.

Environmental Artists and the Use of Plastic Waste

Plastic pollution has a dangerous toll on the environment. In response to plastic pollution, recycling has become an artist's way of reducing plastic waste (Rakhetsi, 2021). Some contemporary artists have realized the transformation of plastics to create beautiful art and accessories as a point to raise awareness of plastic pollution. Again, material content for the artist has grown from time to time. Artistic materials ranging from traditional (conventional) to non-traditional (unconventional) have brought a desirable visual depth to the artist. The quest for alternative art materials has resulted in many exploits of the environment. Environmental challenges such as plastic pollution have also given artists the edge to explore more such situations to improve their visual arts qualities. Visual artists such as Serge Attukwei Clottey and Essilifie Banton of Ghana have exploited plastic waste by turning it into treasures to save the environment. Elsewhere, visual artists such as Mandy Barker (UK), Pam Longobardi (USA), John Dahlsen (Australia) and the rest have established plastic waste from different angles of art. The concept of aesthetics from these visual artists has motivated the study by reviving plastic waste on TTU's main campus into functional artworks.

Mandy Barker (born. 1964, UK)

Mandy Barker is a British photographic artist. She is especially famous for her work on marine plastic debris. Barker worked with scientists to raise awareness about the massive quantity of plastic floating in our oceans. She graduated from the University of Montfort in England with a Master of Arts (MA) in photography. After completing her degree, she began investigating marine plastic debris. Barker collaborates primarily with scientists to raise public awareness about ocean plastic pollution. She received a National Geographic Society Research and Exploration Fellowship in 2018. She was nominated for the Pictet Prize in 2017 and the Deutsche Börse Photography Foundation Prize in 2018. Barker is a member of the Royal Photographic Society located in Leeds ("Mandy Barker", 2021). Style and technique: Construction of pieces of plastic into a work of art (relief projections).

Figure 1. Mandy Barker and her artwork

Pam Longobardi (born. 1958, USA)

Pam Longobardi is a contemporary, eco-feminist artist from Atlanta, Georgia. As a primary material, she is internationally renowned for her sculptures and installations made of plastic debris, mainly in marine and coastal environments. Longobardi's work involves community-based research, such as carbon or plastic audits and collaborative artistic creation. In 2013, Longobardi received the Hudgens Prize and in 2014, she obtained the title of Distinguished Professor of Art from the University of Georgia State and was named Artist-in-Residence of the Oceanic Society. In 2019, she was appointed Regent Professor by the Board of Regents from the State of Georgia.

Longobardi grew up in New Jersey as a child of an ocean rescuer and a champion scuba diver from the State of Delaware. Longobardi attributes the bond between his parents and water to her scientific and artistic interests. Longobardi moved to Atlanta in the 1970s. She earned a BSc in Science Education from Montana State University in 1982. Longobardi then obtained a master's degree in fine arts from Montana State University ("Pamela Longobardi", 2021; Artsciweb, 2020). Style and technique: Construction of plastic fragments into a work of art (in-the-round/three-dimensional forms).

Figure 2. Pam Longobardi and her artwork

John Dahlsen (born. 1963, Australia)

John Dahlsen is a contemporary environmental artist from Australia. He uses found objects such as plastics from oceanic waste from Australian beaches to create his artworks. John Dahlsen has been to the Victorian College of the Arts and Melbourne College of Advanced Education. Dahlsen studied art at the Victorian College of the Arts from 1977 to 1979. In 1989, he continued at the Melbourne College of Advanced Education. He was awarded his doctorate at Charles Darwin University in 2016. In addition to his art, he is a lecturer at Australian universities and environmental conferences worldwide. He has exhibited in several solos and collective exhibitions since 1979. Dahlsen lives in Byron Bay-New South Wales, Australia (Carroll, 2020: 1; "John Dahlsen", 2021). Style and technique: Construction of plastic fragments into a work of art (In-the-round/three-dimensional forms).

Figure 3. John Dahlsen and his artwork

MATERIALS AND METHODS

The materials and methods focused on two aspects: the studio-based inquiry and the production process under the qualitative approach. The materials and methods covered tools, equipment, materials, studio data collection, and analysis tool. Paudi et al. (2020: 1006) cited Newbury's (1996: 215) and Sullivan's (2006: 20) studio-based inquiry as research that has a basis for producing artifacts that contributes knowledge to the creative field (Daichendt, 2012: 6). This research was conducted in 2019 academic year at Takoradi Technical University, Takoradi-Ghana. The collection of studio data was done using personal interviews and direct observation. Fifteen (15) respondents who consisted of two TTU management staff, five art lecturers, and eight students were purposively sampled. The studio data were analyzed using a descriptive analysis tool for describing the data collected into words or texts (Bush, 2020: 1) and supported the production process with visuals such as photographs that allowed the study to reflect on the practical explanation of exploring plastic waste in art. The production process involves the studio production process (methods) required for the work. The studio-based research design was employed for the study. This research design was chosen to analyze plastic waste bottles as an artistic material for the interior space by mitigating the environmental challenges on TTU's main campus. The study used the modeling and casting process for studio-based processes. This studio-based inquiry provided a systematic way of looking at the production process, collecting studio data, analyzing information, and documenting the results.

Materials, tools and equipment

The studio practice allowed the opportunity to experiment with materials, tools and equipment available to carry out the task. Materials, tools and equipment were used for the production processes with plastic waste bottles as a material to create flower vases. The study made effective use of specific tools and equipment. The material diversification of sculpture allowed the artists to choose from a wide range of unconventional materials to explore its content for art. In contemporary sculpture, the artists are not bound to traditional materials but countless ones. The sole material used in this research project was plastic waste bottles. Aside from the plastic waste bottles, supporting materials were Plaster of Paris (P.O.P), clay, chicken mesh, sisal fiber, styrofoam, artificial flowers, gloves, nose mask. Different types of tools and equipment were used to carry out the task of the project work. They were pencil, tape measure, knife, rolling pin, metal shims, modelling stand, sandpaper, angle grinder, spatulas, scissors, potter's wheel, air compressor, thinner, and enamel (oil) paint.

RESULTS AND DISCUSSION

Plastic Waste Challenge on TTU's Main Campus (Studio-Based Inquiry)

The challenge posed by plastic waste has been associated with non-biodegradable plastics, including polyethylene, polypropylene, polystyrene, poly (vinyl chloride), and poly (ethylene terephthalate). The availability of plastic waste on TTU's main campus is significant due to the incessant littering by plastic users (Wienaah, 2007: 3). This action was seen with plastic users dumping refuse into bushes. Again, overflowing garbage containers, excessive plastic waste into rivers and gutters by

heavy torrential rains were some of the solid waste factors on the main campus. It was found that the accumulation of plastic waste on TTU's main campus was one of the most pressing environmental problems facing the institution. This plastic waste situation supports Flynt's (2020: 1) statement that the ever-growing consumption of goods packaged in plastic and the superior economics of plastic production has made plastics an unavoidable part of individual daily lives. This statement attests that the organic component of solid waste may not be an issue as it is biodegradable (Wienaah, 2007: 4; Nyavor-Akporyo et al., 2013: 2177). The plastic waste component of solid waste is problematic because it is not biodegradable. Plastic waste remains in the environment for a considerable length of time. It causes many health and environmental problems (MESTI, 2020: 2; Wienaah, 2007: 5; Nyavor-Akporyo et al., 2013: 2177). The study also found that solid waste management in the TTU, per the TTU's environmental policy (2016: 2) and Collins' construction (2018: 1), includes:

> Prevent pollution by managing and reducing emissions to air and discharges into water. Encourage the development of curriculum and extra-curricular activities to promote environmental awareness and responsibility amongst the University community and to enable individuals to develop values, skills and knowledge to contribute to sustainable development by providing appropriate communication and training. (Collins, 2018: 1)

Contrary to this statement in the TTU's (2016: 2) environmental policy, sorting, recycling, and packaging plastic waste has become a significant bottleneck for the institution. However, solid within the institution is collected and disposed of by municipal solid waste management. Amid all these situations, however, there seems to be very little attention to plastic waste as a non-biodegradable material as shown in Figure 6. Therefore, the exploration of plastic waste and its potential to serve as alternative raw materials for the artist is a laudable contribution to the quota of environmental sanitation on TTU's main campus (Donkor et al., 2021: 71).

Figure 4. Garbage of plastic waste at TTU

Plastic waste as an artistic material for art (Studio-based production process)

Acquisition of materials (Plastic waste bottles)

Perceiving plastic and its detritus from an artistic point of view, it possesses a material strength of hardness, density, tensile strength, thermal resistance, melting point, and glass transition temperature (Kupis, 2018; Davis, 2020a: 1; Osborne, 2018: 1). This potential of plastic waste provided the artists with another dimension of the material base with the unwanted plastics that seem less important to anyone. For this study, this part of studio-based research was focused on exploring the concept of Garbage in, Garbage out disposal of waste to produce functional art objects (flower vases) for interior space from the realization of the plastic waste challenges on TTU's main campus. The study specifically selected plastic waste bottles as bottles constructed from LDPE (Low-Density Polyethylene) and HDPE (High-Density Polyethylene) (Wienaah, 2007: 3; Ampofo, n.d: 3). Figure 5 shows plastic waste bottles being gathered or collected from the refuse dump at the Effiakuma new-site campus of Takoradi Technical University,

Takoradi-Ghana. Plastic waste bottles were materials used for the artwork. These discarded bottles were collected and processed into art.

Figure 5. Picking plastic waste bottles for the artwork

Idea development

Five (5) sketches, as shown in Figure 6, were drawn and developed through a critical thinking process, from which one (1) sketch was selected for the execution of the work. The development of sketches was based on the concept of plastic waste as a material concept and content in art. This stage was to generate meaningful ideas from the Akan traditional elements such as mask, horn, pot, tortoise and snail shells. The Akan traditional elements gave the study more ideas beyond its initial thoughts. Symbolically, this creative process was crucial to the intellectual development of the artists (Fanizza, 2016). Idea development brought the realization of the concept of "Garbage in, Garbage out" waste disposal into a functional art object for the environment.

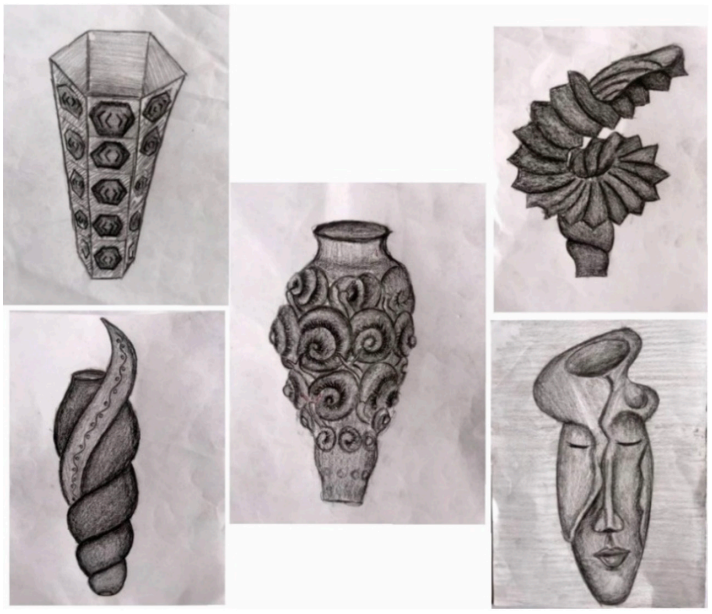

Figure 6. Idea development of hexagon vase, sea shell vase, horn vase, snail shell vase, and mask vase

Experiment (Execution of Hexagon flower vase with designs of a tortoise shell)

Step one: Preparation of plastic waste bottles, clay, and making clay slabs

The selection of one (1) sketch from the five (5) sketches was used as a reference point to produce a flower vase. The hexagon flower vase with a design from the

tortoise's shell was used for experiment, as shown in Figure 7. The plastic waste bottles were prepared by cleansing them from filth with water and drying them. Again, clay was prepared and used for creating the vase by pounding, kneading, rolling the slab, cutting the slab into shapes, and building the clay to make a hexagonal vase. Figure 7 shows how the slab was used to create a hexagon flower vase.

Figure 7. The preparation process of the artwork

Step two: Taking mould and heating the plastics for casting process

At this stage, the mould of the clay hexagon vase was taken with P.O.P mixture and supported the mould with sisal fiber mesh, as indicated in Figure 8. P.O.P was used for mould-making for the clay work. Sisal fiber was used to reinforce the mould-making process of P.O.P The chicken wire mesh was used to build a supportive framework to ensure that the plastic artworks were always safe and secure in the casting process of the plastic. After that, the P.O.P mould was separated from the clay hexagon vase. The fire was lit up to heat the plastic waste bottles in a metal crucible by melting them into a liquid form for the cast of the flower vase at 110 Degree Celsius (Kupis, 2018). Figure 8 also shows the heating and casting processes to achieve the final cast.

Step three: Joining and sanding the vase

The separated P.O.P moulds were joined together by tying with binding wire. The hollow space and seams of the P.O.P moulds were filled with melted plastic waste bottles. After this stage, the mould was allowed to set. Finally, the cast work was separated from the P.O.P mould and sanded with a sanding machine to achieve a fine edge. Figure 8 shows the joining, the sanding processes and the final cast work.

Figure 8. The finishing process of the artwork

Step four: Finishing the cast work with oil-based paint

The cast defects, such as holes in the work, were sealed with paint filler and primer. The spraying of cast work was done with oil-based paint to give it a colorful finish, as illustrated in Figure 9.

Figure 9. Spraying the cast work with oil-based paint and the finished artwork as exhibited in the interior space of the Faculty of Applied Arts & Technology building corridors, TTU-Takoradi

The philosophical basis of the material content and concept of the cast work

The philosophical basis hinges on the knowledge and understanding of the universal and timeless qualities that identify the material content of plastic waste and its concept in art (Davis, 2021a: 1; Linnartz, 2020: 1). The theme for the artwork is shown in Figure 9, "Abofra bo nnwa na ommo akyekyedee," is an Akan (Twi) concept which means a child breaks the shell of a snail but not that of a tortoise. The snail shell is easier to break than that of a tortoise. Thus, in the Akan society, the child should behave like a child and not like an adult (Quoterich, 2021; Adinkra Symbols, 2020). The materials used for the artwork are plastic waste bottles, artificial florals, oil paint and styrofoam. The size is 50 cm (16 inches high).

The idea of selecting the tortoise and the snail philosophy hinges on the material philosophy of plastic waste as "The soft and hard" concept. On the soft side, it is believed that plastics have served their purpose to humanity and are very beneficial to society. On the hard side, when plastics are mishandled, they can deplete the environment.

In an actual sense, the Akan adage tells society that once plastics have been manufactured for human usage, they also have a downside when mishandled. Plastics can be difficult as part of the tortoise's shell that is hard to break and solve. As a reflection of society, when the adult behaves like a child without taking responsibility as a grown-up, the adult becomes a laughing stock. As in the case of managing the environmental situation of plastic waste, plastic waste accumulates and can have adverse effects on the environment and ecosystems. The choice and selection of plastic waste as a material informed the study as plastics are non-biodegradable materials that are difficult to decompose in the environment. Once plastics are discarded, they become a potential material to be repurposed into art. Based on the formidability and non-decomposition of plastic waste as a material (Micah et al., 2021: 10; Davis, 2020b: 1; Osborne, 2018: 1), the material content ensures the longevity of the artwork.

CONCLUSIONS

The study hinges on the detrimental effects of waste challenges, such as plastic waste at some parts of TTU's main campus resulting in landscape disfigurement, pollution, and blockage of river and gutter channels. With the qualitative approach, the studio-based research was adopted for the study. The study gave a systematic approach to studio-based inquiry and its production processes by using the concept of Garbage in, Garbage out waste disposal to produce functional art objects (flower vases) for the environment. From the studio-based inquiry, the

study concludes that the plastic waste challenge on TTU's main campus became significant through the incessant littering of plastic waste by plastic users dumping refuse into bushes, overflowing garbage containers and pouring heavy torrential rains carrying excessive plastic waste into rivers and gutters on the main campus. The accumulation of plastic waste on TTU's main campus was one of the most pressing environmental problems of the institution. It is hoped that TTU management could explore flexible packaging solutions for plastic waste by selling them to heavy plastic industries in Ghana or beyond to generate income for the institution. Again, TTU must consider collaborative solutions with plastic recycling industries to provide fully-fledged plastic recycling technology to support reducing plastic waste at TTU.

The quest for plastic waste on TTU's main campus proved efficacious for its exploration as viable artistic material for interior space through the studio-based production process. This finding was evident in the plastic waste cast works as functional art objects (flower vases) for the environment using the waste disposal concept of Garbage in, Garbage out. The artworks (flower vases) produced from the realization of plastic waste bottles had advantages over traditional sculpture materials such as cement and stone. It was observed that the flower vase produced from plastic waste bottles offered a lighter weight and could make handling easier without the need for any industrial logistics. It was also observed that the modeling and casting method used to execute the work helped replicate the plastic artwork into mass production. Again, plastic waste bottles served as a creative material for art in the environment. It is, therefore, recommended that the use of plastic waste for art should be encouraged among the students and the lecturers of the Departments of Sculpture and Interior Design Technology, Takoradi Technical University. This formation must be done by creating an expedition team to learn about different methods for plastic waste in art and use those methods to conduct their field research in their departments since plastics are cheaper and viable for art. It is also recommended that the two departments (Sculpture and Interior Design Technology) should partner with local plastic waste management to collect plastic waste in quantities to fuel the material need of the artists for plastic art. This practice minimizes the plastic waste situation within the locality and beyond. Furthermore, artists should explore large-scale artworks with plastic waste materials as this practice improves dynamism in the studio-based research.

Authors' Contributions

The authors contributed equally to the study.

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Competing Interests

There is no potential conflict of interest.

Ethics Committee Declaration

This research was conducted before 2020 and does not require an ethics committee report.

REFERENCES

Adinkra Symbols. (2020). Adinkra symbols and meanings: The 50 most important Akan proverbs. *Adinkra Symbols.* https://www.adinkrasymbols.org/pages/the-50-most-important-akan-proverbs/ (10.01.2022).

Alabi, O. A., Ologbonjaye, K. I., Awosolu, O. & Alalade, O. E. (2019). Public and environmental health effects of plastic wastes disposal: A review. *Journal of Toxicology and Risk Assessment,* 5(2), 1-13.

American Chemistry Council. (2005). How plastics are made. *Plastics. American Chemistry Council*. https://plastics.americanchemistry.com/How-Plastics-Are-Made/ (11.01.2022).

Ampofo, S. K. (n.d). The options for the effective management of plastic waste in Ghana. *Fonghana*. http://fonghana.org/wp-content/uploads/2013/02/REPORT-ON-MANAGEMENT-OF-PLASTIC-WASTE-IN-GHANA-21-328-STASWAPA.pdf (11.01.2022).

Andrady, A. L., & Neal, M. A. (2009). Applications and societal benefits of plastics. Philosophical transactions of the Royal Society of London. Series B. *Biological Science, 364*(1526), 1977-1984. https://www.doi.org/10.1098/rstb.2008.6304

Artsciweb. (2020, January 16). Visiting artist lecture: Pam Longobardi. *School of Art*. http://art.utk.edu/pam-longobardi/ (10.01.2022).

Brown, W. H., & Poon, T. (2016). *Introduction to organic chemistry* (Sixth edition). Wiley.

Bush, T. (2020, June 22). Descriptive analysis: How-to, types, examples. *Pestle Analysis*. https://pestleanalysis.com/descriptive-analysis/ (10.01.2022).

Byju. (2022). Garbage in, garbage out. *Byjus*. https://byjus.com/biology/garbage-in-garbage-out/ (31.03.2022).

Carroll, A. (2020, February 3). Five inspiring abstract reuse artists. *The Scrap Exchange*. https://scrapexchange.org/five-inspiring-abstract-reuse-artists/ (08.02.2022).

Collins construction. (2018, January 01). Environmental and sustainability policy. *Collins construction*. https://www.collins-construction.com/media/2265/hsp013-environmental-sustainability-policy-2018.pdf (08.02.2022).

Daichendt, G. J. (2012). *Artist scholar: Reflections on writing and research*. Intellect.

Dandessa, C. (2021, July 30). Environmental effects of plastic wastes. *Ethiopians Today*. http://ethiopianstoday.com/blog/2021/07/30/environmental-effects-of-plastic-wastes/ (31.03.2022).

Daniyan, I. A., Adeodu, A. O., Onibokun, A. W., & Adewumi, D. F. (2017). Development of a plastic recycling machine. *Journal of Advancement in Engineering and Technology, 5*(3), 1-7.

Davis, B. (2020a, August 2). What is spatial architecture? Mvorganizing. https://www.mvorganizing.org/what-is-spatial-architecture/ (31.03.2022).

Davis, B. (2020b, August 8). What type of structure is the canopy of an umbrella? *Mvorganizing*. https://www.mvorganizing.org/what-type-of-structure-is-the-canopy-of-an-umbrella/ (13.01.2022).

Davis, B. (2021, February 27). What is the focus of the humanities Brainly? *Mvorganizing*. https://www.mvorganizing.org/what-is-the-focus-of-the-humanities-brainly/ (13.01.2022).

Donkor, E. K., Micah, V. K. B., & Akomea, D. (2021). Plastic waste and its artistic context. *Detritus (Journal for Waste Resources & Residues)*, 17, 71-88.

Donkor, E. K., Eshun, J. F., & Micah, V. K. B. (2021). Wood detritus: A functional concept in interior design. *IDA: International Design and Art Journal, 3*(2), 184-197.

Dow. (2021). Polyethylene: Proven performance. *Dow*. https://www.dow.com/en-us/product-technology/pt-polyethylene.html (10.02.2022).

Dutta, J., & Choudhury, M. (2018). Plastic pollution: A global problem from a local perspective. *Open Access Journal of Waste Management & Xenobiotics, 1*(1), 1-2.

Fanizza, S. D. (2016). *The Tao of audience development for the arts: Philosophies about audience development five years in the making*. Lulu Publishing Services.

Flynt, J. (2020, September 2). The plastic waste problem and the challenges of plastic recycling. *3Dinsider*. https://3dinsider.com/plastic-recycling-challenges/ (10.02.2022).

Gunzelmann, A. (2020, April 29). What does plastic artist mean? *Find Any Answer*. https://findanyanswer.com/what-does-plastic-artist-mean (15.03.2022).

John Dahlsen. (2021, March 21). In Wikipedia. https://en.wikipedia.org/w/index.php?title=John_Dahlsen&oldid=1013418122 (02.03.2022).

Kehinde, O., Babaremu, K., Akpanyung, K., Elewa, R., Tobiloba, O., & Oluwafemi, J. (2018). Renewable energy in Nigeria: A review. *International Journal of Mechanical Engineering and Technology*, 9, 1085-1094.

Kehinde, O., Ramonu, O., Babaremu, K., & Justin, L. (2020). Plastic wastes: Environmental hazard and instrument for wealth creation in Nigeria. *Heliyon, 6*(10), 1-7.

Klein, R. (2011). *Laser welding of plastics* (1st Edition). Wiley-VCH Verlag GmbH & Co. KGaA.

Kota, K. P., Shaik, S. S., Kota, R. K., & Karlapudi, A. P. (2014). Bioplastic from chicken feather waste. *International Journal of Pharmaceutical Sciences Review and Research, 27*(2), 373-375.

Kupis. (2018, August 18). Plastic melting point chart. *Reviews of Chart*. https://www.undergraceovercoffee.com/plastic-melting-point-chart/ (15.03.2022).

Linnartz, T. (2020, May 22). Why is art appreciation a way of life? https://findanyanswer.com/why-is-art-appreciation-a-way-of-life (31.03.2022).

Mandy Barker. (2021, August 3). In Wikipedia. https://en.wikipedia.org/w/index.php?title=Mandy_Barker&oldid=1036982358 (02.03.2022).

McCreery, K. (2016). Plastic in interior design – Affordable style for your home. *Business Brokerage Blogs*. https://www.businessbrokerageblogs.com/plastic-interior-design-affordable-style-home-link-roundup/ (10.02.2022).

MESTI. (2020). National plastics management policy. *Ministry of Environment, Science, Technology and Innovation Government of Ghana*. https://mesti.gov.gh/wp-content/uploads/2021/02/Revised-National-Plastics-Management-Policy_-FINAL.pdf

Micah, V. K. B., Donkor, E. K., & Ankrah, O. (2021). *Proverbial Akan culture: Philosophical and aesthetic expressions with sculptures*. Auxano Impressions.

Nara Loca Abadi. (2020, April 10). History of plastic. *Nara Loca Abadi*. https://www.naraloca.com/post/history-of-plastic-part-2-2 (15.03.2022).

Newbury, D. (1996). Knowledge and research in art and design. *Design Studies*, 17, 215-220.

Noor, A. (2021, May 10). First mega project blog: Plastic Free Greenland. *Ayesha.Noor180*. https://ayesha-noor180.medium.com/first-mega-project-blog-94f526283d44 (20.01.2022).

Nyavor-Akporyo, A. B., Kutsanedzie, F., Achio, S., Nyame-Tawiah, V., Appiah Gyekye, L. & Mensah, E. (2013). Alternative way of managing plastic waste on campuses. *International Journal of Development and Sustainability, 3*(2), 2176-2187.

Osborne. (2018, March 18). The Properties of plastic: What makes them unique? *Osborne*. https://www.osborneindustries.com/news/plastic-properties/ (20.01.2022).

Pamela Longobardi. (2021, July 22). In Wikipedia. https://en.wikipedia.org/w/index.php?title=Pamela_Longobardi&oldid=1034918216 (02.03.2022).

Puadi, M. F., Bin Khairani, M. Z., & Bin Othman, A. N. (2020). Studio investigation: An approach in studio-based research. *Psychology and Education, 57*(8), 1006-1011.

Quoterich. (2021, August 16). List of Akan proverbs and their meanings. *Quoterich*. https://quoterich.com/list-akan-proverbs/ (28.02.2022).

Rakhetsi, A. (2021, February 12). 5 Activists who are transforming plastic waste into beautiful art, accessories, and more. *Global Citizen*. https://www.globalcitizen.org/en/content/activists-creating-art-from-plastic-waste/ (19.07.2022).

Smith, A. (2021, June 17). What are the chemical properties of plastic? *Rehabilitation robotics*. https://rehabilitationrobotics.net/what-are-the-chemical-properties-of-plastic/ (28.02.2022).

Sullivan, G. (2006). Research acts in art practice. *Studies in Art Education, 48*(1), 19-35.

Thomson, V. E. (2009). *Garbage in, garbage out: Solving the problems with long-distance trash transport*. University of Virginia Press.

Trevor, M. (2019, November 1). The invention, the breakthrough, the exploitation- Complete history of plastic. *NYK Daily*. https://nykdaily.com/2019/11/the-invention-the-breakthrough-the-exploitation-complete-history-of-plastic/ (31.03.2022).

TTU. (2021). *Takoradi Technical University Five-year Strategic Plan 2021-2025*. Takoradi Technical University Press.

TTU. (2016). *Takoradi Technical University health, safety and environmental policy*. Takoradi Technical University Press.

Ujeh, C. K. (2021, August 15). The negative environmental effects of plastic shopping bags. *International Bar Association*. https://www.ibanet.org/article/76F8D2A9-1A1D-4A2F-8A6F-0A70149FD4D5 (02.03.2022).

Wienaah, M. M. (2007). *Sustainable plastic waste management – A case of Accra, Ghana*. TRITA-LWR Master's thesis, Department of Land and Water Resources Engineering, Royal Institute of Technology (KTH), Stockholm, Sweden.

World Wildlife Fund-India. (2021). The Zero-Plastic Waste Campaign. *Environmental Campaign of the WBPCB*. http://web.wbpcb.gov.in/html/front_env.shtml (16.03.2022).

Zafar, S. (2020, May 29). Methods for plastic wastes collection. *Ecomena*. https://www.ecomena.org/plastic-waste-collection/ (16.03.2022).

FIGURE REFERENCES

Figure 1: Mandy Barker. (2021, August 3). In Wikipedia. https://en.wikipedia.org/w/index.php?title=Mandy_Barker&oldid=1036982358 (02.03.2022).

Figure 2: Pamela Longobardi. (2021, July 22). In Wikipedia. https://en.wikipedia.org/w/index.php?title=Pamela_Longobardi&oldid=1034918216 (02.03.2022).

Figure 3: John Dahlsen. (2021, March 21). In Wikipedia. https://en.wikipedia.org/w/index.php?title=John_Dahlsen&oldid=1013418122 (02.03.2022).

Table 1: Kupis. (2018, August 18). Plastic melting point chart. *Reviews of Chart*. https://www.undergraceovercoffee.com/plastic-melting-point-chart/ (15.03.2022).