



Development of Teaching – Aid Materials for Teaching and Learning Biology: A Waste to Wealth Approach (Paper Mache)

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ABSTRACT

The campus today is littered with varieties of waste materials, which were generated from students' activities. The bulk of these wastes were solid wastes, and it is obvious that papers form a larger percentage of the waste on our campuses. These papers could include leftovers from students marked test scripts, detached textbook materials, personal notebooks, and jotters. Environmentalists have listed improper dumping of refuse and sewage disposal contamination as one of the major factors that hinder an eco-friendly society, most importantly in schools. One of the greatest problems confronting the education sector today is the lack of adequate instructional materials to teach the students. The cost of purchasing foreign-made instructional materials is on the high side. Hence, there has been serious agitation by educational technologists to venture into improvisation as alternatives to real objects. Using campus waste paper to mould improvised teaching aids for the teaching and learning of basic biological concepts will not only be of benefit to educators but also to environmentalists who are concerned about proper waste management. Up-cycling methodology was adopted for this study, which is the process of reusing waste materials without breaking them down into their base state to create another product.

1. Introduction

Environmentalists have described Junks as the collection and assemblage of different compositions of waste materials (Golden Plains Shire Council, 2016). Waste has been described to be domestic waste, industrial waste, chemical waste, biological waste, Agricultural waste and toxic and non toxic waste, depending on the sources it is on those bases that it could be classified. There are many human activities throughout the world that may have a sufficient and significant impact on the environment, either negatively or positively, depending

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on how they are utilized, expressed, or exploited, as well as how they are managed. Because of the exponential population growth and the indiscriminate exploitation and use of the environment's natural resources, waste production and generation have been observed to have increased (Seik, 1997).

In an effort to stop environmental degradation and indiscriminate solid mineral exploration, the Federal Government of Nigeria tried to set up a legal framework a decade ago. This effort resulted in the promulgation of the Harmful Waste Decree (HWD) in 1987, which provides the legal foundation for the efficient control of both refuse and sewage disposal of toxic and hazardous waste into any environment. At the moment of the decree pronounces, it was promptly followed by creating a regulating organization, the Federal Environmental Protection Agency (FEPA) (Parry, 1998).

The task of maintaining a safe, clean, eco friendly and sustainable school environment requires much more than the school management alone. This has been calling for creative approaches by the individuals or groups. Reusing, Cycling and recycling campus municipal waste should become a way of life for teachers, students and the school management, a situation where these waste materials such as paper could be used to manufacture goods (Parry, 1998). Hence, this study aimed at producing instructional materials for the teaching and learning of some biological concept using waste papers (Paper Mache) generated from the school environment as mean of managing paper waste in the school.

This research will examine the Arts of converting waste to wealth, towards achieving sustainable and eco-friendly and sustainability campus environments in our various schools in Nigeria. The campus today is littered with varieties of waste materials, which were generated mainly from student's activities. The bulk of these wastes were solid wastes, and it is obvious that papers form a larger percentage of the waste on our campuses or any school premises. These papers could include leftover from students marked test scripts, detached textbook materials, personal notebooks, and jotters. The nation today is confronted with diverse problems, ranging from insecurities of lives and properties, corrupt practices, and environmental degradations among others. Environmentalist has listed improper dumping of refuses and sewage disposal contamination as one of the major factor that hindered an eco-friendly society and most importantly in schools.

Sensitive papers that are created as paper waste in educational institution require special handling during waste management or disposal. Sensitive paper documents became outdated over time and needed to be disposed of properly. The school library is another area where bulky paper waste was produced. The decision of how to manage these outdated, sensitive documents after their usefulness has passed is a bigger concern for the school administration. Meanwhile, one the greatest problem confronted by the educational sector today is inadequate instructional materials to teach the students and also to guide the students during learning in the classroom. The reason is not far-fetched from the inadequate funding on the part of the government and also the school management

in some instance. The cost of purchasing foreign made instructional materials is on the high side due to high exchange rates.

Hence, there has been serious agitation by educational technologist to venture into improvisation as alternatives to real object. Using campus waste paper in form of paper Mache in making improvised teaching aids for teaching and learning of some basic Biological concepts will not only be of benefit to educators but also to environmentalist whom are concern about proper waste management generated from the school activities, hence this will be a win –win approach for all, that is; the Students, the teacher, the School management, the Government and the environmentalist.

Problem Statement/Justification

The paper waste generated in several units in the school setting are always describe as sensitive documents that needed proper channel for it wastes managements and disposal as the case maybe. Over the years sensitive paper document become obsolete and they needed to be discarded in a proper manners, the school library is another unit where bulky paper wastes were being generated frequently, most importantly that the world is going digitalized and advent of PDF's e-books were forming basis of e-library, all these were making the paper library becoming absolute, disposing these hard copies of books stored in the library has become a great concern to various school management. It is also of greater concern for the school management in deciding the channels in which theses old sensitive document could be managed after they must have out used their usefulness.

Meanwhile, the cost of purchasing instructional materials for teaching and learning, specifically science-oriented teaching aids is on the high side; most rural schools do not even have access to basic teaching aids, much fewer complex ones. Raw materials used in producing these teaching aids are now very expensive; the global economy meltdown has affected some of these educational technology outlet foldouts, which, coupled with low demand for these materials, have greatly limited the number of instructional materials available for teaching in mostly rural schools in Nigeria and some urban schools as well. Therefore, producing teaching aids from waste paper generated in the school is a good avenue to locally produce these materials.

Hence, this study would be of immense benefit to stakeholders in the field of educational technologist, the lecturers, students, managements of colleges of education, governments, entrepreneur, environmentalist and other researcher who are concern on how to produce cheap durable materials for teaching and learning from locally source materials so as to cut cost and likewise turning waste to wealth.

Objectives of the Study

The main aim of the research is to construct instruction materials from campus waste paper for the teaching of selected biology using paper Mache technology. The study aimed at reusing the approach method of waste management, specifically campus waste paper management, as opposed to recycling papers as popularly noticed.

Specifically, the study sorts to;

1. Construct instructional materials from waste paper for the teaching of biology.
2. Find out the major sources of paper waste generation on campus;
3. Finding a lasting solution to paper waste generation sources

Literature Review

In literature waste management involves the scientific, culture, and technological approaches adopted to waste control and its disposal. Furthermore, waste management involves the conversion of waste to other useful materials and products that are beneficial to man and the society at large. "3 Rs", acronym has been used to describe the principle of waste management which are namely, reducing, re-use, and recycling (Courchamp et al., 2017). The study find is theory on the proposed theory of waste management by Golden Plains Shire Council (2016) called "THE 7 R'S OF RECYCLING" which is Recycle, Refuse, Reduce, Reuse, Repair, Re-gift and Recover. Although the researcher here is focusing directly on the fourth 'R' which is to 'Reuse'. Reuse is explained as according to the 7 R's as a means to find new ways to use things that otherwise would have been thrown outs.

A common understanding of waste is the unwanted by-products of human activities generated from and within the Environment (Ivanova et al., 2016). Human lives in an environment that posed complex problems. However, for man to survive in this Environment, he must be able to solve several problems. Such problems include managing the threats posed by human waste generation (Hilson, 2002). One such complex problem is environmental waste (Courchamp et al., 2017).

These may take different dimensions and approaches, Waste management are those activities, process and actions required to manage and process waste from its inception to the final point of disposal, including from the collection point, transportation route, treatment procedure, and disposal of waste, together with monitoring team and regulation agency of the waste management processes (Ivanova et al., 2016). It intended to reduce the adverse effect of waste on human health, the Environment, or aesthetics.

Waste management processes are approached at different levels. Governmental, municipal solid waste is the government handles the bulk of the waste created by household, industrial, and commercial actions (Müller, 2014).

The concept of waste and waste management in this regard does not lay too much emphasis on waste paper recycling but its re-use. Recycling has been criticized as giving life to same materials that you did not need it waste on the street. Therefore, reusing is a better approach. Re using paper will give it another life in another form with permanent usage that can't generate any waste in its second life. Hence this is also a means of converting waste to wealth. These days, artistic activities help to convert waste to wealth by the creation of new materials from waste materials through the application art and technology. Part of the of this study is to curbing the menace of improper waste disposal and management in our schools and ensuring a safe and sustainable environment. The nonchalant altitude of our younger one and some adults has resulted in the littering of unwanted materials called waste.

Education supports the growth of a person's intellectual capacity and social usefulness. Those who receive an education are better equipped to deal with difficult situations and offer helpful solutions. Education is the process of providing people with the necessary knowledge, abilities, and competences for successful participation in society. This shows that, in order to create excellent citizens who will contribute favorably to the development of the country, the quality of education in every country must be improved (Lukman, 2021).

In teaching and learning circumstances, improvisation is the act of creating and utilizing local resources in the lack of genuine ones. When there is a lack of direct first-hand instruction, improvisation also refers to the act of employing alternate materials and resources to facilitate instructions. The use of instructional materials has been noted as a potent method for fostering efficient teaching and learning. Through their efficient use in classroom education, instructional materials can be used to demonstrate the significance of quality and adequate materials in teaching and learning. All the resources that teachers can utilize to make learning more engaging and memorable are included in the instructional materials.

Instructional materials are crucial and important instruments required for the teaching and learning of academic subjects in order to increase teachers' effectiveness and boost student achievement. They enhance learning by making it more engaging, useful, realistic, and appealing. Also, they make it possible for both teacher and students to actively and productively participate in class. They provide opportunities for learning new things, increasing one's knowledge, and become more self-aware. The things that students and teachers utilize for practical and demonstrative purposes in a classroom setting are known as teaching aids. Objects or tools that help the teacher communicate a lesson to the students in a clear and logical way are known as instructional resources (Lukman, 2021).

Improvisation tends to remove abstraction(s) in learning theories because the products of improvisation are tangible, handy and concrete. Improvised instructional materials must be very safe to use during demonstrations and experiments. It must be hazard free or danger free. The improvised product must not be capable of inflicting injuries on the user or person operating it. Improvised

instructional materials are used effectively in teaching Biology and other science subjects, at all levels of education (Zarewa, 2005).

Although the preceding paragraph described how vital instructional materials are, one barrier preventing their use in schools by teachers is the high expense of obtaining those materials. Improvisation is usually encouraged in the absence of real objects (real educational materials). So, this research aims to provide improvised teaching aids for a few specific biological concepts using locally obtained raw materials (campus waste papers).

2. Methodology

The methodology adopted for this will be on Up-cycling. Up-cycling is the process of reusing waste materials without breaking them down into their base state to create a product of higher value or quality.

Description of Study Area/Site

The study was conducted at the Kwara State College of Education, Ilorin. The school is located in the core of Ilorin metropolitan specifically; around the popular sawmill area, Geri Alimi axis, Umar Saro Road, Ilorin Kwara state. The main subjects/materials that will be used in this study are waste papers

The procedures to be followed were breakdown into the following activities

Activity 1: Identification of a biological diagram to be constructed with paper Marché

There are concepts in biology that are difficult to teach as well as difficult to learn. Part of the reason why some topics are hard to teach and learn is because of irrelevant instruction materials that are sometimes used in the teaching of these topics by the teachers. Hence, it is at this stage that the researcher focuses his attention on the selection of basic biological concepts in the biology curriculum that are hard to teach and learn, as identified by teachers and students, as inadequate teaching aids to be used among other reasons. It was the aim of the researcher to add to the growing number of instructional materials that would be available to teach topics in these categories as different researcher recommendations advised.

Activity 2: Collection of Waste Papers

The research, in conjunction with some selected students, picked up all pieces of paper littering around the school halls, premises, and classrooms. Moreover, the researcher personally writes to the school management to request approval to purchase all waste papers in the care of the registry unit, bursary units, library section and examination units of each school, as well as the directorate of examinations and records. According to the researcher, these units harbor and keep old documents of students and staff, and they are constantly confronted with how to dispose of and safely keep them due to environmental factors such as

termite attachment and the like. A total of 5–10 tons of waste papers are projected to be collected for use in this study.

Activity 3: Sorting collected waste papers into different sizes, textures, and colors

It is necessary to sort the collected paper along these criteria to achieve optimum usage of the papers.

Activity 4: Removing cellophane nylon from the collected waste papers that are laminated

It is important to remove the nylon film used in laminating some of these waste papers before soaking so as to prevent the nylon from not allowing them to glue together when adhesive materials are added, as described by Marché.

Activities 5: Soaking of Collected Waste Papers

The collected paper needed to be soaked with water in different containers due to its various colors and textures. This mixture will be left for 24 hours to allow fermentation to take place.

Activities 6: Pounding of the Soaked Waste Papers

The soaked papers will be pounded with the use of mortar and pestle. This is to soften the papers in preparation for a mold.

Activities 7: Mixing with Adhesive

At this stage, the pounded papers will be mixed together with starch and top-bound. This will allow the particles to glue together while being used to mold any models of choice.

Activities 8: Sketching the model on a plank

The chosen biological concept diagram to be molded with waste paper will be sketched on a plain plank surface. This is used to guide and direct the creation of the mold.

Activity 9: Building and Constructing

At this stage, the pounded paper that has turned into paper Mache after the addition of adhesive during the soaking process will be used in the construction of the chosen instructional materials.

Activity 10: Finishing, Labeling, Automation, and Branding

This is the final stage where finishing touches will be put on the instructional materials produced so that they will measure up and serve the purpose they were designed to do.

Biological diagrams contain labels; it is at this stage that proper labeling will be done to confirm compliance with the acceptable standing rules guiding the diagram illustration in biology.

Lastly, the produced instructional materials carry the name of the researcher's institution and Tertiary Education Trust Fund (TETFUND) as the sponsor.

Activity 11: Data Analysis

No primary or secondary data is expected to be collected and none was collected. Where data is needed to be analyzed, Descriptive statistics such as ratio, frequency and percentages and Pictorial representation of data such as pie chart, histogram was used to present the data analysis where required. Areas where these will be carried out include;

1. Total grams of waste paper picked
2. Ratio of waste paper to water used
3. Ratio of Waste paper and adhesive used

Activity 12: Dissemination Workshop and Media Chats

Workshop for both awareness and training on the use of waste paper in form of paper Marche was organized for teacher and students in Kwara state in general. The workshop runs for 7 days, with practical experience. Video Documentary was produced and shared on all popular social media platforms.

3. Results and Discussion

Results (Expected outputs/Results): At the conclusion of the above activities, a beautiful locally made improvised instructional materials (See Appendix I) that can be used to teach, difficult to teach, and difficult to learn selected biology concepts in schools.

Table 1. Statistics Analysis of the Building

Items	Statistics
1. Total grams of waste paper picked	4500grams
2. Ratio of waste paper to water used	3:1
3. Ratio of Waste paper and adhesive used	3:1

Table 2. Properties Instructional Materials Constructed

Improved materials	Dimension	Weight
1. Human Kidney,	4ft. by 2ft	3.5kg
2. Mammalian Heart,	2ft. by 2ft	1.6kg
3. Mammalian Lung,	2ft. by 3ft	1.5kg
4. Skeletal System.	12ft. by 2ft	5kg

Since the purpose of the study is to develop improvised instructional materials for the teaching of selected concepts in biology, the result of this study will provide a good substitute for foreign synthetic and expensive instructional materials that most schools in Nigeria patronize at a high cost. Enough tons of waste paper would be collected around the college campus, leading to a clean and eco-friendly campus environment.

Lastly, to be precise, a model of the human kidney, heart, lung, and skeletal system will be produced from campus waste paper and made available for school use. Step by Step of the procedures involved the making of Mache and Output produced can be found in Figure 1-8.



Figure 1. Socking The Waste Paper



Figure 2. Pounding of the Waste Paper



Figure 3. Leaving the Waste Paper for Days to Socked Well



Figure 4. Separating the Socked Papers in to Different Colors and Textures



Figure 5. Sketching the Model of Human Skeleton to be Model as Teaching Aids



Figure 6. Molding with the Mache to form Various Instructional Materials



Figure 7. Adding Colors Before Labeling



Figure 8. A Cross Section of The Constructed Teaching Aids Displayed for Proper Drying in The Sun

4. Conclusion

The three "Rs" of waste management—recycling, reusing, and reducing the status quo—should not be prioritized with recycling as the first option. Environmental waste management can be achieved through diverse processes by different platforms, including individuals, corporate organizations, researchers, non-governmental organizations, the government, and community efforts. From this study, it is imperative for us as the custodians of our immediate environment to look into the secondary uses of the waste we generate from our domestic

consumption rather than recycle, as it is commonly practiced in most parts of Nigeria.

Campus waste paper reuse will be a more environmentally friendly and cost effective method of waste paper management since it will give the paper a second chance to life, but this time it will be completely destroyed. This may be preserved by creating teaching tools out of waste paper that would be utilized in the classroom as a type of practical activity in various trade courses. One way to create a secure and sustainable environment is to turn trash into wealth. Making teaching and learning more straightforward is the main aim of educational resource creation. The trick is to not use these instructional tools as decorations in our classrooms or as exhibits at big national exhibitions rather putting them into use during teaching and learning.

Recommendations

The administration of Kwara State College of Education, Ilorin, Kwara state government, federal government of Nigeria, and governments of other nations around the world where tons of waste paper are generated in large quantities due to high demand for its usage should embrace, encourage, appreciate, patronize, and include the reusing of waste papers as a raw material in creating improvised teaching aids and other uses in the school that is not currently done. There are theories on how we view objects as well. Hence, if a classroom teacher wishes to create educational materials, his creation must be based on sound ideas.

Instead of importing instructional materials from overseas, locally constructed teaching aids could be made using the methodology adopted in this study. This will make the material friendlier to the students and the teacher. The low cost of producing locally improvised waste paper will be more pocket-friendly. When constructing the teaching aids, the students should be involved in the making; this will awaken their psychomotor skills and allow them to be creative in their future endeavors.

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Competing Interests: The author declares that there are no competing interests.

Ethics Statement: The Kwara State College of Education, Ilorin, Nigeria, approved and granted the permission to mop up waste-sensitive paper in different sessions of the college for use in this study, which also received full free ethical approval (human subject not required) from the board of the Center for Research Development, Innovation, Incubation, and In-House Training (CREDIIIT) in the institution.

Contribution / Originality: In this study, an alternative method of managing paper waste was discovered rather than recycling, as it is mostly done. It is equally worthy to note that waste papers generated on our campuses by students have always been incinerated as a means of getting rid of them. This study made use of up-cycling. Thus, this process was used to make quality and cheaper instructional materials from waste paper for teaching some selected concepts in biology.

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