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Development and Standardization of a Substitute Triangular Prism for Creative Physics and Basic Science Instructions

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Abstract
The Nigerian National Policy on Education requires that education given to students should inculcate sound scientific knowledge for reflective thinking. However, our science classroom instructions generally and physics in particular, today, learners are not giving the desired experiences due to lack of instructional materials. To change the status quo, this study developed a substitute triangular prism using plastic materials and water. The study employed one shot experimental group design to test the functionality as well as standardize the material. thirty students were made to locate the image of the rays through the improvised triangular prism and find the refractive index (RI) of the material. The RIs obtained by the students were compared with that of water using the one sample t-test. The results revealed no significant difference in the students observed RIs and that of water (1.33). This confirms the functionality of the improvised materials and their Ability to instill the desired skills in learners. It is recommended that teachers should not limit their improvisation to the classroom only, but should seek for avenues to standardizing the materials and making them available for others to use.
Keywords: Development, Standardization, triangular prism, refractive index
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1. Introduction

Science, Technology, and Mathematics (STM) Education has been recognized as the instrument for National development by the Federal Government of Nigeria (FME, 2014). This position made the National Policy on Education (FME, 2014) to emphasize the inculcation of a sound bases for scientific and reflective thinking in the Nigerian citizens through STM Education. To achieve this, the Policy (having appreciated the place of science in national development) introduced the teaching of science as a core subject at Primary school level as Basic Science and Technology and at Junior Secondary School level as Basic Science. Functional science teaching at formidable stage ensures the inculcation of the desired skills for the leaners to be creative.

Unfortunately however, the attainment of the above objectives has persistently remained a mirage! This is because, science teaching in Nigerian schools is not producing the desired results (Shaibu, 2014; Baikie, 2011). This situation is evidenced in the poor academic performances exhibited by graduates of all levels of Nigeria's education system (Badmus and Omosewo, 2018). The simple reason (among others) alluded for the poor performance was the instructional process that are mainly expository (Ogbu, 2015; Eniayeju, 2001). Teachers who resort to this teaching approach, banks on the lack of instructional materials (Ogbu, 2015; Ayogu, 2000). Thus, teaching became more of 'talk-chalk affair' even in situations where practicals are required (Badmus and Omosewo, 2018; Eniayeju, 2001) thereby forcing students to learn by rote!

Efforts to move away from the above, saw teachers advocating for alternative instructional procedures that will give students concrete experiences through the use of effective instructional materials (Amadioha, 2009; Ayogu, 2000). They suggested that in situations where a given instructional material is lacking, it should not result to 'no practical'. The teacher should improvise. Akinkugbe (2007) stressed that a scientist or science teacher who waits for the most perfect set of equipment to conduct his duties will never succeed! It is on these basis that this paper presents improvised and standardized glass triangular prism for instructions in optics at the Basic and secondary education levels.

The understanding of the nature/behavior of light as it travels through two or more media of varying optical densities is an important aspect of Basic Science and Physics. In Basic Science, the major objectives include that students being able to explain refraction, illustrate apparent depth, determine the path of an emerging ray as well as explain the concept of dispersion and composition of white light (NASENI, 2012). To attain the above objectives, there is the need for appropriate instructional materials. However, the materials required to provide the practical experiences are not available due to cost! This study improvised a triangular prism. The model was produced by a plastic company. This paper also presents a stepwise approach to the development of a substitute triangular prism; for the teachers that may not be able to access the plastic industry. So as to produce an instrument needed for the illustration of refraction and dispersion of light.

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2. Objectives of the Study

1. To design and develop substitute optical prism from simple plastic;
2. To test the functionality of the improvised material;
3. To standardize the improvised materials

3. Research Questions

1. What is the functionality of the improvised triangular prism?
2. What is the difference in refractive indices of the improvised triangular prism and that of water?

4. Research Hypothesis

Ho_1: there is no significant difference in the refractive indices obtained by students from the improvised triangular prism and that of pure water.

5. Procedure for developing the materials

5.1 Materials needed for teacher production

Blade, plain/flat transparent plastic sheet (preferably thin), adhesive (super glue), thumb pin.

5.2 Procedure

1. Cut the plastic sheet into a shape as in figure 1.
Note that the dimensions are not stated here, but the developer should consider dimensions suitable to his needs that would produce a look alike of the original.
2. Fold the parts and glue them into (a hollow) desired shape for triangular prisms in figure 2.
3. Make a hole (using a syringe needle) on one of the either side of the triangular faces as in figure 3.
4. Add water (using a syringe) into the hollow part of the prism to make it optically active.
5. Use the thumb pin to close the hole

Fig. I – III: Steps in folding the transparent plastic sheet (Teacher made procedure)

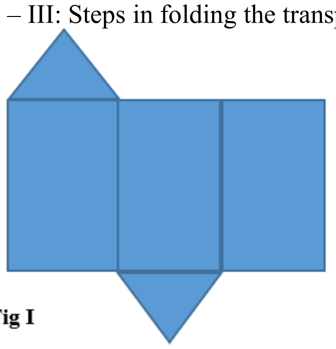

Fig I

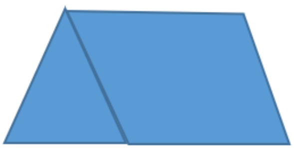

Fig. II

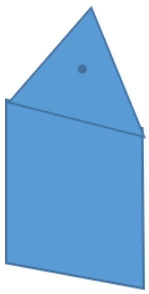

Fig. III

The above shape was a guide to the teacher who intends to produce by self. For this study however, the hollow prisms were produced by a plastic industry in Kano. And water was added and tested.

6 Testing the optical activity/functionality of the improvised prism

6.1 Methodology

To answer the research questions, the study used a one shot experimental group design (Sambo, 2005). 30 Senior Secondary School II (SS II) students (all males) were randomly selected and exposed to the improvised prism. The students were made to trace the path of ray and record the angles of deviation and emergence. They were also to plot the graph from the data obtained using a prescribed procedure. From the curve they were made to determine the minimum deviation corresponding to the minimum angle of incidence and consequently use a formula to find the refractive index of the light through the prism. The various refractive indices obtained by the students were subjected to one sample t-test to test to determine if there was any significant difference between the refractive indices of the improvised material and that of water.

6.2 Basic assumption

The improvised glass prism was made from a thin plastic sheet which this study assumes has negligible impact on the refraction of light passing through it. Thus the main refracting substance is water hence the refractive indices obtained by students were compared to that of water.

7 Result and discussion

Table 1: one sample test t-test analysis for student obtained refractive index

	N	Mean	Std. Dev	S.E.Mean	df	t	p-value
RI	30	1.2630	0.11	0.04	9	1.879	0.093

From table 1, the calculated t value ($t\ (29) = 1.879$; $p>0.05$) reveals that there is no significant difference in the mean refractive indices obtained by students using the improvised material and that of water at 0.05 level of significance. Hence the null hypothesis is retained. This shows that the improvised material is functional and can impart on students, the required experience in tracing the path of the ray after refraction through a prism.

This finding agrees with those of Shabiralyani, Khuram, Naqvi,and Nadeem (2015), Mari and Peni (2010), Adekunle (1997) who reported that improvised instructional material have the potential to be effective at enhancing students learning.

8. Conclusion

The study presents the investigation of functionality of improvised triangular prism at presenting to students the desired experience. The results revealed that the students effectively used the improvised the materials and obtained the desired results. Hence, the study concludes that improvised triangular prism developed from plastic and water is a reliable substitute for the teaching of the refraction of light. Similarly, the less delicate nature of the improvised material makes it usable by all levels of students.

9. Recommendation

1. Teachers should explore more avenues of improving teaching and learning process through improvisation;
2. Governments should engage plastic industries to produce the materials for supply and use in teaching secondary Physics especially in rural areas;
3. Further research on the functionality of the materials should be conducted to enable its complete adoption.

References

Adekunle, A. Y. (1997).the Role of Improvisation as a means of Improving Teacher Education and Technology Education in Nigeria. 40th Anniversary Conference proceeding of the Science Teachers Association of Nigeria (STAN).

Akinkugbe, O. O. (2007). Paucity of Resource, Poverty of Ideas: The Reluctant Duo in Science. The Ajumogobia Foundation Lecture. 50th Anniversary Conference of the Science Teachers Association of Nigeria (STAN). August, 23

Amadioha, S. W. (2009). The Importance of Instructional Materials in Our Schools, an Overview. New Era Research Journal of Human, Educational and Sustainable Development, 2, (3 & 4), 61 -63. Retrieve from https://www.researchgate.net/publication/322368912 on 6th March 2022.

Ayogu, Z. U. (2000). Enriching Science, Technical and Mathematics Education. Proceedings of the 41st Conference of the Science Teachers Association of Nigeria (STAN) 396 - 398.

Badmus, O. T. and Omosewo E. O. (2018). Improving Science Education in Nigeria: The Role of Key Stakeholders. European Journal of Health and Biology Education, 7, https://doi.org/10.29333/ejhbe/xxxxx

Daluba, N. E. (2013). Effect of Demonstration Method of Teaching on Students' Achievement in Agricultural Science. World Journal of Education 3 (6), doi:10.5430/wje.v3n6p1

Baikie, A. (2011). Quality Education and Rebranding Nigeria. Kumbotso Prime Journal of Education. 1(1), v - xiv

Eniayeju, P A. (2001). Competencies Required of Science Education Teachers. A paper Presented at the UNESCO train-the-Trainers Workshop for the Revitalization of Science Education in Nigeria. Held at the Federal College of Education Kano. 7th October - 5th December.

Federal Ministry of Education (FME, 2014). *National Policy on Education*, Lagos, NERDC press

Mari, J. S. & Peni, H. Y. (2010). Effects of Improvised Instructional Materials on Students Academic Achievement and Attitude to Volumetric Analysis in Kano State. *Journal of Business Educational Research and Development. (JOBERD)* 1, 2. 60 – 67

NASENI (2012). User Guide. Science Toolkits for Junior Secondary School Students. NASENI, Abuja. https://naseni.org

Ogbu, J. E. (2015). Influences of Inadequate Instructional Materials and Facilities in Teaching and Learning of Electrical/Electronics Technology Education Courses. Journal of Education and Practice. 6, (33), 39 – 46. Retrieved from www.iiste.org on 6/3/2022

Sambo, A. A. (2005). Research Methods in Education. Ibadan, Stirling-Horden Publishers

Shaibu A. A. M. (2014). Navigating the Maze of Students Underachievement in Science: Does Science Education Research provide a Road Map? University Inaugural Lecturer Series. Ahmadu Bello University Zaria. Nigeria.

Shabiralyani, G., Khuram S. H., Naqvi H. and Nadeem I. (2015).Impact of Visual Aids in Enhancing the Learning Process Case Research: District Dera Ghazi Khan. Journal of Education and Practice 6, (19). Retrieved from www.iiste.org on 2nd March, 2022.

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