IJEIR
International Journal of Educational Innovation and Research
Volume 2, Number 1, 2023, pp 82-89
DOI: https://doi.org/10.31949/ijeir.v2i1.4100
ISSN: 2810-0808

Students' knowledge on the identification and use of physics laboratory apparatus in post-basic schools in Ilorin, Nigeria

Wasiu Olayinka Yahaya[1]*, Abdulrasaq Oladimeji Akanbi[2]
[1]Department of General Studies, Federal College of Fisheries and Marine Technology, VI., lagos
[2]Department of Science Education, Faculty of Education, University of Ilorin, Ilorin, Nigeria
*Coresponding Author: yahayawasiu361@gmail.com

ABSTRACT
Physics teaching and learning theoretically may not achieve its full objectives without the integration of laboratory activities. The study measures post-basic school students' knowledge of identification and use of physics laboratory apparatus so as to ascertain their readiness for external examinations. The method adopted was descriptive survey of cross sectional type of research that enables data collection through measurement tool. One hundred and forty-three physics students' check-lists were analysed using descriptive statistics (frequency count and simple percentage). The findings of this study revealed that out of the commonly identified physics laboratory apparatus, students high strength was recorded in identifying the apparatus like retort stand, weight/mass, meter rule, pendulum bob, knife edge, optical pin, glass prism and test tube. The students show high strength in stating correct use of the apparatus like meter rule, stop watch, beaker, ammeter and voltmeter. It is recommended that pasting and displaying the apparatus pictures, name of the apparatus, its uses/functions beside it in the physics laboratory wall and early exposure of the students to laboratory activities will help the students in apparatus identification and prepare them for external examinations.

ARTICLE HISTORY
Received 2022-11-02
Accepted 2023-01-27

KEYWORDS
Physics laboratory apparatus
Physics laboratory apparatus identification
Physics
Laboratory apparatus use/function(s)

INTRODUCTION

Physics as a subject is popularly known to be the foundation and bedrock of the modern day technology with its division into quantitative and qualitative aspects (Gok, 2017). The quantitative aspect of physics explains the concepts and quantities in physics and possible marriage with mathematical functions and notations. The other aspect which is qualitative aspect deals with verification of laws, facts, principles and theories experimentally. All physics laws, principles, facts, and theories except some abstract ones are verifiable in the physics laboratory.

Physics is a science known and generated through experimentation and observations initiated by scientists, scholars and physicists to construct laws, theories, principles, concepts and show the rule of mathematical functions, notations and equations connecting the physics concepts (Sarjono, et al., 2018).

Adolphus and Aderonmu (2013) opined that the minimum requirement of each apparatus in the physics laboratory should be thirty-five (35) and the study found out that all sampled schools failed to meet up the required number and even the available number were not significant and reasonable. The scholars

concluded that absence of these apparatus in the laboratory could hinder the experimental classes, inability to have assess to the apparatus and also by extension affect their academic performance negatively.

Muhammad and Fayyaz (2011) asserted that it is very regretful that the students were taught the abstract and theoretical part of physics without the laboratory activities as backup. The scholars concluded that misallocation and deficiency in the use of laboratory apparatus and resources wastage posed a threat to students' academic performance. An obstacle to the effective learning and teaching of physics in secondary schools does not limited to lack of physics laboratory apparatus but poor and under utilization of the available apparatus (Danjuma & Adeleye, 2015). Students' engagement in laboratory activities plays crucial roles in the teaching of science and in the performance of any science subject (Marietta, 2017). Ronoh (2017) opined that laboratory activities are an essential medium to enhance students' interest, attitude, curiosity and enjoyment and motivation to learn.

Students enjoy learning science through its laboratory activities, positive change in attitude, being active in the activities and familiarity with science equipment make science teaching more unique (Townsend, 2012). The integration and students cohesiveness dimension of laboratory learning environment through minds on and hands on enhances students' attitude and academic performance in chemistry (Odutuyi, 2015). Jack and Suleiman (2017) opined that practical session entails a major part of science, should be well handled and delivered properly so as to avoid low strength and negative academic performance direction of students in an internal and external examination.

Babafemi (2016) asserted that students prior exposure and working with laboratory apparatus as a form of activities encourages student, experimental knowledge, student knowledge gain and curiosity about science.

The teaching and learning of physics is not complete without careful examination of laboratory activities which also serve as essential tool to classroom teaching and learning. Identification of physics practical apparatus, and their functions/uses is a necessary determinant of students learning outcome in qualitative aspect of physics and laboratory activities whether it's been assessed by internal or external examiner.

The examination bodies like WAEC, NECO, NABTEB, IJMB and other evaluation agencies assess students' practical skills through laboratory practical activities in which the identification and functions of apparatus are involved and it's also predictor of the end result of students' performance.

Liew et al. (2019) worked on the modeling of students' practical skills into design, execution, and analysis and evaluation domain. The design domain of practical skills explains in details needs to understand the practical set up and apparatus used and their functions.

Ibe et al. (2013) worked on assessment of secondary school chemistry teachers' quality through identification and use of laboratory apparatus. The study sampled four hundred and forty four (454) teachers that were purposely selected from the three educational zones of Cross River State. An instrument tagged Laboratory Apparatus Identification and Use questionnaire (LAIUQ) containing 71 items of laboratory pieces of apparatus. The simple percentage, frequency count and independent t-test statistics were employed to analyze the data and the results revealed that 354 representing 78.0% of the respondents could not identify and name the listed apparatus correctly.

Nuru (2015) carried out a search on competency of students in the identification of biology laboratory apparatus in secondary school. The study was survey in nature with the total of 176 (78 female and 98 male) senior secondary school students as respondents which was determine through the use of Krejcie and Morgan sample size selection table out of the total population of the five thousand, five hundred and eighty seven (5587). A researcher designed questionnaire tagged Biology Students Laboratory Apparatus Questionnaire (BSLAQ) with two sections. Section A provided questions on students bio data and section B focused on questions on identification, names and uses of biology laboratory apparatus. The use of

frequency count and percentage was used to analyze the collected data. The study found out that few students were able to identify and state the correct uses of biology laboratory apparatus and it also found out that the female students outperformed their male counterpart with mean values of 10.0 and 6.83 respectively.

METHODS

Measurement Tool

The research instrument used for the study was tagged "Physics apparatus identification Checklist" which was open ended in nature. Some selected common physics laboratory apparatus's pictures were placed on the instrument and the respondents were asked to identify them with their name and their use as used in the physics laboratory activities. The measurement tool was divided into two sections. Section A was used to elicit information about bio data of the participants and section B consist of the common physics apparatus' picture/image and another open space for the apparatus name and use The validation of the instrument was carried out by three experienced physics teachers that have been teaching and marking external examination physics practical for minimum of five years. The validity and reliability indexes are 0.72 and 0.80 respectively.

Participants

Senior secondary school physics students that have registered for West Africa Senior Secondary Certificate Examination (WASSCE) were considered for the study. The choice of the sample was premised on the researchers' believes that they might have been exposed to laboratory activities and learn the uses of some commonly used physics laboratory apparatus. One hundred and fifty (150) students were randomly selected from five accredited schools for WASSCE (i.e. 30 students per school) that were purposively selected based on their physics students' class population. One hundred and forty eight checklists were retrieved and One hundred and forty three provide useful information for the analysis.

Table 1. Demographic profile of participants (N=143)

Gender		N	%
	Female	49	34.3
	Male	94	65.7
Age			
	10-15	16	11.2
	16-20	92	64.3
	21-25	35	24.5

RESULTS AND DISCUSSION

Table 2 shows 140 students representing 97.9 % were able to identify Retort Stand while 3students representing 2.1% gave incorrect/wrong response. 102 students representing 71.3 % were able to identify Vernier caliper and gave correct name and 6 students representing 4.2 % of the participants gave no response and 35 students representing 24.5% gave incorrect/wrong response. 113 students representing 79.0 % were able to identify Meter rule while 30 students representing 21% gave incorrect/wrong response. 141 students representing 98.6 % were able to identify Weight/mass while2 students representing 1.4% gave incorrect/wrong response. 142 students representing 99.3 % were able to identify Pendulum bob while 1 students representing 0.7% gave incorrect/wrong response. 139 students representing 97.2 % were able to identify Stop watch while 4 students representing 2.8% gave incorrect/wrong response. 67 students representing 46.9 % were able to identify G-clamp and gave

correct name and 22 students representing 15.4% of the participants gave no response and 54 students representing 37.8% gave incorrect/wrong response.

132 students representing 92.3 % were able to identify Beaker and gave correct name and 2 students representing 1.4 % of the participants gave no response and 9 students representing 6.3% gave incorrect/wrong response.

Table 2. The result of students' knowledge of physics laboratory apparatus identification

Apparatus's Name	Correct Attempt		No Attempt		Incorrect Attempt		Ranking Order
	Freq.	%	Freq.	%	Freq.	%	
Retort Stand	140	97.9	-	0	3	2.1	3rd
Vernier Caliper	102	71.3	6	4.2	35	24.5	12th
Meter Rule	113	79.0	-	0	30	21	11th
Weight/Mass	141	98.6	-	0	2	1.4	2nd
Pendulum Bob	142	99.3	-	0	1	0.7	1st
Stop Watch	139	97.2	-	0	4	2.8	4th
G-clamp	67	46.9	22	15.4	54	37.8	16th
Beaker	132	92.3	2	1.4	9	6.3	7th
Measuring Cylinder	114	79.7	7	4.9	22	15.4	10th
Bunsen Burner	52	36.4	6	4.2	85	59.4	18th
Knife Edge	142	99.3	-	0	1	0.7	1st
Lens	57	39.9	21	14.7	65	45.5	17th
Ray Box	19	13.3	23	16.1	101	70.6	19th
Prism Glass	138	96.5	3	2.1	2	1.4	5th
Optical Pin	137	95.8	2	1.4	3	2.1	6th
Thumb Pin	101	70.6	5	3.5	37	25.8	13th
Ammeter	132	92.3	2	1.4	9	6.3	7th
Voltmeter	131	91.6	5	3.5	7	4.9	8th
Galvanometer	79	55.2	11	7.7	53	37.1	14th
Test Tube	139	97.2	-	0	4	2.8	4th
Potentiometer	68	47.6	39	27.3	36	25.2	15th
Resistance Box	123	86.0	6	4.2	14	9.8	9th

114 students representing 79.7 % were able to identify measuring cylinder and gave correct name and 7 students representing 4.9 % of the participants gave no response and 22 students representing 15.4% gave incorrect/wrong response. 52 students representing 36.4 % were able to identify Bunsen Burner and gave correct name and 6 students representing 4.2 % of the participants gave no response and 85 students representing 59.4% gave incorrect/wrong response. 142 students representing 99.3% were able to identify Knife edge and gave correct name and 1 students representing 0.7% gave incorrect/wrong response. 57 students representing 39.9% were able to identify Lens and gave correct name and 21 students representing 14.7 % of the participants gave no response and 85 students representing 85% gave incorrect/wrong response. 19 students representing 13.3% were able to identify Ray box and gave correct name and 23 students representing 16.1% of the participants gave no response and 101 students representing 70.6% gave incorrect/wrong response. 138 students representing 96.5% were able to identify Prism glass and gave correct name and 3 students representing 2.1% of the participants gave no response and 2 students representing 1.4% gave incorrect/wrong response. 137 students representing 95.8% were able to identify Optical pin and gave correct name and 2 students representing 1.4% of the participants gave no response and 3 students representing 2.1% gave incorrect/wrong response. 101 students representing 70.6% were able to identify Thumb pin and gave correct name and 5 students representing 3.5% of the participants gave no response and 37 students representing 25.8% gave incorrect/wrong response. 132students representing 92.3% were able to identify Ammeter and gave correct name and 2 students representing 1.4% of the participants gave no response and 9 students representing 6.3% gave incorrect/wrong response. 131 students representing 91.6%

were able to identify Voltmeter and gave correct name and 5 students representing 3.5% of the participants gave no response and 7 students representing 4.9% gave incorrect/wrong response.

79 students representing 55.2% were able to identify Galvanometer and gave correct name and 11 students representing 7.7% of the participants gave no response and 53 students representing 37.1% gave incorrect/wrong response. 139 students representing 97.2% were able to identify Test Tube and gave correct name and 4 students representing 2.8% gave incorrect/wrong response. 68 students representing 47.6% were able to identify Potentiometer and gave correct name and 39 students representing 27.3% of the participants gave no response and 36 students representing 25.5% gave incorrect/wrong response. 123 students representing 86.0% were able to identify Resistance box and gave correct name and 6 students representing 4.2% of the participants gave no response and 14 students representing 9.8% gave incorrect/wrong response .

Table 3. The students' knowledge of the use of physics laboratory apparatus

Apparatus	Function	Correct Attempt		No Attempt		Incorrect Attempt		Ranking Order
		Freq.	%	Freq.	%	Freq.	%	
Retort Stand	Use to hold lab wares	62	43.4	34	23.8	47	32.9	10th
Vernier Caliper	Use to measure inner and outer dimensions of an objects	57	39.9	56	39.2	30	21	11th
Meter Rule	Use to measure length of an objects	132	92.3	2	1.4	9	6.3	1st
Weight/Mass	Use to explain the amount of matter in a material	44	30.8	51	35	48	33.6	14th
Pendulum Bob	Use to determine the motion of a body at fixed point	12	8.4	33	23.1	98	68.5	18th
Stop Watch	Use to measure time interval	123	86.0	-	0	20	14.0	2nd
G-clamp	Use to hold wood or metal workpiece	43	30.0	18	12.6	82	57.3	15th
Beaker	Use to store or mix liquids	116	81.1	12	8.4	15	10.5	3rd
Measuring Cylinder	Use to measure the volume of liquids/solution	98	68.5	10	7.0	35	24.5	7th
Bunsen Burner	Use for heating, sterilization and combustion	44	30.8	47	32.9	52	36.4	14th
Knife Edge	Use as fulcrum for beam	67	46.9	17	11.9	59	41.3	9th
Lens	Use to form an image and magnifying image	36	25.2	62	43.4	45	31.5	17th
Ray Box	Use to create beams of light	4	2.8	31	21.7	108	75.5	19th
Prism Glass	Use to analyze reflection, refraction and separation of light	39	27.3	15	10.5	89	62.2	16th
Optical Pin	Use to locate/pinpoint the reflected or refracted image of an object	67	46.9	5	3.5	71	49.7	9th
Thumb Pin	Use to fasten items to a board	98	68.5	7	4.9	38	26.6	7th
Ammeter	Use to measure current	111	77.6	2	1.4	30	21.0	5th
Voltmeter	Use to measure voltage	113	79.0	1	0.7	29	20.3	4th
Galvanometer	Use to measure small amount of current	46	32.2	41	28.7	56	39.1	13th
Test Tube	Use to hold, mix and heat liquids	101	70.6	2	1.4	40	28.0	6th
Potentiometer	Use to measure electric potential	51	35.7	14	9.8	78	54.5	12th
Resistance Box	Use to resist the free flow of current	91	63.6	8	5.6	44	31.0	8th

62 Students representing 43.4% state the use of Retort Stand correctly, 34 representing 23.8 % gave no response while 47 students representing 32.9 % gave incorrect/wrong responses. 57 Students representing 39.9% state the use of Vernier Caliper correctly, 56 representing 39.2 % gave no response while 30 students representing 21.0 % gave incorrect/wrong responses. 132 Students representing 92.3% state the use of Meter rule correctly, 2 representing 1.4 % gave no response while9 students representing 6.3% gave incorrect/wrong responses. 44 Students representing 30.8% state the use of Weight/mass correctly, 51 representing 35.0% gave no response while48 students representing 33.6% gave

incorrect/wrong responses. 12 Students representing 8.4% state the use of Pendulum bob correctly, 33 representing 23.1% gave no response while 98 students representing 68.5% gave incorrect/wrong responses. 123 Students representing 86.0% state the use of Stop watch correctly, while 20 students representing 14.0% gave incorrect/wrong responses.

43 Students representing 30.0% state the use of G clamp correctly, 18 representing 12.6% gave no response while 82 students representing 57.3% gave incorrect/wrong responses. 116 Students representing 81.1% state the use of Beaker correctly, 12 representing 8.4% gave no response while 15 students representing 10.5% gave incorrect/wrong responses. 98 Students representing 68.5% state the use of measuring cylinder correctly, 10 representing 7.0 % gave no response while 35 students representing 24.5 % gave incorrect/wrong responses. 44 Students representing 30.8% state the use of Bunsen Burner correctly, 47 representing 32.9 % gave no response while 52 students representing 36.4 % gave incorrect/wrong responses. 67 Students representing 46.9% state the use of Knife edge correctly, 17 representing 11.9 % gave no response while 59 students representing 41.3 % gave incorrect/wrong responses. 36 Students representing 25.2% state the use of Lens correctly, 62 representing 43.4% gave no response while 45 students representing 31.5% gave incorrect/wrong responses. 4 Students representing 2.8% state the use of Ray Box correctly, 31representing 21.7% gave no response while 108 students representing 75.5% gave incorrect/wrong responses.

39 Students representing 27.3% state the use of Prism glass correctly, 15 representing 10.5% gave no response while 89 students representing 62.2% gave incorrect/wrong responses. 67 Students representing 46.9% state the use of Optical pin correctly, 5 representing 3.5% gave no response while 71 students representing 49.7% gave incorrect/wrong responses. 98 Students representing 68.5% state the use of Thumb pin correctly, 7 representing 4.9% gave no response while 38 students representing 26.6% gave incorrect/wrong responses. 111 Students representing 77.6% state the use of Ammeter correctly, 2 representing 1.4% gave no response while 30 students representing 21.0% gave incorrect/wrong responses. 113 Students representing 79.0% state the use of Voltmeter correctly, 1 representing 0.7% gave no response while 29 students representing 20.3% gave incorrect/wrong responses. 46 Students representing 32.2% state the use of Galvanometer correctly, 41 representing 28.7% gave no response while 56 students representing 39.1% gave incorrect/wrong responses. 101 Students representing 70.6% state the use of Test Tube correctly, 2 representing 1.4% gave no response while 40 students representing 28.0% gave incorrect/wrong responses. 51 Students representing 35.7% state the use of Potentiometer correctly,14 representing 9.8% gave no response while 78 students representing 54.5% gave incorrect/wrong responses. 91 Students representing 63.6% state the use of Resistance box correctly, 8 representing 5.6% gave no response while 44 students representing 31.0% gave incorrect/wrong responses.

The physics laboratory apparatus identification result shows pendulum bob and knife edge as the most correctly identified apparatus by the respondents and ray box was rated least correctly identified apparatus. Most respondents were able to state the correct uses of the meter rule and substantial percentage of the respondents were unable to state the correct use of the ray box. The implication of the result is that most students won't be able to attempt questions relating to propagation of light. Careful analysis of the result revealed that students' find it difficult to explain the uses of the apparatus required for optics, heat and electricity experiments activities in the laboratory. The findings of this study is similar to the findings of Kim and Lee (2016). Kim and Lee (2016) concluded that students' encounter difficults in the identification and stating of functions of most physics laboratory apparatus.

CONCLUSION

The students' identification and mastery of the physics laboratory apparatus' use plays significant roles in their performance strength and directions both in internal and external examination. This knowledge prepares them for post secondary education challenge especially higher education institution's challenge where most of these apparatus becomes the major reference points. The findings of this study show that larger percentages of students were unable to identify and state the correct use of the some apparatus that were used for optics and waves practical in the physics laboratory. The students' inability to identify and state the use of these apparatus may affect the students' performance in the optics and waves aspect of practical questions in their internal and external examinations.

From the findings of the study, the following measures were recommended so as to improve the knowledge of senior secondary school students' apparatus identification and its uses: (1) Pasting and displaying the apparatus pictures, name of the apparatus, its uses/function beside it in the physics laboratory wall; (2) Early exposure of the students to laboratory activities; (3) Teaching the students with the real apparatus where necessary in the classroom activities; (4) Continuous re-examination of students' knowledge of physics apparatus identification and its uses; (5) Provision of common and mostly used/needed physics laboratory apparatus to the school.

REFERENCES

Adolphus, T. & Aderonmu, T. S. B. (2013). Difficulties students' encounter in reporting physics practical at the senior secondary school level in Rivers State, Nigeria. *Asian Journal of Education and e-learning*, 1(11), 29-33.

Babafemi, A. J. (2016). Impact of prior exposure to laboratory apparatus on acquisition of process skills and academic performance in chemistry at secondary schools in Giwa zone, Nigeria. *American Journal of Educational Research*, 4(12), 903-906. DOI:10.12691/education-4-12-8.

Danjuma, T., T. & Adeleye, M. O. (2015). The effect of the availability and the utilization of laboratory apparatus in the teaching of physics: A case study of secondary schools in Karu LGA, Nigeria. *Research Journal of Educational Studies and Review*, 1(5), 116-122.

Gok, T. (2017). The comparisons of quantitative and qualitative problems on students' physics achievement. *Research Highlights in Education and Science*, 91-99.

Ibe, J. O., Adah, S. & Ihejiamaizu, C.C. (2013). Assessment of secondary school chemistry teachers' quality through identification and use of laboratory apparatus in Cross River State, Nigeria. *Journal of Science and Practice*. 4(5), 135-141.

Jack, G., U. & Suleiman, Z. (2017). Effectiveness of guided-inquiry laboratory experiments on senior secondary schools students academic achievement in volumetric analysis. *American Journal of Educational Research*, 5(7), 717-724. DOI:10.12691/education-5-7-4

Kim, I. & Lee, I. (2016). Middle-school students' understanding of an experimental apparatus: A focus on physics. *New Physics: Sae Mulli*, 66(3), 340-350. http:/dx.doi.org/10.3938/NPSM.66.340

Liew, S. S., Lim, H. L., Saleh, S. & Ong, S. L. (2019). Development of scoring rubrics to access physics practical skills. *EURASIA Journal of Mathematics, Science and Technology Education*. *15*(4), 1-14. https.//doi.org/10.29333/ejmste/103074

Muhammad, A., D. & Fayyaz, A. F. (2011). Effect of the availability and the use of science laboratories on academic achievement of students in Punjab (Pakistan). *European Journal of Scientific Research*, 51(2), 193-202. http://www.eurojournals.com/ejsr.htm

Marietta, N., M. (2017). Influence of laboratory facilities on students performance in science subjects in public secondary schools in Machakos sub-county, (M.Ed.) Machakos University, Kenya

Nuru, A. R. (2015). Competency of students in the identification of biology laboratory apparatus in secondary schools in Kaduna. *Journal of Science, Technology & Education* (JOSTE), 3(3), 111-119.

Odutuyi, M. O. (2015). Effects of laboratory learning environment on students learning outcomes in secondary school chemistry. *International Journal of Art & Science*, 8(2), 507-525.

Ronoh, K. W. (2017). Effect of laboratory management in students' performance in physics in public secondary schools in BOMET county, (M.Ed.) Kenyatta University, Kenya

Sarjono, Djemari, M. & Mundilarto (2018). Development of physics lab assessment instrument for senior high school level. *International Journal of Instruction*, 11(4), 17-28.

Townsend, L. A. (2012). The effects of laboratory-based activities on students' attitude toward science (M.Sc.) Montana State University, USA