Assessment of Science Resources in Higher Education

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Abstract: *This study assessed the availability, adequacy and utilization of science resources. These science resources were categorised as audio, visual, audiovisual resources, and reference materials. Three research objectives and questions were raised for the study. The study adopted the descriptive research design. The population of the study comprised of the entire academic staff of the University of Abuja, Nigeria. The sample size used was made up of 293 lecturers from 2 sampled Institutions of the university (Institute of Education, and Centre for Distance Learning and Continuing Education). Data were analyzed using descriptive statistics of mean, standard deviation. Results showed that science resources that involves audiovisual materials were available but not adequate, and not effectively utilized by academic staff and students. However, reference materials such as textbooks and posters were sufficiently utilised in the classroom setting. Based on the results of the findings, it was recommended that government and stakeholders should endeavour to adequately procure and effectively utilise the science resources available in other to enhance the acquisition of necessary science skills, especially in ICT which is the new normal.*

Keywords: *Science resources, audiovisual, reference materials, higher education.*
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1.0 INTRODUCTION

Science resources are major instructional materials used in implementation of any curriculum. The success and failure of any school curriculum depends on the quality of the teacher in the utilization of this instructional materials and the availability and adequacy of the teaching resources. As a result of covid-19 pandemic, blended face-to-face and online teaching and learning has become the new normal. Some of the challenges that came with this paradigm shift from this new normal method of teaching is the availability, adequacy and utilization of these science resources for effective teaching and learning.

Gometi (2011) opined that school facilities include the school buildings, classrooms, accommodation, libraries, laboratories, furniture, recreational equipment, apparatus and other instructional materials, their availability, adequacy and relevance to academic achievement.

It is expected that important science resources such as ICT gadgets and internet access ought to be provided for undisrupted teaching and learning to take place in the post covid-19 era. However, many scholars in the likes of Ogunode, Okwelogu and Olatunde-Aiyedun (2021) has reviewed the challenges and problems of availability, adequacy, utilization, and redeployment of ICT science educational resources in the Nigerian public higher institutions. It was noted among other resources that school buildings/complexes such as classrooms, tables, exam hall, chairs, auditoria, desks, staff offices, seminar/conference/board rooms, laboratories, workshops, studios, farms, gymnasia, central libraries, specialized/professional libraries, faculty libraries, Departmental libraries, lacks appropriate science resources for effective teaching and learning. For instance, the ICT infrastructure, special laboratories, conference facilities, such as interactive magnetic screen board, were mostly unavailable in some universities. Computer laboratories lacks essential science resources such as adequate desktops for available number of students, official laptops for lecturers or tutors, network connectivity/internet access, multimedia system, public address system, slides, and video projectors (Ogunode, 2020; Ajemba, Ahmed, Ogunode & Olatunde-Aiyedun, 2021).

Learning materials have been attributed to academic performance. Okongo, Ngao, Rop and Nyongesa (2015) stated that schools with adequate science resources performed better because of the adequate instructional resources for effective teaching and learning. Adalikwu and Iorkpilgh (2013) opined that the quality and value of learning and teaching resources have maximum impact on students' performance. The learning centers with enough facilities, such as textbooks, are better positioned to get good grades than schools with inadequate amenities. As a result, poor performance might be linked to a lack of science resources and inadequate training on the effective usage of the learning resources and tools. In line with this, the World Bank (2017) reported that there is inadequacies of science resources for teaching and learning, with only 19 percent (19%) of universities having the minimum requirement.

Many researches have also investigated the shortage of instructional resources in primary and secondary schools but limited articles have been about science resources in tertiary institutions. For instance, Ogunode, Jegede, & Ajape (2021) stated that most primary schools in Nigeria do not have adequate infrastructural and instructional resources to implement the various policies in their schools as a result of problem of unstable electricity and poor quality of internet services when using instructional strategies that requires the use of ICT tools. The importance of educational resources as propounded by Ogunode, Somadina, Yahaya and Olatunde-Aiyedun (2021) include: the promotion of effective delivery of teaching strategies and administrative functions in schools, as it enhances an efficient, fast and reliable delivery.

However, this study aim to assess the availability, adequacy, and utilization of these science resources in the classrooms, libraries, laboratories, and at ICT centres in the university.

1.1 Research Objectives

The objectives of this study is to assess the availability, adequacy, and utilization of science resources in University of Abuja. The specific objectives aimed to:

1. assess the extent of availability of science resources in the sampled universities in North Central Zone of Nigeria.

2. ascertain the extent of adequacy of science resources in the sampled universities in North Central Zone of Nigeria.

3. assess the extent of effective utilization of available science resources in the sampled universities in North Central Zone of Nigeria.

1.2 Research Questions and hypothesis

1. To what extent are the science resources available in the sampled universities in North Central Zone of Nigeria?

2. To what extent are the science resources adequate for equal distributions in the sampled universities in North Central Zone of Nigeria?

3. To what extent are the science resources utilised in teaching of sciences in the sampled universities in North Central Zone of Nigeria?

2.0 LITERATURE REVIEW

2.1 Theoretical Framework

Theories on Instructional Material

The instructional resources used by teachers have a correlation with the learning outcomes of their students, according to instructional material theories. Higher learning skills, quality techniques for learning and performing classroom tasks, and a positive attitude toward learning are among these outcomes. Furthermore, these hypotheses assume that educational materials have the ability to improve the highest order of academic skills in students because they show students how to obey rules/principles and elaborate on concepts in a simple, step-by-step manner, both of these factors help solve novel problems by assessing the circumstance and developing a technique (Gagné, Wager, Golas, & Keller, 2005). According to Gagne et al., teaching and learning resources can be used to promote higher-order learning capabilities in learners through self-teaching or directed learning. This means that the instructional materials for guided discovery learning primarily consist of "eliciting results" and "providing input on performance correctness," as well as "providing learning guidance." Many of Gagne's concepts have far-reaching consequences for high school teachers in Ghana. Many of these concepts accentuate the development of critical thinking and problem-solving skills in learners. The theory, on the other hand, has little to do with whether or not students should think critically about what they're learning or how they can solve a problem on their own. However, it is believed that the aim of educational materials and technology is to stretch students' imaginations and inspire them to creativity and problem-solving capabilities. Similarly, Lev Vygotsky, believed teaching learning resources have the ability to improve learners' higher-order thinking capacities, which is essential in problem-solving activities (Vygotsky, 1978).

2.2 Conceptual Framework

2.2.1 Science Resources

The concept of resources has been applied in diverse realms, with respect to Geography, Economics, Biology and Ecology, Computer Science, Management, Human Resources, and material resources, and is linked to the concepts of availability, adequacy and utilisation (Miller and Spoolman, 2011). Science resources are materials used in a learning environment to help and assist students' development and knowledge acquisition. These resources are designed to reinforce learning and make complex concepts easy to comprehend and interesting. Smith, Nelson, Trygstad and Banilower (2013) stated that science teaching and learning requires access to equipment to engage in hands-on, inquiry-based science.

2.2.2   Types of Science Resources

In a school setting, resources are critical for teaching and learning. Three categories of Science Education resources are: material, human, and social resources. However this study focuses on the material resources, which include: audio, visual, audio-visual, and reference materials such as pictures and maps, graphs and charts, and reading materials such as textbooks, magazines, newspapers, and articles.

1. Audio Teaching Resources

These are teaching devices appeal mostly to auditory sense. They consist of radio programs, audio recordings such as cassettes, compact disc records and mp3. Some examples of these media are devices like the telephone and radios walkie-talkie. Since audio aids appeals mostly to the auditory sense, for them to be effective, pupils must not be auditory impaired. Radios, records players, tape recorders and mp3s that are becoming common house hold items could be judiciously and effectively utilized in the classroom as well (Doosuur & Sandra, 2013). Radio is more useful since some types may be uses without electricity, this can be used to tape a radio broadcast which can be repeated at any time. Tape recorder is among the most useful piece of equipment. Tape can be replayed over and over. Speeches of the guest speaker can be kept and use by other students at other time. A panel discussion, debate or cultural music and drama can be kept filed and used again (Anzaku, 2011).

2.   Visual Teaching Resources

These are teaching and learning devices that appeal mostly to the visual sense. In this category, we have such devices like simple visual devices like pictures such as slides, film strip, and transparencies. Visual aids involves three dimensional (3D) objects or projects and so on. Instructional material is another category. It comprises of text books, real objects, maps. Projected material is the category that includes film slide, film strip. Non-projected materials category among such includes maps and globes. Also they are inexpensive, often simple to use and above all clear and impressive in their presentation (Opara, 2015).

3. Audio-Visual Teaching Resources

These are instructional devices that have the capacity to provide the features of audio and visual media simultaneously. Doosuur and Sandra, (2013) on this note also asserted that typical of media in this category are the television, video taped programs/recordings, sound films, film strips and slides with synchronized sound. Audio visual provides students with audio and visual experience by appearing to the hearing and seeing sense at the same time. As there is special apparatus in teaching and learning process in secondary schools from such teaching and learning; thus, it could almost have endless categories of items. Basically instructional materials are classified into three groups: Visual resources, Audio resources and Audio visual resources (Doosuur & Sandra, 2013). These are often produced commercially and sold at expensive rate to schools, such as projectors, opaque projectors and overhead projectors. The effective usage of audio-visual materials will enhance students' academic achievement, retention and interest in the teaching and learning of science (Ojelade, Aregbesola, **Ekele,** Aiyedun, 2020).

4.   Reference Materials

i.   Pictures and Maps

Pictures also provide date which can be critically examined through carefully observed map. Instructors usually use map of some kinds, but many in rural area especially in primary schools have none at all. So sometime where maps are available they are not relevant to use. It is therefore important that it is up to date and relevant map be among reference materials in the schools or class library or in the personal library of every teacher (Ballad, 2010). Maps should not be drawn on the board because they cannot be

preserved until you need them again. Ngozi, Samuel and Ameh (2012) further added that it is better to draw the maps on materials which may be preserved in case of frequently usage especially map of States, Nations, and the World. Production of maps and those of complete active and valuable learning activities are useful resource that encourages sustainability and promote recycling of resources (Ekpo & Aiyedun, 2019).

ii. Graphs and Charts

Graphs and chart are useful ways of illustrating information in dramatic visual presentation. Graphs are of various types; bar graphs, line graphs, pictorial graphs, circle (pie) graphs which could be drawn or placed on notice board, flamed board and chalk board (Ngozi, *et al.,* 2012)

iii. Reading Materials

Most schooling has to do with reading materials as the first resource. A student that read well can succeed in school. Teachers need to select book and other reading materials to become consistent with the objective of the subject. Textbook is the most frequently used reading materials. The book has certain advantage in the subject in a meaningful way and they providing assorting place of learning. Book equally has disadvantages to both the students and the teachers, thereby becoming over dependent upon it (Anzaku, 2011) indicated that students learn fast and better when they are motivated properly through different teaching aids. This is because teaching aids develop the proper image when the students see, hear, taste and smell properly. It also creates the environment of interest for the student. Shukla, (2021) put that many resources are necessary to student's need to search in many places of information from different text book. He added some reference books are important for all schools and especially for primary school pupils. The teacher is expected to develop library for himself. Developing library in the school where teachers and pupils' library in a particular, write up magazines and articles are useful sources of research read widely and encourage pupils to do some. A primary school teacher must have a broad education. On this note Shukla, (2021) also critically opined in a modern perspective that instructional materials are those items that assist and describe the information aspect of teaching. These could take the form of textbooks, worksheets, 3D models, charts, info-graphics, etc. He further stated many decades ago, the very definition of the classroom has changed. To Shukla (2021) again the world has moved online and online classes are now a valid alternative method of conducting educational activities. Lectures can now be presented via ZOOM, Skype, and Microsoft Meetings. All notes are provided digitally and many books have digital copy as ebooks. A typical modern and digital class now appears on a screen as a collection of students and teachers. What teaching aids, instructional materials, and resources for the digital learning sphere mean is entire different from those days.

2.2.3 Availability, Adequacy and Utilisation of Science Resources in Universities

Availability of science resources refers to the provision made to the schools for effective teaching and learning. Provision of educational science resources should be among the very first preparation necessary for opening a new school (Olatunde-Aiyedun, Ogunode & Ohiosumua, 2021). Teachers use a variety of educational materials in the teaching and learning process, which are referred to as teaching and learning resources. Charts, models, textbooks, maps, the internet, and electronic and audio-visual learning resources such as a tape recorder, radio, cassette, TV, laptops, cell phones, overhead projectors, computers, and classroom improvised materials are just a few examples. Writing resources such as rubbers, pens, crayons, exercise books, chalk, notebooks, drawing books, rulers, pencils, workbooks, slates, and paper supplies are examples of additional learning resources (Blazar & Kraft, 2017; Yeboah, Abonyi, & Luguterah, 2019). The non-availability of these facilities to teach the students are likely to lead to poor learning outcomes in Agricultural Science and also affects the lecturers output thereby frustrating their efforts.

Adequate availability of equipment and facilities and their proper utilization have been positively correlated to good performance in examinations while poor performance has been blamed on inadequacies, (Olamoyegun, Olatunde-Aiyedun & Ogunode, 2022). The National Policy of Education set out criteria for determining the adequacy of facilities. For instance, a standard chemistry laboratory is meant to serve only 50 students at a time and would be considered inadequate when utilized by more than that number of students. Uzoechina (2014) reported that the Ministry of Education among several other responsibilities usually carry out a resource visit to any new public or private school to ascertain the extent of availability of educational teaching facilities for its programmes. Consequently, proprietors of both public and private schools ought to ensure that provisions are made for these facilities as availability of such facilities as lecture halls, equipment are pre-requisite for approval of accreditation by the National University Commission (NUC) in any Nigerian University. The non-availability of these facilities to teach the students are likely to lead to poor learning outcomes in Science Education and also affects the lecturers output thereby frustrating their efforts (Olatunde-Aiyedun, 2021b).

Utilization is the proportion of the available time (expressed usually as a percentage) that a piece of teaching facilities or instructional materials is being used. It is the ratio of when teaching facility is used (working) divided by the time it is available (Aboyade, 2018). Science Educational Resources are used in schools to facilitate learning and teaching are teaching and learning materials (Machaba, 2013; Yeboah, Abonyi, & Luguterah, 2019). Science resources and methods used by teachers to apply instructions and offer learners with the achievement of learning objectives during learning activities, which include active learning and measurement. They aid in the concretization of a learning experience, making learning more engaging, energetic, and interesting. Audio, visual, and audio-visual (Olatunde-Aiyedun, 2021a). Textbooks and visual resources were shown as wall charts. As a result, audio learning materials are those that only use the sense of hearing, such as tape recorders and radios. As a result, audio-visual learning materials incorporate both visual and auditory elements, such as computers, movies, and television. Learners should be equipped with problem-solving skills and critical analytical thinking through the materials, which should provide them with the necessary information, skills, and abilities to grow and support institutions (Saad & Sankaran, 2020).

2.2.4   Problems of Availability of Science Resources

Most countries in Africa experience a shortage of teaching and learning materials with the difference in availability between rural and urban schools (Quansah, Sakyi-Hagan, & Essiam, 2019; Yeboah, Abonyi, & Luguterah, 2019). World Bank (2012) found out that many African countries do not have enough resources to meet the demand for education. This was in a report by all the Sub-Saharan Conference on Education for All (Obara & Were, 2020). The self-discovery of both instructors and learners is aided by teaching and learning resources. They improve child-centered teaching and learning approaches by involving students (Machaba, 2013). Academic success is aided by the use of educational materials. According to the data reported by Ashiono, Mwoma, and Murungi (2018), employing ICT during classroom instruction boosts learners' interest in learning, leading to improved cognitive recall. The results presented by Lyimo, Too, and Kipngetich (2017) assert that teaching learning resources can significantly enhance teaching efficiency, help to identify distinctive requirements for various students, and enrich lesson plans, all of which have an advantageous influence on learners' and school's achievement. Regardless of how well-staffed a school is, without adequate teaching and learning materials, the school's basic aims, such as teaching and studying Integrated Science in order to achieve outstanding results, can be severely hampered (Saad & Sankaran, 2020). Instructional resources of many forms can be used to encourage development since they excite, stimulate, and hold the attention of Science students.

2.2.5 Problems of effective distribution of science resources

Some notable researchers stated that inadequate infrastructural facilities are one of the major problems in education (Osiesi, 2020; Ogunode, Ahmed, Deborah & Abubakar, 2020; Ogunode, 2020) conclude that another problem facing the administration of primary school education in Nigeria. Many primary schools in Nigeria do not have adequate infrastructural facilities. It may be difficult to implement any educational policy or plan effectively with the present situation. The school facilities and equipment are in total disrepair at all levels of education. The school buildings are collapsing, the ones still standing are with leaking roofs, no windows and doors. Most schools have few good chairs and tables left for the use of teachers and ever-increasing enrolment. Many schools have no library, workshop and science laboratory.

3.0 METHODOLOGY

The study adopted the descriptive research design. The population of the study comprised all academic staff of the Institute of Education, and the Centre for Distance Learning and Continuing Education (CDL & CE), University of Abuja, Nigeria. Random sampling technique was used to select the two institutions in the University. The sample size used was 293 lecturers from the 2 sampled institutions of the University of Abuja, Nigeria. Checklists were designed to extract the needed data for the study. Data were analyzed using descriptive statistics of mean, and standard deviation.

4.0 DATA ANALYSIS AND INTERPRETATION

4.1 Results

Research Question one: To what extent are the science resources available in the sampled universities in North Central Zone of Nigeria?

Table 4.1: Availability of Science Resources

Number of Respondents: 293

S/N	Science Resources	Mean	Std. D
1	Audio (radio, tape-recorder, cassette player, talking books, and other sound recordings)	2.06	0.86
2	Visual (paintings, drawings, projectors, 3D art, black and white board)	2.12	0.88
3	Audiovisual (videotapes, slides, desktops, laptops)	2.64	0.77
4	Reference Materials (textbooks, articles, magazine, newspapers)	3.15	0.68
	Mean Total	**2.50**	

Decision Rule: Mean score of 2.5 and above means science resources are available

From table 4.1, the mean total of 2.50 implies that science resources for audiovisual and reference materials are available with a mean score of 2.64, and 3.15 respectively. However, audio, and visual materials with mean scores of 2.06, and 2.12 respectively, are lower than 2.5. This implies that audio and visual science materials are not available. The mean total of 2.50 was derived, which means that it can be agreed that science resources are available in the university.

Research Question Two: To what extent are the science resources adequate for equal distributions in the sampled universities in North Central Zone of Nigeria?

Table 4.2: Adequacy of Science Resources

Number of Respondents: 293

S/N	Science Resources	Mean	Std. D
1	Audio (radio, tape-recorder, cassette player, talking books, and other sound recordings)	2.05	0.86
2	Visual (paintings, drawings, projectors, 3D art, black and white board)	2.08	0.86
3	Audiovisual (videotapes, slides, desktops, laptops)	2.33	0.74
4	Reference Materials (textbooks, articles, magazine, newspapers)	2.83	0.70
	Mean Total	**2.32**	

Decision Rule: Mean score of 2.5 or greater means there are adequate science resources

From table 4.2, the grand mean of 2.32 is less than 2.5, which means that the level of adequacy of science resources in the university are not adequate. However, reference materials which included textbooks, articles, magazine, newspapers, had a mean score of 2.83 which means that the reference materials are adequately available in the school libraries than the audio, visual, and audiovisual resources with lesser mean scores of 2.05, 2.08, and 2.83 respectively.

Research Question Three: To what extent are the science resources utilised in teaching of sciences in the sampled universities in North Central Zone of Nigeria?

Table 4.3: Utilisation of Science Resources

Number of Respondents: 293

S/N	Science Resources	Mean	Std. D
1	Audio (radio, tape-recorder, cassette player, talking books, and other sound recordings)	1.90	0.89
2	Visual (paintings, drawings, projectors, 3D art, black and white board)	1.87	0.87
3	Audiovisual (videotapes, slides, desktops, laptops)	2.18	0.77
4	Reference Materials (textbooks, articles, magazine, newspapers)	2.86	0.71
	Mean Total	**2.20**	

Decision Rule: Mean score of 2.5 or greater means there are adequate science resources

From table 4.3, the mean total of 2.20 is less than 2.5, which implies that the use of science resources that were more technological in nature such as the audio, visual, and audiovisual with mean scores of 1.09, 1.87, and 2.18 respectively, were not effectively utilised by lecturers of the university. However, the reference materials with a mean score of 2.86 were mostly preferred and used by senior lecturers and professors in the university.

4.2 Discussion of Findings

Result collected from question one in table 4.1 revealed that science resources like audiovisual and reference materials are partially available. It was deduced that reference materials such as textbooks, articles, magazine, and newspapers were more available in the school libraries than audiovisual materials such as the desktops, laptops, and projectors which are moderately available at the ICT centre and e-libraries of the university. This result contradict the discovery of Ogunode (2020); Ogunode, Eyiolorunse-Aiyedun & Olatunde-Aiyedun, (2021); and the World-Bank (2017) report on shortages of science resources Nigerian schools.

Result from question two, table 4.2 deduced that science resources are inadequate at the Institutions. However, reference materials were adequately available as compared to the audio, visual, and audiovisual resources. This result is in line with the submission of UNICEF (2017); Ogunode (2020a) and World-Bank (2012) that one of the major hindrances towards achieving quality education is as a result of inadequate science resources in teaching and learning.

Result from question three, table 4.3 revealed that science resources are not effectively utilised by academic staff of the university. This may be attributed to the level of ICT literacy among the lecturers. These results are in consonance with the findings of Aboyade (2018) that stated that teachers need to educate themselves on the effective usage of the 21st century skills in teaching, especially ICT literacy, which are essential skills needed in handling audiovisual science resources.

5.0 CONCLUSION AND RECOMMENDATIONS

Science resources serves as instructional materials that assist both the teachers and students in learning general rules and concepts of a subject matter. The objectives of this study is to investigate availability and adequacy of science resources in Nigerian universities, especially in North Central Nigeria. The study hereby concluded that the problem may not be the unavailability nor inadequacies of science resources required for teaching and learning but on the effectiveness of usability of the available resources in the university. Based on these findings, the study, the following were recommended:

1. Government should ensure that there is effective usage of the available science resources in universities. There should be training and retraining of lecturers on ICT skills for effective usage of science resources and adopting the audiovisual teaching aids as part of their teaching strategies.

2. The school authorities should make efforts in securing, preserving and maintaining science resources sustainably.

3. Government should provide adequate funding for availability of adequate science resources in universities.

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