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Assessment of Availability and Utilization of Hands-On Activities in Stem Education among Lower Basic Teachers in Ilorin Metropolis, Nigeria

Ahmed, Tijani Ayinla

ahmed.ta@unilorin.edu.ng

+2347030434451

Department of Adult and Primary Education, Faculty of Education, University of Ilorin, Ilorin, Nigeria

Abstract

The study was carried out in order to explore the availability and teachers' utilization of hands-on activities in STEM education among lower basic pupils Ilorin metropolis. The research design adopted for this study was descriptive survey research design. The population of the study consists of all the lower basic teachers in Ilorin, Kwara State while a sample of 300 teachers was selected for the study using simple random sampling technique. A self-constructed questionnaire titled: "Questionnaire on Availability and Teachers' Utilization of Hands-on Activities in STEM Education (QATUHASTEME)" was used for data collection. The instrument was content validated by two experts while Cronbach Alpha reliability estimate yielded 0.83. The data collected were analysed using mean and standard deviation to provide answer to the research questions. The findings of the study revealed that hands-on activities in STEM education are available and moderately utilized by the teachers in teaching lower basic pupils in Ilorin Metropolis. It was concluded that these hands-on activities are good for learning STEM education concepts when they are available and highly utilized by the teachers. It was recommended among others that frequent supervision and monitoring should be encouraged in order to ensure that hand-on activities are made available and that teachers appropriately utilize hands-on activities in STEM education in lower basic schools.

Keywords: Hand-on activities, STEM education, Lower basic education, Teachers' utilization

Introduction

Learning through hands-on activities is very effective and influential for both feeling and emotion of students. Hands-on activities are educational or learning experiences that involve actively engaging with physical objects, materials, or processes. These activities are designed to encourage active participation and experiential learning, where learners can explore concepts through their own senses and actions, rather than just reading or hearing about them. Hands-on activities are often considered to be a more effective form of learning compared to traditional methods because they engage learners in a more active and immersive experience. By doing hands-on activities, learners can manipulate objects, observe cause-and-effect relationships, and engage in trial-and-error processes that help them develop a deeper understanding of the concepts they are learning.

Consequently, hands-on activities are particularly useful for learners who may struggle with traditional learning methods, such as those with learning disabilities or who are visual or kinesthetic learners (Ahmad, Hui & Ahmad, 2019). These activities can also be used to cater to different learning styles, helping learners retain information and develop critical thinking skills. Hands-on activities can be designed for any subject or topic, and they can range from simple activities like creating a collage to complex experiments like building a functioning robot. They can also be used to promote cross-curricular learning by integrating multiple subjects into one activity. For example, an activity that involves designing and building a bridge could involve concepts from science, math, and engineering (Tumay & Cakmakci, 2019). Examples of hands-on activities include experiments, art projects, building and construction tasks, outdoor games and sports, cooking, and scientific investigations. These activities are often used in educational settings, such as schools or museums, to promote critical thinking, problem-solving, creativity, and teamwork.

The concept of hands-on activities is rooted in the philosophy of constructivism, which argues that students construct their own understanding of the world through experiences, interactions, and reflection (Dunn & Mulvenon, 2009). Therefore, hands-on activities are designed to create a more authentic learning environment where students can explore, experiment, and reflect on their own learning. Hands-on activities can provide numerous benefits for learners of all ages and skill levels. They can be a fun, engaging, and effective way to learn new concepts and skills, and can help participants to develop a range of valuable cognitive, social, and practical skills that are applicable in a variety of settings.



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According to McNair (2018), there are many different types of hands-on activities that can be used in different subject areas. In science classes, hands-on activities might involve conducting experiments, making observations, or building models. In mathematics classes, hands-on activities might involve using manipulatives, creating graphs, or designing experiments to test mathematical concepts. In language arts classes, hands-on activities might involve creating and performing skits or plays, or writing and illustrating their own stories. In social studies classes, hands-on activities might involve conducting historical reenactments, creating maps or timelines, or building models of historical structures or monuments. Johnson and Oludipe (2019) pointed out that hands-on activities are a powerful tool for promoting active learning, engagement, and creativity. They can be used in a variety of educational settings, from classrooms to informal learning environments like museums or community centers.

These activities provide students with the opportunity to engage with the subject matter in a more tangible and interactive way, allowing them to better understand and retain the information presented to them. Research such as Jones and Jones (2017), Alspaugh and Hartman (2015) and Demir, Kocakoyun and Aydin (2020) have shown that hands-on learning activities can significantly improve students' engagement and retention of STEM concepts. When students are actively involved in the learning process, they are more likely to remember what they have learned and to develop a deeper understanding of the material (Gega, 2018).

Hands-on activities are an essential part of STEM (Science, Technology, Engineering, and Mathematics) education among lower basic pupils. The core components of STEM education are science, technology, engineering, and mathematics. Science refers to the study of the natural world and its phenomena, including physical, chemical, and biological processes. Technology involves the application of scientific knowledge to design and develop tools, machines, and systems that solve practical problems. Engineering involves the design, development, and optimization of systems, structures, and processes that solve real-world problems. Mathematics is the language of science and engineering, and is used to model, analyze, and solve problems in these fields.

STEM education is an interdisciplinary approach to teaching and learning that integrates science, technology, engineering, and mathematics. It emphasizes an interdisciplinary approach to learning, where pupils are taught to see the connections and relationships between different subjects, and how they apply to real-world situations. Its purpose is to prepare students with the skills and knowledge needed to excel in the 21st-century workforce, where jobs are increasingly centered around these subjects. Early exposure to STEM subjects is crucial for all children, regardless of their backgrounds. These subjects help to develop important problem-solving, critical thinking, and analytical skills, which are essential for success in both academic and professional life. (Biancarosa & Griffiths, 2012). By focusing on these subjects, STEM education fosters creativity and curiosity in pupils.

In Nigeria, lower basic schools refer to the first three years of primary education, which is also referred to as primary 1 to primary 3. The Nigerian educational system is divided into six years of primary education, three years of junior secondary education, three years of senior secondary education, and four years of tertiary education. During the lower basic school years in the country, children typically start their primary education at the age of six and continue through to the age of eight. The curriculum at this level focuses on developing foundational skills in reading, writing, and arithmetic, as well as basic knowledge in other subjects such as science, social studies, and basic computer studies. The Nigerian lower basic schools also aim to instill moral and cultural values in children, as well as promoting social interaction and physical development through extracurricular activities such as sports, music, and drama.

Lunn, McIntosh and Mioduser (2020) pointed out that hands-on activities in STEM education have numerous benefits for lower basic pupils. Hands-on activities often involve real-world applications of skills and concepts, which help lower basic pupils to see the relevance and importance of what they are learning. They can appeal to different learning styles of pupils by providing opportunities for them to learn in ways that are more comfortable to them and that allow them to engage with the material in different ways. By incorporating hands-on activities into STEM education for lower basic pupils, teachers can make learning more engaging and effective, helping pupils to develop a love of learning and a deeper understanding of the world around them. Teachers can also increase learning through activities that make learning effective. These activities allow pupils to actively participate in the learning process, making learning more fun and memorable.

The availability and utilization of hands-on activities in STEM education can vary depending on a variety of factors such as the resources available to schools, the training of teachers in incorporating hands-on activities into their lessons, and the curriculum requirements set by educational authorities. In some schools, there may be a lack of funding or resources to purchase materials needed for hands-on activities. In these cases, teachers may have to rely on less expensive materials or find alternative ways to engage pupils in hands-on learning, such as using virtual simulations or online resources. Teachers play a



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critical role in promoting STEM education among lower basic pupils. They need to be trained to incorporate STEM concepts into their teaching practices and to use instructional strategies that are effective in engaging children in STEM learning. (National Academies of Sciences, Engineering, and Medicine, 2018).

However, the availability of hands-on activities in STEM education has been found to be limited, especially in lower basic schools. A study conducted by Johnson and Oludipe (2019) revealed that the availability of hands-on activities in primary schools was inadequate due to various factors such as lack of funding, limited access to materials, and lack of teacher training. Similarly, a study by Lee and Kim (2019) in South Korea found that the availability of hands-on activities in elementary schools was limited due to insufficient resources, lack of teacher training, and insufficient time. One of the gap that exist between the strengths and weaknesses of the availability and utilization of hands on activities in STEM education revolves around resources. While hands-on activities have the strength of engaging pupils and making learning tangible, the availability of materials, equipment, and resources can be a weakness. This means that some schools may lack the necessary materials and resources to support hands-on learning experiences, limiting the implementation and variety of activities.

Statement of the Research Problem

Hands on activities in STEM education among lower basic schools is often given little consideration compared to traditional instruction method. One major reasons are the lack of resources and infrastructure to support hands-on activities in STEM education (Anubi, 2023). Many schools in Nigeria lack basic resources such as laboratory equipment, computers, and internet connectivity, which makes it difficult for teachers to incorporate hands-on activities in their teaching. Another factor is the lack of training and professional development opportunities for teachers in STEM education (Ekueme, Okon & Ezenwa, 2015). Many teachers in Nigeria are not adequately trained in STEM subjects and are not familiar with hands-on teaching methods, which makes it difficult for them to incorporate such activities into their lessons. There is a concern about the availability and utilization of hands-on activities in STEM education for lower basic pupils. Despite the benefits of hands-on activities in promoting student engagement and understanding of STEM concepts, it is unclear whether schools have the necessary resources and support to implement such activities effectively. Additionally, it is unclear whether teachers have the training and knowledge necessary to utilize hands-on activities in their instruction. However, implementing hands-on activities in the classroom can be challenging, especially for lower basic pupils especially where the schools lack the necessary resources, such as materials and equipment, to conduct such activities and where teachers may not have the required training or needed knowledge to effectively incorporate hands-on activities into their instruction. Hence, this study examines the availability of hands-on activities and teachers' utilization of hands-on activities in STEM education among lower basic pupils in Ilorin metropolis.

Objectives of the Study

The main objective of this study is to assess the availability of resources and materials required for hands-on activities, as well as the extent to which teachers use these activities in their instruction.

The specific objective of the study was to:

- i. find out the availability of hands-on activities in STEM education among lower basic school teachers.
- ii. determine the extent of teachers' utilization of hands-on activities in STEM education in lower basic schools.
- iii. find out teachers' perceived challenges in the utilization of hands-on activities in STEM education in lower basic schools.

Research Questions

The following research questions were generated and guided the study:

- i. How available are hands-on activities in STEM education in lower basic schools in Ilorin Metropolis?
- ii. To what extent do teachers utilize hands-on activities in STEM education in lower basic schools in Ilorin Metropolis?
- iii. What are the challenges faced in the utilization of hands-on activities in STEM education in lower basic schools?

Methodology

The research design adopted for this study was descriptive survey design. Survey research design is a method used to collect information from sample of respondents in order to describe the characteristics of the respondents as it relates to variables under study. The study utilized questionnaire to collect information about availability and teachers' utilization of hand-on-activities in STEM education among lower basic pupils. The population of the study consists of all lower basic school teachers in Ilorin, Kwara State. Using multistage sampling technique, a sample of thirty public primary schools were randomly



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selected across the three local government in Ilorin metropolis at first stage, while at second stage, ten teachers were selected from each of the thirty public primary schools using simple random sampling technique. A total sample size of 300 lower basic school teachers was selected for the study. A self-constructed questionnaire titled: “Questionnaire on Availability and Teachers’ Utilization of Hands-on Activities in STEM Education (QATUHASTEME)” was used for data collection from the respondents. The instrument was a close-ended structured questionnaire. It was developed in line with four-point Likert scale of Strongly Agreed (SA) Agreed (A) Disagreed (D) and Strongly Disagreed (SD) in relation to the three research questions raised for the study. The questionnaire consists of two sections; section A contains personal data information of the respondents, while section B is made up of 30 items which were arranged into three parts. The first part contains items on availability of hand-on activities, second part had items on teachers’ utilization of hand-on activities in STEM education while the third part contain items on challenges in the use of hand-on activities in STEM education. The instrument was content validated by two experts in the area of Sciences Education and Educational Testing while Cronbach Alpha reliability method was used to establish the reliability index which yielded a value of 0.83. The data collected were analysed using descriptive statistics of mean and standard deviation to provide answer to the research questions.

Presentation of Results

Three research questions were generated and were answered with the use of mean and standard deviation. The results were presented below.

Research Question 1: How available are hands-on activities in STEM education in lower basic schools in Ilorin Metropolis? In order to ascertain the availability of hands-on activities in STEM education in lower basic schools in Ilorin Metropolis, mean response of the teachers to each item on availability of hand-on activities in the questionnaire were analysed, having four Likert scale format of Strongly Agreed (4 points), Agreed (3 points), Disagreed (2 points), and Strongly Disagreed (1 point). In other to have the bench mark, the average of the total point was calculated to be 2.5 (i.e. $4+3+2+1 = 10$: $10/4 = 2.5$). Therefore, any item with mean value above 2.5 stands for available and item with mean value below 2.5 means unavailable. The result is presented in table 1.

Table 1: Mean and Standard Deviation showing the Availability of Hands-on Activities in STEM Education among Lower Basic School Teachers



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S/N	Items	Mean	SD	Remark
1.	Hands-on activities are readily available for STEM education among lower basic pupils.	2.56	1.06	Agreed
2.	Hands-on activities in STEM education among lower basic pupils are incorporated to a great extent	2.55	1.11	Agreed
3.	Hands-on activities are effectively used by the teachers in enhancing the understanding of STEM concepts among lower basic pupils	2.98	1.09	Agreed
4.	School administration provides supports and resources for teachers to facilitate hands-on activities in STEM education among lower basic pupils	2.99	1.13	Agreed
5.	Teachers have the ability to confidently design and implement hands-on activities that align with STEM curriculum for lower basic pupils	2.88	1.04	Agreed
6.	Schools have access to the necessary materials and tools for conducting hands-on STEM activities.	2.81	1.17	Agreed
7.	There are adequate space in classrooms for students to engage in hands-on STEM activities, such as building models, conducting experiments, or working on projects.	2.87	1.24	Agreed
8.	Schools partnering with local science museums, technical companies to bring in resources on hands-on STEM experiences	2.61	1.14	Agreed
9.	Schools participate in STEM fairs, workshops and competitions that promote hands-on learning for students	2.58	1.15	Agreed
10.	Local community provide resources, volunteers, or mentorship opportunities to support hands-on STEM education.	2.53	1.19	Agreed
Weighted Mean		2.73		

Key: Disagreed = Mean < 2.50; Agreed = Mean > 2.50

Source: Field work, 2024

Table 1 above revealed the availability of hands-on activities in STEM education in lower basic schools in Ilorin Metropolis. It was evident from the results in the table above that the mean value of all the items were greater than 2.50. This revealed that teachers agreed to all the items on the availability of hands-on activities in STEM education. The weighted mean value of 2.73 which is greater than the benchmark of 2.50 indicated that hands-on activities in STEM education is available among the lower basic teachers in Ilorin Metropolis, Kwara State.

Research Question 2: To what extent do teachers utilize hands-on activities in STEM education in lower basic schools in Ilorin Metropolis?

In other to ascertain the extent to which the teachers utilize hands-on activities in STEM education in lower basic schools in Ilorin Metropolis, the total points of the respondents which was in continuous data were summed up for each respondent, thereby having a total minimum point of 10 and maximum points of 40. Hence, the range between the minimum and maximum total points is 30. This was categorized into three levels. The points between 10 - 20 is Low, 21 - 30 is Moderate, and 31 - 40 is High. Therefore, the summary of result on teachers' utilization of hands-on activities in STEM education among lower basic teachers in Ilorin Metropolis is presented in the table 2.

Table 2: Summary of the extent of Teachers' Utilization Hands-on Activities in STEM Education in Lower Basic Schools in Ilorin Metropolis.



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Range	Frequency	Percent	Remark
10 – 20	53	17.67%	Low
21 – 30	206	68.67%	*Moderate
31 – 40	41	13.67%	High
Total	300	100%	

Source: Field work, 2024

The above table 2 revealed that 53 (17.67%) of the respondents indicated low utilization of hand-on activities, 206 (68.67%) of the respondents had moderate utilization, while 41 (13.67%) respondents had high utilization of hand-on activities. This revealed that majority (68.67%) of the respondents showed that hands-on activities in STEM education are moderately utilized by the teachers in lower basic schools in Ilorin Metropolis.

Research Question 3: What are the challenges faced in the utilization of hands-on activities in STEM education in lower basic schools?

In order to find out the challenges faced in the utilization of hands-on activities in STEM education in lower basic schools, mean of responses of the teachers to each item on the questionnaire were analysed, having four Likert scale format of Strongly Agreed (4 points), Agreed (3 points), Disagreed (2 points), and Strongly Disagreed (1 point). In other to have the benchmark, the average of the total point was calculated to be 2.50 (i.e. $4+3+2+1 = 10$; $10/4 = 2.5$). The result is presented in the table 3.

Table 3: Mean and Standard Deviation showing the challenges faced in the Utilization of Hands-on Activities in STEM Education in Lower Basic Schools.



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S/N	Items	Mean	SD	Remark
1.	Lack of adequate resources for the implementation of hands-on activities	2.61	1.04	Agreed
2.	Challenges in aligning hands-on activities with the curriculum and learning objectives	2.58	1.09	Agreed
3.	Lack of confidence on the part of the teachers in facilitating hands-on activities	2.54	1.16	Agreed
4.	The cost of purchasing and maintaining materials for hands-on experiments and projects is prohibitive for schools.	2.91	1.14	Agreed
5.	Resources that are available are not enough for each student to actively engage in the activity.	2.88	1.04	Agreed
6.	Planning and preparing for hands-on activities can be time-consuming	2.71	1.13	Agreed
7.	Hands-on activities can lead to disorganized, noisy, or chaotic classrooms, making it challenging for teachers to maintain control.	2.77	1.04	Agreed
8.	Some hands-on activities, especially in science or technology, can present safety risks.	2.71	1.14	Agreed
9.	Teachers not receiving sufficient training on how to effectively teach using hands-on methods.	2.54	1.13	Agreed
10.	Teachers may lack the pedagogical knowledge to use these methods effectively.	2.63	1.09	Agreed
Weighted Mean		2.69		

Key: *Disagreed* = Mean < 2.50; *Agreed* = Mean > 2.50

Source: *Field work, 2024*

Table 3 above revealed the challenges faced in the utilization of hands-on activities in STEM education in lower basic schools in Ilorin Metropolis. From the teachers' response, it was revealed that the major challenges in the utilization of hands-on activities in STEM education in lower basic schools are; cost of purchasing and maintaining materials for hands-on experiments and projects is prohibitive for schools., resources that are available are not enough for each student to actively engage in the activity, hands-on activities can lead to disorganized, noisy, or chaotic classrooms, making it challenging for teachers to maintain control, planning and preparing for hands-on activities can be time-consuming, and some hands-on activities, especially in science or technology, can present safety risks. These were all ranked 1st, 2nd, 3rd, 4th, and 5th, respectively in accordance with their mean values from the highest to the least. The overall mean value of 2.69 which is greater than the benchmark means of 2.50 indicated that all the above items are the challenges facing the utilization of hands-on activities in STEM education in lower basic schools in Ilorin Metropolis.

Discussion of findings

It was revealed from the findings that hands-on activities in STEM education are available and moderately utilized by lower basic school teachers in Ilorin Metropolis. This was evident from the response of the lower basic school teachers, which made it known that hands-on activities in STEM education are available in lower basic schools. This is because teachers have found out that the use of hands-on activities in teaching lower basic school teachers have achieved better results, compared to traditional ways of teaching. More so, it was revealed from the findings that lower basic school teachers in Ilorin Metropolis moderately utilize hands-on activities in STEM education in schools. This was seen from the response of the teachers, which showed how lower basic school teachers actively utilize hands-on activities in STEM among lower basic pupils. This is because teachers have seen how their pupils react to the use hands-on activities in STEM education, thereby resulting to different beliefs that determined the extent of the teachers' utilization. This finding was supported by Ahmad, Hui and Ahmad (2019), Alsbaugh and Hartman (2015) and Gega (2018) who observed that hands-on activities in STEM education can be made very lovely and interesting for the children when they are being used by the teachers who always guide them during the activities. This tells us that active engagement by teachers enhances students' learning experiences and outcomes.

Additionally, it was shown from the response of the teachers that lower basic school teachers are faced with some challenges in the availability and utilization of hands-on activities in STEM education. This is because hands on activities takes much time in order to get it prepared. Major challenges that teachers face are cost of purchasing and maintaining materials for



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hands-on experiments and projects is prohibitive for schools., resources that are available are not enough for each student to actively engage in the activity, hands-on activities can lead to disorganized, noisy, or chaotic classrooms, making it challenging for teachers to maintain control, planning and preparing for hands-on activities can be time-consuming, and some hands-on activities, especially in science or technology, can present safety risks. In support of this finding, Dunn and Mulvenon (2009), Garelick and Sherman (2018), and Ekueme, Okon and Ezenwa (2015) asserted that these challenges are as a result of lackadaisical attitude of government and school owners towards the provision of adequate resources, incorporating hands on activities in STEM education in the curriculum, teachers' inability to manage time, or mix hands on activities with traditional ways of teaching because of inadequate time, and lack of knowledge of the concept that leads to lack of confidence on the part of teachers.

Conclusion

In conclusion, hands on activities in STEM education are available and utilized by teachers among lower basic pupils in Ilorin metropolis. These hands-on activities are unique and best for learning STEM education concepts when they are available and properly utilized by the teachers. Ultimately, hands on activities in STEM education advocates will be needed in order to promote the importance and benefits of hands-on activities in STEM education and early childhood professionals can become advocates for hands-on activities in STEM education for young children. So, therefore, hands-on activities in STEM education are available and utilized by teachers among lower basic pupils.

Recommendations

Based on the findings of this study, the following recommendations were made:

1. All stakeholders in the education sector should make sure that hands on activities are available and well utilized by teachers in STEM education among lower basic pupils.
2. Frequent supervision and monitoring should be encouraged in order to make sure teachers appropriately utilize hands on activities in STEM education among lower basic pupils.
3. Challenges facing the utilization of hands-on activities in STEM education can be resolved through different ways like proper allocation of time, teacher training programs, inclusion of hands-on activities in the curriculum, and motivation. Also, addressing these challenges may require a multi-faceted approach that includes professional development, adequate resource allocation, supportive policies, and collaboration among educators, administrators, parents, and the wider community.

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