IOJPE

ISSN: 1300 – 915X
www.iojpe.org

International Online Journal of Primary Education 2021, volume 10, issue 1

SCIENCING ACTIVITIES AND SCIENTIFIC SKILLS OF CHILDREN AT PRE-PRIMARY LEVEL IN NIGERIA

Eileen Oluwakemi AKINTEMI
Ph.D., University of Ibadan, Early Childhood Education Unit,
Department of Early Childhood & Educational Foundations, Nigeria
ORCID: https://orcid.org/0000-0003-0233-6504
eileen_akintemi@yahoo.com

Esther Abiola ODUOLOWU
Ph.D., University of Ibadan, Early Childhood Education Unit,
Department of Early Childhood & Educational Foundations, Nigeria
ORCID: https://orcid.org/0000-0001-5783-299X
omorinola2000@yahoo.com

Received: March 22, 2021 **Accepted:** May 15, 2021 **Published:** June 30, 2021

Suggested Citation:
Akintemi, E. O., & Oduolowu, E. A. (2021). Sciencing activities and scientific skills of children at pre-primary level in Nigeria. *International Online Journal of Primary Education (IOJPE), 10*(1), 106-118.

Abstract

Science is taught at the pre-primary level to foster scientific skills, essential for learning science at other levels of education. There is evidence that children are deficient in the scientific skills of observation, classification, communication, measurement, prediction and inference. This problem has been attributed to teachers' non-use of sciencing activities for children. This study was, therefore, carried out to determine the effects of sciencing activities (formal and informal) on pre-primary school children's scientific skills in Ibadan, Nigeria. The pretest-posttest control group quasi-experimental design was adopted. Three public primary schools were purposively selected from three Local Government Areas in Ibadan, Nigeria. An intact pre-primary class was used from each school, and randomly assigned to Formal Sciencing (17), Informal Sciencing (19) and Control (24) groups. Science Process Skills Rating Scale (r=.73) was used to measure the scientific skills of children before and after exposure to sciencing activities. Data was analysed using descriptive statistics, Analysis of covariance and Scheffe post-hoc test. There were significant main effects of treatment on children's scientific skills ($F_{(2, 57)}$=47.72; partial $\tilde{\eta}^2$=.65). Among the recommendations made was that sciencing activities should be adopted by pre-primary teachers to foster scientific skills of pre-primary school children.

Keywords: Sciencing activities, formal and informal sciencing activities, pre-primary science, scientific skills.

INTRODUCTION

Pre-primary education is essential for children's holistic development and wellbeing. In the Nigerian education setting, it is the one year education given to five year old children before they begin primary school (Federal Republic of Nigeria [FRN], 2013). Haque, Nasrin, Yesmin, and Biswas (2013) identifies the essence of this level of education as ensuring a smooth transition to the primary level of education and laying the foundation for lifelong learning. This period is considered the right time to expose children to meaningful science learning that will build the scientific skills needed at other levels of education. It is in recognition of this that the Nigerian Government has made one of the objectives of pre-primary education to be to foster scientific skills through the exploration of various objects in the environment (FRN, 2013).

Hernawarti et al. (2018) described scientific skills as thinking skills that teachers and children use while engaged in science related activities. Durham (2017) also described these skills as the process of doing science which for young children involves observation, communication, classification, measurement, prediction and inference. It has been established that scientific skills of children can only be developed when they are actively engaged in exploration and manipulation of objects in their environment (Suryanti, Ibrahim, & Lede, 2018; Andiema, 2016).

Oduolowu and Akintemi (2017a) observed that pre-primary school children in Ibadan, Nigeria learn science in abstraction without any form of active learning and experimentation, exploration and investigation. Pre-primary school children will not acquire scientific skills by just sitting down and listening to their teachers rather they acquire such skills through hands-on activities, inquiry, direct experience, experimentation, discovery and investigation is in line with children's nature as active learners.

This is why Yennizar, Eriyam, Susanti, and Kausari (2020) stressed that science teaching at the pre-primary level should not emphasise teaching children facts but should involve them in observation and manipulation of objects. The danger in teaching science in abstraction to pre-primary school children is that they are not adequately prepared for science at the primary level and other levels of education and teachers only concentrate on scientific facts thereby neglecting the development of the scientific skills in these children. Consequently, children who are not given the opportunity to be actively involved during science lessons will not develop these skills and will not be able to use the more complex integrated science process skills later in life.

However, the way children in Ibadan, Nigeria are learning is bereft of experiential/hands-on learning activities for children during science lessons as they do not explore, observe and experiment with materials (living and non-living) in their environment. Invariably, their lack of exposure to hands-on science activities has negatively affected the development of their scientific skills as they were observed by Oduolowu and Akintemi (2017b) to be deficient in the basic science process skills of observing, communicating, classifying, measuring, predicting and inferring. In other words, they have deficiencies in the skills of observing, classifying, communicating, measuring, predicting and inferring. For Nigeria to produce the next generation of scientists needed to make scientific advancements and to be globally recognised scientifically, pre-primary teachers need to go beyond the use of conventional teaching methods to those that will produce quality science education.

There is thus a dire need to use hands-on activities for pre-primary science which is not only developmentally appropriate, but can also be very effective in developing the process skills of young children. Sciencing activities allow children to observe, explore their environment, experiment with materials and discuss the results of their experiments with others as recommended in the one-year curriculum for pre-basic science activities (NERDC, 2013). Seefeldt and Galper (2007; 2017) defined sciencing as hands-on, brains-on endeavor for young children. Neuman (1972) defined sciencing as science related activities for young children and categorised the activities into three; formal sciencing, informal sciencing and incidental sciencing.

Lind (1999) observed that these activities differ in terms of who controls the choice of activity, the teacher or the child and stressed that for formal sciencing activities, the teacher chooses the activities for the child and gives some directions to the child's actions, for informal sciencing activities the child chooses the activity and action but the teacher intervenes at some point and for the incidental sciencing the child controls choice and actions. Formal and informal sciencing activities were of interest to this study because by nature both can be planned by the researchers in line with the Nigerian pre-primary curriculum that was used for this study. Neuman (1972) described formal sciencing activity as a type of sciencing whereby the teacher plans the lessons, prepares materials and guides children to explore with the materials and make discoveries.

Researchers have found that formal sciencing activities improve children's process skills. For instance, studies by Aydin (2020) and Raymond (2015) indicated that formal sciencing activities enhance the process skills of children. Despite the benefits of formal sciencing activities to children especially in the acquisition of scientific skills, Oduolowu and Akintemi (2017a) observed that many pre-primary teachers do not make use of sciencing activities in their classrooms. Moreover, there seems to be dearth of studies on the impact of formal sciencing activities on pre-primary science learning outcomes in Nigeria.

Another type of sciencing activity which was of interest to the investigators is the informal sciencing. According to Mayesky (1990) informal sciencing is non-directional, free investigation by a child. It is a type of sciencing activity whereby the teacher sets up a science corner and allows children to independently explore with science materials at the science corner (Neuman, 1972). Creating a science corner in the classroom allows children to freely explore and experiment with things kept in the science corner which can foster scientific skills, independence, curiosity and creativity in children. Studies have established that informal sciencing activities improve scientific skills of children. For instance, Murphy, Smith, and Broderick (2019) and Legoria (2012) reported that informal sciencing improved the process skills of children. While Colgrove (2012) reported that informal sciencing activities did not improve the process skills of children.

Despite these benefits of informal sciencing activities for children, Oduolowu and Akintemi (2017b) observed that many pre-primary classrooms in Ibadan, Nigeria have no science corners for children to carry out informal sciencing activities. Where there were science corners, the materials were not adequate. What was available in most of the corners were old cartons, there were no living things such as small animals, fishes and plants. Thus, pre-primary children in Ibadan Metropolis may grow up not to appreciate and love nature because they are not exposed to nature in their classrooms. Appreciation and stewardship of the natural environment has been identified as one of the 10 pillars of a good childhood (Association for Childhood Education International, 2012). It also, appears that the impact of informal sciencing activities on pre-primary science learning outcomes have not been explored by researchers Ibadan, Nigeria.

Another major problem with pre-primary teachers' non-use of active learning strategies is that it is not individually appropriate as it does not consider individual differences in children. According to Browne and Gordon (2009) teachers' understanding and considerations for each child's strengths, weaknesses and interests will help them to plan and provide learning activities that are adaptable and responsive to individual differences within a group of children. There are, therefore, certain individual differences in children that can affect the way they learn science. Martin (2001) identified them as; learning modalities, locus of control, learning style, gender bias, multiple intelligence and cultural/ethnic differences. Shrooti (2011) stressed that learning can only be effective when learners' individual differences are considered. In other words, science learning at the pre-primary level can only be effective when teachers take cognizance of individual differences of children in their classroom. However; gender and ethnic affiliation were of great interest to the investigators because they have been found by researchers to influence learning outcomes in language during the early years.

Ethnic affiliation determines what children already know about science (pre-existing knowledge) and how they respond to science or do science (Universal Basic Education, 2010; Martin, 2001). Some of children's weaknesses or misconceptions about science come from their socio-cultural beliefs. According to Chidiebere (2008) socio-cultural beliefs are already formed in the African child before they begin formal schooling and that there are so many socio-cultural beliefs in Nigeria that make it difficult for children to learn science because they are contrary to what science is all about. For example, thunder, lightning, rainbow, rain, sun, stars, moon, rivers, land, trees in the forest are all believed to have supernatural powers (Chidiebere, 2008). These beliefs can affect children's understanding of scientific concepts. Similarly, Luykx, Lee, Mahotiere, Lester, and Deaktor (2007) pointed out that children's linguistic characteristics may be inconsistent with the way in which science is taught in schools. Similarly, the linguistic characteristics of pre-primary school children in Nigeria may also interfere with their ability to learn science if the medium of instruction used is different from that of their ethnic affiliation especially when they do not understand the language. This interference will make it difficult for children to be involved in science activities as they will find it difficult to listen to instructions, express themselves or talk about their science experiences if the language that is used in the classroom is different from their home language.

Scholars have documented the influence of ethnic affiliation on scientific skills of children. For instance, Githinji (2011) observed that ethnic affiliation of children influences the science process skills of children. On the other hand, Duda, Susilo, and Newcombe (2019) observed that cultural background does not influence the science process skills of learners. As much as ethnic affiliation is important to the learning of science, it appears that nothing has been done on how ethnic affiliation influences science learning outcomes (science knowledge and process skills) at the pre-primary level in Nigeria. There is thus a need to examine whether the ethnic affiliation of children at the pre-primary level will influence learning outcomes in science (science knowledge and process skills) while they are carrying out sciencing activities.

For many years, gender has continued to play a significant role in science education globally. There still exists a wide gap between the females and males in terms of participation in science. According to the Soete, Schneegans, Eröcal, Angathevar, and Rasiah (2015) women constitute minority of the world's science researchers and in the Sub-Saharan region only 30.0% of the science researchers are women while the remaining 70.0% are men. The reason for this disparity could have stemmed from the gender stereotyping of the image of a scientist very early in life. Newton and Newton (2012) observed that children both boys and girls across many cultures view a scientist as a man in a laboratory coat. This stereotype if not addressed, could hinder female participation in science as girls would grow up feeling that they are not competent to learn science or science is meant for boys. Secondly, with the strategy used where there are no hands-on activities, girls may never be given the opportunity to try out things for themselves in order to discard this belief and gain confidence in their ability to do science.

Studies have being carried out to examine the influence of gender on science learning outcomes for young children. For instance, Simsar (2013) observed that gender influences children's performance in the science process skills. Similarly, Yuliskurniawati, Noviyanti, Mukti, Mahanal, and Zubaidah (2019) observed that gender influences the science process skills of learners at the senior secondary level. On the other hand, Ihejiamazu, Neji, and Isaac (2020) reported that the gender does not influence the science process skills of learners at the senior secondary level. These studies were not carried out in Nigerian pre-primary classrooms. Therefore, there is the need to examine how the gender of pre-primary school children will influence their science process skills while they are involved in sciencing activities.

Purpose of the Study

This study was carried out to determine the effect of sciencing activities (formal and informal) on the scientific skills of pre-primary school children in Ibadan and the moderating effects of ethnic affiliation and gender on the scientific skills of children.

Hypotheses of the Study

The following null hypotheses were tested in this study at .05 level of significance.

Ho1: There is no significant main effect of treatment on pre-primary school children's acquisition of scientific skills.

Ho2: There is no significant main effect of ethnic affiliation on pre-primary school children's; acquisition of scientific skills.

Ho3: There is no significant main effect of gender on pre-primary school children's; acquisition of scientific skills.

METHOD

This study adopted a pretest-posttest, control group quasi experimental design (Cohen, Manion, & Morrison, 2007). Purposive sampling technique was used to select three public primary schools in Ibadan, Nigeria based on the criteria that; the public primary schools have 5 year old children in pre-primary classes, teachers' willingness to participate in the study and parents' willingness to allow their children to participate in the study. The sample comprised 60 pre-primary school children selected from the three public primary schools and intact classes were used. The three schools were randomly assigned to formal sciencing, informal sciencing, control groups and intact classes were used. Formal sciencing group comprised 17 children, informal sciencing group comprised 19 children and control group comprised 24 children.

Research Instruments

Science Process Skills Rating Scale

Science Process Skills Rating Scale (r=.73) was used to measure the scientific skills of children before and after exposure to sciencing activities. It was designed by the researchers using the basic science process skills indicators by Padilla (1990). It was used to determine the performance of children in the process skills of observing, classifying, communicating, measuring, predicting and inferring using an Activity Guide for Hands-on Assessment of Science Process Skills and Science Process Skills Rubric. The rating scale is made up of two sections A and B. Section A contains the demographic data of the children. The items in this section are; gender and ethnic affiliation. Section B contains the indicators for each process skill and the level of performance for each skill. There are four levels of performance for this instrument (0=no performance, 1=moderate performance, 2=satisfactory performance, 3=excellent performance). To determine the reliability of the instrument; it was administered to pre-primary school children who did not participate in this study. Using test-retest method, the reliability coefficient of the Science Process Skills Checklist obtained was .73 using Pearson Product Moment Correlation.

Activity Guide for Hands-on Assessment of Science Process Skills (AGHASPS)

This instrument was designed by the researchers to guide the activities that were used to determine pre-primary school children's proficiency in the science process skills of observing, classifying, inferring, communicating, measuring and predicting before and after intervention. It is a hands-on assessment guide and the children were required do each of the activities specified for all the process skills to be assessed while the researchers or research assistant recorded their observation using the rating scale prepared for the hands-on assessment. There are specific process skills activities children must carry out to demonstrate their proficiency in each skill. It is made up of four columns; which are; serial number, materials to be used, activity and process skills to be assessed The hands-on assessment is the most suitable type of process skills assessment for pre-primary school children as multiple choice format of process skills assessment is not appropriate for young children. The content and face validity was established by experts in Early Childhood Education, Science Education and pre-primary school teachers who have taught this class for a minimum of five years. Necessary adjustments were made based on their recommendations.

Science Process Skills Rubric

This instrument was designed by the researchers to guide teachers' and research assistants' scoring of the Science Process Skills Rating Scale. It was used to determine specifically what children did to obtain the following marks indicated in the Science Process Skills Rating Scale; no performance (1mark), moderate performance (2marks), satisfactory performance (3 marks) and excellent performance (4 marks) using the activity guide for hands–on assessment of science process skills. For instance to determine children's performance in the process skills of observation, children were expected to utilise all the senses. A child was scored no performance or 0 mark when he/she could not utilise any of the senses, moderate performance when he/she can utilise at least two senses, satisfactory performance when he/she could utilise three senses and excellent performance when he/she could utilise all five senses. This instrument is made up of five columns which are; process skills indicators, no performance (1mark), moderate performance (2 marks), satisfactory performance (3 marks) and excellent performance (4 marks). Copies of the instrument were given to experts in Early Childhood Education and Science Education. Also, pre-primary school teachers who have taught this class for a minimum of five years were given copies of the instrument. They determined its content and face validity and the clarity of its items.

Procedure

This study lasted for nine weeks. Five scientific activities were selected for the study in line with the Nigerian pre-primary school curriculum. These activities are; exploring with living things, exploring with non-living things, sense organs, exploration of seeds, planting of seeds and exploring with sinking and floating objects. During the first week, a letter of authorization was collected from the Local Government Education office and presented to Head teachers of participating schools for permission to use their schools, staff and pre-primary children for the study. For ethical reasons, consent letters were written and given to parents of the children that participated in the study to give their consent.

By the second week, pre-primary teachers assigned to both formal and informal sciencing groups and research assistants were trained on how to teach science using formal and informal sciencing activities and to administer the Science Process Skills Rating Scale (SPSRS). By the third week all pre-primary school children in the experimental and control groups were exposed to pre-test where the researcher and research assistants administered Science Process Skills Rating Scale (SPSRS) in order to determine the comparability of the three groups and this phase lasted for one week. The treatment phase lasted for five weeks, the experimental groups were exposed to treatments (formal sciencing and informal sciencing) while the control group were exposed to the conventional strategy.

For the formal sciencing group the activities were as follows:

Step 1 (Sciencing Stage): The teacher plans the sciencing activities, prepares materials to be used for sciencing activities, and uses questions to activate children's prior knowledge. Children answer teacher's questions and make predictions before the exploration. Children watch short video on the lesson to be taught and answer questions. Both teacher and children sing science songs relevant to the topic and recite poems relevant to the science topic.

Step 2 (Sciencing Stage): Teacher guides children's explorations and documentation of science experiences. Children make their own discoveries, and document their discoveries in their science journal by drawing.

Step 3 (Post-Sciencing Stage): Children and teacher reflect on the science experiences and apply the knowledge gained into real life situations.

For the informal sciencing group the activities were as follows:

Step 1 (Pre-Sciencing Stage): The teacher provides science materials which are structured in line with all the lesson/activities that were carried out during this study in the science corner for children to explore. The teacher also provides short videos, songs and rhymes relevant to the lessons/activities at the science corner.

IOJPE
ISSN: 1300 – 915X
www.iojpe.org
International Online Journal of Primary Education 2021, volume 10, issue 1

Step 2 (Sciencing Stage): Children explore the materials in the science corner in whatever way they choose to, the teacher observes their exploration and gives them minimal support.

Step 3 (Post-Sciencing Stage): After exploration, the teacher finds out about children's discoveries by asking them questions and the teacher guides them to relate their experiences into real life situations.

For the control group the activities were as follows:

Step I: The teacher introduces the lesson to the children by asking questions.

Step II: The teacher teaches directly using chalk board.

Step III: Teacher asks children questions to see if they understand the lesson.

During the ninth week administration of post-test occurred across all groups.

Data Analysis

Analysis of Covariance (ANCOVA) was utilized to analyse the data collected. In order to determine the magnitude of the mean scores of each group, estimated marginal means aspect of ANCOVA was used. Also, to determine the sources of significant treatment effects observed on the ANCOVA, Scheffe Post-hoc analysis was used.

RESULT

$H_0$1: There is no significant main effect of treatment on pre-primary school children's acquisition of science process skills.

Table 1. Summary of analysis of covariance on pre-primary school children science process skills

Source	Type III Sum of Squares	Df	Mean Square	F	Sig.	Partial Eta Squared
Corrected Model	1404.512[a]	12	117.043	35.194	.000	.890
Intercept	234.785	1	234.785	70.598	.000	.576
Prescoreskills	142.769	1	142.769	42.930	.000	.452
Treatment	317.381	2	158.691	47.717	.000	.647
Gender	.465	1	.465	.140	.710	.003
Ethnic	22.463	1	22.463	6.754	.012	.115
treatment * gender	.298	2	.149	.045	.956	.002
treatment * ethnic	1,750	2	.875	.263	.770	.010
gender * ethnic	,127	1	.127	.038	.846	.001
treatment * gender * ethnic	12.108	2	6.054	1.820	.172	.065
Error	172.934	52	3.326			
Total	7190.000	65				
Corrected Total	1577.446	64				

a. R Squared = .890 (Adjusted R Squared = .865)

Table 1 shows that there is a significant main effect of treatment on children's science process skills ($F_{(2, 52)}$=47.72; p<.05; $\tilde{\eta}^2$=.65). Therefore, hypothesis 1 is rejected. To identify which of the three treatments have more effect on science process skills, Table 2 presents the estimated marginal means scores across the various groups.

IOJPE

ISSN: 1300 – 915X
www.iojpe.org

International Online Journal of Primary Education 2021, volume 10, issue 1

Table 2. Estimated marginal means of the science process skills across the three groups

Variables		Mean	Std. Error
Intercept			
	Pre-score process skill	5.28	-
	Post-score process skill	9.552	.292
Treatment			
	Exp. I (Formal)	13.21	.476
	Exp. II (Informal)	10.35	.464
	Control (Conventional)	5.11	.628

Table 2 indicates that the general performance of the children in science process skills at post-test level known as the post behaviour (Mean=9.55) is higher than their performance at the pre-test score (Mean=5.28) known as the entry behaviour. Again, the Table 2 shows that children exposed to formal sciencing (Experimental I) have the highest science process skills mean score (13.21), followed by those exposed to informal sciencing (Experimental II) (10.35) while those exposed to conventional strategy have the lowest science process skills mean score (5.11). The performance in science process skills across the groups are hereby presented in figure 1 as a bar chart.

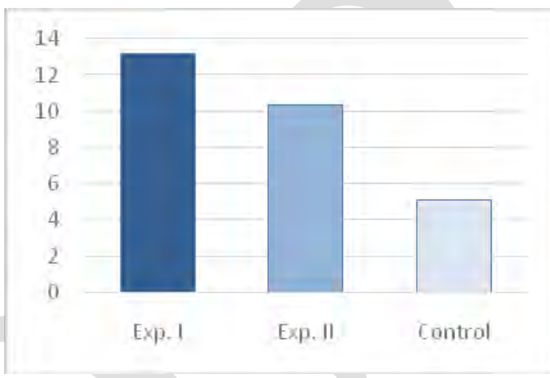

Figure 1: Performance of children in science process skills across the groups

Table 3. Scheffe' post hoc pairwise comparison on science process skills

Groups	Exp. I	Exp. II	Control
Exp. I		*	*
Exp. II	*		*
Control	*	*	

*Note, * implies that there is a significant difference*

Table 3 shows that the significant main effect that was revealed by Table 1 is as a result of the significant difference between:

i. Experimental I and Experimental II,
ii. Experimental I and control and
iii. Experimental II and control

This implies that formal sciencing enhances the children acquisition of science process skills significantly better than informal sciencing while informal sciencing is also significantly better than conventional strategy in enhancing the skills acquisition.

$H_0$2: There is no significant main effect of ethnic affiliation on pre-primary school children's science process skills.

Table 1 shows that there is a significant main effect of ethnic affiliation on children's science process skills ($F_{(1,\ 52)}$=6.75; p<.05; $\tilde{\eta}^2$=.12). Therefore, hypothesis 2 is rejected. In order to know which of the ethnic groups has the higher science process skills, estimated marginal means was performed and the summary is presented in Table 4.

Table 4. Estimated marginal means of children's process skills across ethnic groups

Variables	Mean	Std. Error
Science process skills		
Yoruba	10.33	.288
Non-Yoruba	8.70	.518

Table 4 shows that Yoruba children had significantly higher science process skills mean score (10.33) than non-Yoruba children (8.70). This performance is graphically represented in a bar chart as shown in figure 2.

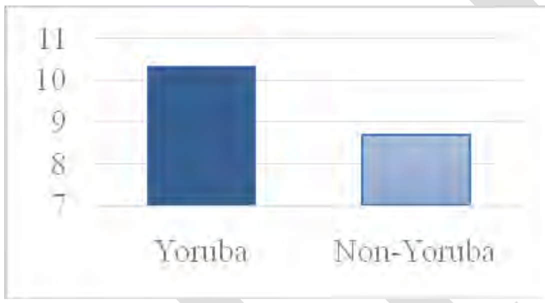

Figure 2: Children's science process skills across the ethnic affiliations

H$_0$3: There is no significant main effect of gender on pre-primary school children's science process skills.

Table 1 shows that there is no significant main effect of gender on children's science process skills ($F_{(1,52)}$=.14; p>.05; $\tilde{\eta}^2$=.00). Therefore, hypothesis 3 is not rejected.

DISCUSSION and CONCLUSION

The findings of this study indicated a significant main effect of treatment on pre-primary school children's science process skills. Children exposed to formal sciencing activities had the highest mean score, followed by children exposed to informal sciencing activities while children taught with the conventional strategy had the least mean score. This means that both formal and informal sciencing activities are more effective in fostering the acquisition of the science process skills of pre-primary school children than the conventional strategy. The reason for this could be attributed to the fact that children exposed to formal and informal sciencing activities were actively engaged in hands-on activities where they interacted with both living and non-living materials provided for them while children who were taught with the conventional strategy were not actively engaged in hands-on activities but they were taught science in abstract. Children's active engagement during sciencing activities helped them to see and manipulate materials and subsequently enhance their science process skills. This supports the assertions of Suryanti, Ibrahim, and Lede (2018) and Andiema (2016) that the science process skills of children can only be developed when they are engaged in experiential or active learning experiences that involve exploration and manipulation of materials.

This therefore explains why formal and informal sciencing activities were more effective than the conventional strategy. The significant main effect of sciencing activities on pre-primary school children's science process skills is in agreement with the findings of Raymond (2015) that sciencing activities improve the science process skills of children. Furthermore, the findings also showed that formal sciencing activities enhanced the science process skills of pre-primary children better than informal sciencing activities. This does not uphold the findings of Legoria (2012) that informal sciencing activities are more effective in fostering the science process skills of children than the formal sciencing activities. It was also established that children in the informal sciencing activities group performed better than children in the conventional strategy group. This is contrary to the findings of Colgrove (2012) that there was no significant difference between informal and conventional strategy in terms of the science process skills of pre-primary school children. The findings that formal sciencing activities mean score is higher than the conventional strategy mean scores corroborates the findings of Aydin (2020) that formal sciencing activities were more effective than the conventional strategy in the fostering of the science process skills of children.

The findings of the study also established a significant main effect of ethnic affiliation on pre-primary school children's science process skills. Yoruba children had significantly higher science process skills mean score than non-Yoruba Children. In other words, Yoruba children performed better than non-Yoruba children in science process skills. This finding could be as a result of the fact that the medium of instruction/communication used in this study was the Yoruba language as recommended in the National Policy on Education and majority of the children were Yoruba children. Therefore, non-Yoruba children found it difficult to communicate with and interact with peers and teachers while carrying out sciencing activities. The finding is in line with the assertions of Harlen (2014) that language particularly discussion and interaction with others plays an important role in the development of skills. This therefore explains why Yoruba children out performed non-Yoruba children in the science process skills. The significant effect of ethnic affiliation on pre-primary school children's science process skills is in congruence with the findings of Duda, Susilo, and Newcombe (2019) that ethnic affiliation of children influences their science process skills.

The findings of the study showed no significant main effect of gender on pre-primary school children's science process skills. This finding corroborates Yuliskurniawati et al. (2019) study outcomes which found no gender difference in the science process skills of children. However, this result is contrary to the study outcomes of Ihejiamazu, Neji, and Isaac (2020) and Simar (2013) which found gender difference in the science process skills of children. This could be because sciencing activities allowed both girls and boys be actively engaged in various activities therefore there were no disparities among both genders.

Conclusion

When pre-primary school children are exposed to formal sciencing activities where experiences/explorations are hands on, structured and are guided by the teacher, it fosters the scientific skills of children better than when they are exposed to informal sciencing activities that are not structured and are given little guidance by the teacher. It also fosters scientific knowledge and skills better than the conventional strategy. This is because formal sciencing activities are more directional, purposeful, intentional and interactive than informal sciencing activities and conventional strategy. The study has also established that ethnic affiliation can hinder pre-primary school children's science process skills especially when the medium of instruction is not their own language.

Based on the findings of this study the following recommendations are made:

- Pre-primary school teachers should adopt sciencing activities in fostering of scientific skills of pre-primary school children.
- All pre-service Early Childhood Education teachers at the Colleges of Education and the Universities should be exposed how to teach science at the pre-primary level using sciencing activities. This can

be done by incorporating and emphasising the use of sciencing activities when pre-service teachers in Colleges of Education are taught ECE 127 (Early Childhood Science) and when pre-service teachers in the Universities are taught the course science in the early years.

- Teachers should also make use of readily available materials in the immediate environment for sciencing activities to be carried out effectively in pre-primary classes.
- The rate at which children at the pre-primary level acquire science process skills when they are taught science in their own indigenous language also demands that children at that level should not be taught science in a language that they do not understand. However, in a situation whereby a teacher notices that some children in his/her class do not understand the language used as medium of instruction, he/she could make use of "Peer interpreters" that is a child or children in the class who understand both languages should be paired with another child who does not.
- Activity based science text books emphasizing sciencing activities and teachers' guides should be written and produced in at least the three major Nigerian languages for the pre-primary level of education.
- Workshops and seminars should be organized to train teachers how to teach science using sciencing activities.

The study is limited to pre-primary school children in Ibadan, Oyo state, Nigeria. The study determined the impact of sciencing activities on pre-primary science learning outcomes. In the course of the study some other constraints encountered were:

1. Transportation of both living and non-living instructional materials, audio visual materials and generator for the sciencing activities daily because there was no safe place to keep them was very tasking.
2. The outcome of the first planting experiment was not successful because the plants had to be locked in the classroom after school hours for fear of being damaged by touts and miscreants that take over the schools after school hours.
3. Technological issues with the generator and audio visual materials.
4. Teachers' carefree attitude towards the study posed some frustrations on the researchers and research assistants.
5. Children's lack of exposure to the science materials made them to damage the materials and be over excited.
6. Children in the informal sciencing group were more interested in watching the video than explore at the science corner.
7. Children from other classes also come to play at the science corner during break time and this caused distractions for the children in the informal sciencing group.
8. The living and non-living materials in the science corner distracted children from other class activities.

REFERENCES

Andiema, N. C. (2016). Effect of child centered methods on teaching and learning of science activities in pre-schools in Kenya. *Journal of Education and Practice, 7*(27), 222-288.

Association for Childhood Education International (2012). Ten pillars of a good childhood. August 6, 2017 retrieved from https://acei.org/decade-for-childhood.html

Aydin, G. (2020). The effects of guided inquiry-based learning implementations on 4th grades students and elementary teachers: A case study. *Elementary Education Online, 19*(3), 1155-1184.

Browne, K. W., & Gordon A. M. (2009). *To teach well: An early childhood practicum guide.* Upper-Saddle River, New Jersey: Pearson Education.

Chidiebere, D. B. (2008). *The effects of problem-solving strategy and lecture method on socio-cultural beliefs hindering science learning at the junior secondary school in FCT Abuja* (Doctoral dissertation), Ahmadu Bello University, Zaria.

Cohen, L, Manion, L., & Morrison, K. (2007). *Research methods in education*. 6th Edition. London: Routledge. p. 276-278.

Colgrove, A. (2012). Approaches to teaching young children science concepts, vocabulary and scientific problem-solving skills and role of classroom environment. January 01, 2021 retrieved from https://digitalcommons.unl.edu/cgi/viewcontent.cgi?referer=https://www.google.com/&httpsredir=1&article=1157&context=cehsdiss

Duda, H., Susilo, H., & Newcombe, P. (2019). Enhancing different ethnicity science process skills: problem-based learning through practicum and authentic assessment. *International Journal of Instruction 12*(1), 1207-1222.

Durham, J. (2017). Science process skills. Retrieved (August 26, 2020) from https://inventorsoftomorrow.com/2017/01/19/science-process-skills/

Federal Republic of Nigeria [FRN] (2013). *National policy on education*. 6th Edition. NERDC, Lagos.

Githinji, A. W. (2011). Pre-School children's performance in prediction and hypothesizing: A study of Isinya and Ngong divisions of Kajiado district, Kenya. Retrieved (September 1, 2020) from https://ir-library.ku.ac.ke/handle/123456789/1817

Haque, N., Nasrin, S., Yesmin, M., & Biswas, M. (2013). Universal primary education: a comparative study. *American Journal of Educational Research, 1*(1), 31-36.

Harlen, W. (2014). Helping children's development of inquiry skills. *Inquiry in Primary Science Education, 1*(1), 5-19.

Hernawati, D., Amin, M., Irawati, H., Indriwati E., & Omar, N. (2018). The effectiveness of scientific approach using encyclopedia as learning materials in improving students' science process skills in science. *Journal Pendidikan IPA Indonesia (JPII), 7*(3), 266-272.

Ihejiamazu, C., Neji, H., & Isaac, A. (2020). Correlates of Science Process Skills Knowledge among Senior Secondary II Biology Students in Cross River State, Nigeria. *European Journal of Scientific Research, 155*(3), 346-355.

Legoria, M. F. (2012). *An exploratory study of informal science learning by children ages 2-12 years at selected US children's garden*. (LSU Doctoral Dissertations). Louisiana State University, US. December 30, 2020 retrieved from https://digitalcommons.lsu.edu/cgi/viewcontent.cgi?article=4578&context=gradschool_dissertations

Lind, K. (1999). Dialogue on early childhood science, mathematics and technology education: Science in early childhood developing and acquiring fundamental concepts and skills. May 27, 2016 retrieved from http:// www.project2061.org/publications/earlychildonline/experience/lind.htm

Luykx, A., Lee, O., Mahotiere, M., Lester, B., & Deaktor, R. (2007). Cultural and home language influences on children's responses to science assessments. *Teachers College Record, 109*(4), 879-926.

Martin, D. J. (2001). *Constructing early childhood science.* Albany, NY: Delmar Thomson Learning.

Mayesky, M. (1990). *Creative activities for young children* (4th ed). Albany, N.Y: Delmar Publishers.

Murphy, C., Smith, G., & Broderick, N. (2019). A starting point: Provide children opportunities to engage with scientific inquiry and nature of science. Research in Science Education. April 4, 2021 retrieved from www.link.springer.com/content/pdf/10.1007/s11165-019-98250.pdf

Neuman, D. (1972). Sciencing for young children. *Ideas that work with young children*. K. R. Baker (ed), ideas that work with young children. National Association for the Education of Young Children Washington, DC

Newton, L. D., & Newton, D. P. (2012). Primary children's conceptions of science and the scientist: is the impact of a national curriculum breaking down the stereotype? *International Journal of Science Education, 20*(9), 1137-1149.

Nigerian Educational Research and Development Council [NERDC]. (2013). One year pre-primary school education curriculum. https://nerdc.org.ng/eCurriculum/

Oduolowu, E., & Akintemi E., (2017a). Analysis of science teaching practices of pre-primary teachers and children in Ibadan, Oyo State, Nigeria. A paper presented at the ToyinFalola International Conference in Africa and the African Diaspora (TOPAC) in conjuction with Adeyemi College of Education, Ondo, Nigeria. 3rd-5th July, 2017.

Oduolowu, E., & Akintemi, E., (2017b). Assessment of pre-primary science learning environment and pre-primary school children's performance in science process skills in Ibadan, Nigeria. A paper presented at the Aga Khan University Institute for Human Development Conference on Early Childhood Development Nov 7-9, 2017 at Der es Salaam, Tanzania.

Padilla, M. J. (1990). The science process skills. Research matters-To the science teacher, No. 9004. Reston, VA: National Association for Research in Science Teaching (NARST). http://www.narst.org/publications/research/skill.cfm

Raymond, C. (2015). *Professional development and family engagement program year one evaluation report*. Raymond Consulting, Inc.

Soete, L., Schneegans, S., Eröcal, D., Angathevar, B., & Rasiah, R. (2015). UNESCO science report: Towards 2030 – Executive summary. UNESCO Digital Library. Retrieved from https://unesdoc.unesco.org/ark:/48223/pf0000235407

Seefeldt, C., & Galper, A. (2007). "Sciencing" and young children. *Early Childhood Today, 21*(7), 12-13.

Seefeldt, C., & Galper, A. (2017). Professional development: "Sciencing" and young children. Retrieved May 6, 2017 from https://www.scholastic.com/teachers/articles/teaching-content/professional-development-quotsciencingquot-and-young-children/

Shrooti, S. (2011). Individual difference and educational implications-thinking intelligence and attitude. Retrieved Dec 31, 2020 from https://www.slideshare.net/Shrootishah/individual-differences-28706183

Simsar, A. (2013). *Turkish students' attitudes towards science in early childhood education*. (Doctoral dissertation). University of Dayton, US.

Suryanti, I., Ibrahim, M., & Lede, N. (2018). Process skills approach to develop primary students' scientific literacy: A case study with low achieving students on water cycle. The Consortium of Asia-Pacific Education Universities (CAPEU). IOP Conf. Series: Materials Science and Engineering 296 (2018) 012030 doi:10.1088/1757-899X/296/1/012030, p. 1-6.1 April, 2021 retrieved from https://iopscience.iop.org/article/10.1088/1757-899X/296/1/012030/pdf

Universal Basic Education (2010). *Manual for the re-training of basic education managers/inspectors and supervisors in Kwara State on UBE 2010*. Teacher professional development programmme.

Yennizar, Z., Eriyam, E., Susanti, W., & Kausari, D. (2020). Application of lesson study with scientific approach: A case study of early childhood education. *Journal of Critical Reviews, 7*(7), 104-111.

Yuliskurniawati, I., Noviyanti, N., Mukti, W., Mahanal, S., & Zubaidah, S. (2019). Science process skills based on genders of high school students. June 2019 Journal of Physics Conference Series 1241:012055 DOI: 10.1088/1742-6596/1241/1/012055. 4 April, 2021 retrieved from https://iopscience.iop.org/article/10.1088/1742-6596/1241/1/012055/meta