IMPROVING J.H.S 1 GIRLS' PERFORMANCE AND ATTITUDES IN WATER HOLDING CAPACITY OF DIFFERENT TYPES OF SOILS USING ACTIVITY METHOD

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Abstract:- The study sought to improve JHS1 girls' performance and attitudes towards water holding capacity of different types of soils concept using activity method. An action research was the design used for the study. A total sample size of 20 JHS 1 girls; with an average age of 12 years was used for the study. A purposive sampling procedure of the non-probability sampling technique was used to select the girls for the study. Tests and interview were the 2 instruments used for the study. Data were analyzed using quantitative and qualitative methods. Statistical package for social science (SPSS) version 17.0 for window was used for data analysis and Microsoft excel program was used to present the data pictorially into tables and bar-chart. It was revealed that girls' performance in water holding capacity of different types of soils concept had improved greatly after they have been exposed to the activity method intervention strategy. It was also observed that girls' negative attitudes towards the concept under study had changed positively after the implementation of the activity method intervention. It was recommended that stakeholders in science education and science teachers should use innovative and child-centered teaching strategies such as activity method intervention to help improve Basic school girls' performance and attitudes towards science in schools.

Keywords:- Improving, girls, performance, attitudes, water, holding, capacity, soils, activity method.

I. INTRODUCTION

One of the goals of science education is to develop each learner's ability to acquire knowledge in science and improve their conceptual understanding so as to solve numerous problems confronting the society (National Research Council, 1996). Therefore, it is the responsibility of the stakeholders in science education to provide these young learners or children with quality education and needed skills so that they become useful citizens in future in the society.

In Ghana, the Basic educational system consists of 2 years kindergarten; 6 years primary school and 3 years Junior High school (JHS). The primary school and JHS aspects of the Basic education system are compulsory for all children between the ages of 6-14 years.

According to (Amankwaah, 2014; Amoah, 2017) the Basic education aims at producing well-balanced individuals with the requisite knowledge, skills, values, aptitudes and attitudes to become functional and productive citizens for the total development and democratic advancement of the nation.

To achieve this laudable aim, the government of Ghana, through 1987 educational reform have introduced several subjects such as science, mathematics, English and many others developed for the Basic (primary and JHS) pupils to study (Ministry of Education (MOE), 2003).

Of all the subjects offered in the Ghanaian Basic schools, studies by (Mitchell Group, 2009; Buabeng, Owusu & Ntow, 2014) reported that science have been and continue to be difficult for JHS students resulting in poor and declining academic performance in the Basic Education Certificate Examination (BECE) and other external examinations such as Trends in International Mathematics and Science Study (TIMSS).

In a comparative study of Ghana's JHS 2 (grade 8) students' performance and that of other African countries in 2003, 2007 and 2011 TIMSS reports respectively; Buabeng, Owusu and Ntow (2014) revealed that although Ghana's JHS 2 pupils' achievement has shown some improvement, yet this achievement has been consistently poor relative to the TIMSS benchmarks since her participation in 2003. The study, concluded that Ghana's JHS 2 (grade 8) students' poor performance relative to other African countries gives some indications that Ghanaian Basic school pupils are not achieving at the levels expected when compared to pupils at comparable grade levels in different parts of the world; and as such there is the need to help improve these pupils performance in science.

The study, though not representative of the whole Basic school population in Ghana, paints a gloomy picture of the performance of JHS pupils in science in a typical Ghanaian JHS. A cursory glance at the JHS 1 science syllabus, one of the concepts in science that are important for students to learn, understand and appreciate how plants are able to grow well and produce better yields in certain types of soil than others in daily life is the "water holding capacity of different types of soil concept".

The water holding capacity of different types of soil concept has been part of the JHS curriculum for some years now (MOE, 2003); yet it is one of the concepts that most JHS students perceived it to be difficult to grasp and master it. Studies by (National Assessment of Educational Progress (NAEP), 2001; WAEC chief examiner's report, 2014) asserted that most JHS students especially girls have difficulties studying this concept, cannot relate it well in their daily life activities and also perform poor in it.

According to the WAEC chief examiner's reports (2014), most JHS students get confused when answering both practical and theory questions on this concept. The report attributed this difficulty to the lecture method often used by science teachers in teaching this concept.

In support of this statement, Shah and Rahat (2014) opined that the traditional lecture method of teaching science is very miserable and has resulted in rote learning among students and that the true understanding of concepts does not occur especially at primary school level.

According to (Rillero, 1994; p.1), "a child best learns to swim by getting into water; likewise, a child best learns science by doing science". Thus, children learn better when they touch, feel, measure, manipulate, draw, record data and when they find answers for themselves rather than being given the answer in a course book (textbook) or during lecture method.

Studies by (Lakshmi, 2005; Shah & Rahat, 2014) have reached conclusions that activity method of teaching is more effective in improving students' performance and attitudes in science in schools as compared to traditional lecture method of teaching.

Since activity method could be used to improve students' performance and attitudes towards science; it is against this background that this study was undertaken to help improve JHS 1 girls' performance and attitudes in the water holding capacity of different types of soil concept in science.

Statement of the Problem

Through series of interactions with the teachers and JHS 1 pupils of Assin Foso Methodist "A" Basic school, it was observed that JHS 1 girls perform poor when it comes to science as a subject. Series of discussions with the girls further revealed that they did not like science and that they have developed negative attitudes towards the study of science in the school.

A careful and critical assessment of the JHS 1 girls' school based assessment (SBA) records showed that none of them had an average pass mark of 50% in science during their previous end-of-term examinations as well as their class quizzes. Almost all the girls in the class performed badly in science; and if this trend does not change for better, then Ghana may lose future female scientists.

As stated in the introduction that, water holding capacity of different types of soil concept is one of the essential topics in Basic school science; and that most students especially girls have difficulties in understanding it and also answer questions on it due to the theoretical lecturer method often used by science teachers in teaching this concept. It is imperative that an innovative and child-centered approach should be used in teaching this concept to these young girls so as to improve their performance and attitudes towards the concept under study.

Numerous studies by (Turpin, 2000; Churchill, 2003; Lakshmi, 2005; Shah & Rahat, 2014) have recommended the use of activity method intervention teaching approach to improve Basic school students' (girls') performance, attitudes and interests in science.

It is in the light of this that the study was carried out to improve Assin Foso Methodists "A" JHS 1 girls' performance in water holding capacity of different types of soils concept using activity method and thereby develop their attitudes towards science.

Purpose of the Study

The study sought to improve JHS1 girls' performance and attitudes in science with regards to teaching and learning of water holding capacity of different types of soils concept using activity method. Specifically, the study intends:-

1) To evaluate the impact of activity method in improving girls' performance in water holding capacity of different types of soil concept using activity method.
2) To assess girls' attitudes towards the teaching and learning of water holding capacity of different types of soils concept using activity method.

Research Questions

The following two (2) research questions were formulated to guide the study.

1) How does the use of activity method help in improving girls' performance in water holding capacity of different types of soils concept using activity method?
2) What are the girls' attitudes towards the learning of water holding capacity of different types of soils concept using activity method of teaching science?

II. REVIEW OF RELATED LITERATURE

This aspect of the study seeks to review related literature associated with this study. The review was done briefly under impact of activity method in teaching and learning of science and students' attitudes towards science.

Impact of Activity Method in Teaching and Learning of Science

Suydam and Higgins (1977) define activity-based learning (ABL) or activity-based teaching (ABT) as the teaching and learning process in which student is actively involved in doing something. Several pioneer studies by (Churchill, 2003; Lakshmi, 2005; Shah & Rahat, 2014) reached conclusions that activity method is more effective to teach science and mathematics in schools as compared to traditional method of teaching these subjects.

In a study, Lakshmi (2005) revealed that students who received instructions in ABT performed significantly better in academic achievement in mechanics than the students who did not received instruction in traditional lecture method.

In a similar study, Harfield, Davies, Hede, Panko and Kenley (2007) opined that students who were exposed to activity method had better performance in the achievement test than their control counterparts in the study of the same scientific concept.

In a recent study, Shah and Rahat (2014) concluded that students who were exposed to the ABT performed better in knowledge, comprehension, application and skills development of a given scientific concept than the control group in the same levels of domains.

It is obvious that literature is full of enough evidence for positive impact of activity method of teaching and learning. It must therefore, be explored to broaden the scope of knowledge.

Students' Attitudes Towards Science

Attitudes are important considerations in learning science. Many researchers posited that learners' attitudes toward subject matter, especially science and mathematics are as important as achievement (Cognition and Technology Group at Vanderbilt (CTGV), 1992; Sedighian & Sedighian, 1996). With science, this linking of attitudes to achievement can be of particular importance because many studies reported that, students have poor attitudes towards science and mathematics when they enter science/mathematics related courses (Gal & Ginsburg, 1994; Sedighian & Sedighian, 1996).

According to (Lehman, 1987) students' attitudes towards science can determine the likelihood of continued study and perseverance of science. Conversely, poor students' attitudes towards subject can result in bad learning and poor performance in the subject's areas (Gal & Ginsburg, 1994).

In a study, Hodson (1990) posited that activity method was perceived by the respondents as an enjoyable and effective form of learning of almost all the major U.S science curriculum reforms of the late 1960s and early 1970s.

In another study, Churchill (2003) revealed that ABT or ABL helps learners to construct mental models that allow for "higher-order" performance in problem solving in science and also developed positive attitudes towards science among students. In a recent study, Bilgin (2006) indicated that activity method help to develop students' attitudes towards science positively.

III. METHODOLOGY

Research Design

The design used for this study was an action research. The rationale for using this design was that the study sought to address problem of JHS 1 girls' difficulties in understanding water holding capacity of different types of soils concept and thereby help improve their performance and attitudes towards the scientific concept. This design was used because it can be adjusted to meet every situation which helps in getting the accurate results needed. On the other hand, this design has a weakness of making the study very cumbersome.

Sample and Sampling Procedure

The total sample size for the study was twenty (20) JHS 1 girls of the selected school. The ages of the girls in the class ranged between 11-14 years; with an average age of 12 years. A purposive sampling procedure was used to select the JHS 1 girls for the study. This is because the JHS 1 girls had difficulties in learning the water holding capacity of different types of soils concept and had developed negative attitudes towards the concept under study.

Research Instruments

The study used both quantitative and qualitative data-gathering instruments. Test and interview were used to collect data from the respondents. Two (2) sets of tests called pretest and posttest were constructed based on the concept under study and used to collect data from the respondents. The pre-test was used to collect data prior to the implementation; whereas post-test was used after the implementation of the intervention activities. Girls' Interview Scheldule (GIS) was used to collect data from the girls during the interview sessions.

Validity and Reliability of the Instruments

The questionnaire and interview items were designed, scrutinized and presented to two (2) senior lecturers at the science education department of the University of Education, Winneba for their comments and improvement of the items. Reliability of the instruments was established by test retest reliability method; and the reliability analysis showed that the designed instruments were reliable and could be used for the study.

Data Collection Procedure

For effective data collection, permission was sought from the school authorities, teachers and the pupils to carry out the study in the school. Data collection was done in an orderly manner within a period of two weeks (January 15th to 29th 2018). Data collection was carried out in 3 stages namely pre-intervention stage, intervention stage and post-intervention stage; and these stages have been described extensively below;

Pre-Intervention Stage

To find out each girl's performance prior to the start of the intervention, 30 minutes pre-test was conducted for the 20 girls. After the 30 minutes, the pretest papers were collected, marked, scored and recorded. The scores obtained in the pretest were not good and therefore, researchers decided to intervene in the situation using activity method.

Intervention Stage

The head teacher, assistant head and researchers met to deliberate on the problem at hand. During the deliberations, it came to light that teachers should motivate the girls to participate in science lessons and that science teaching should be of activity-based lessons.

With regards to lack of girls' negative attitudes in studying science, the researchers took the girls through several activity-based interventions. Female resource persons and role models were invited to school to talk to the girls and also motivate them.

Field trips were also organised for the girls to visit female domineering industry and institutions. Guidance and counselling committee was set up to give special guidance and remediation courses in science for the girls which worked effectively.

On the issue of JHS 1 girls' poor performance in science, the researchers designed activity method intervention strategies and used it to teach some selected topics in science with pivotal attention on the water holding capacity of different types of soils concept as follows;

Lesson's objectives:-

By the end of the lesson, the pupils will be able to explain and demonstrate the water holding capacity of clay, loamy and sandy soils.

Teaching and Learning Materials:-

3 plane glasses used as measuring cylinders; soil samples (clay, loamy and sandy soils), 3 funnels, 3 pieces of white cloths, cotton wool and water.

Teaching and Learning Activities:-

Activity 1:- Pupils were put into 3 groups of 6 by the researchers with each group having three (3) graduated glass containers labelled A, B & C as shown in Figure 1 below:

Activity 2:- Pupils were made to place pieces of white cloth and cotton wool into each of the funnels and placed each of them into open end of the containers A, B & C and held firmly with clamps.

Activity 3:- Pupils were made to collect 3 soil samples (loamy, sandy & clay) and placed them on top of the cotton wool in each of the funnels such that container A's funnel takes clay soil; container B's funnel takes loamy soil and container C's funnel takes sandy soil as illustrated in Figure 1 below:

Activity 4:- Pupils were made to pour about 20cm^3 of water onto each of the funnel containing the different type of soil and leave it the set-up for about 2 days; with close observations each day.
Activity 5:- Each group were asked to present their observations after the 3rd day for class discussion.
Activity 6:- Though extensive discussion and brainstorming strategies, the girls realised that, clay soil in funnel A has the highest water holding capacity; followed by loamy soils in funnel B and the least soil sample was sandy soil in funnel C.

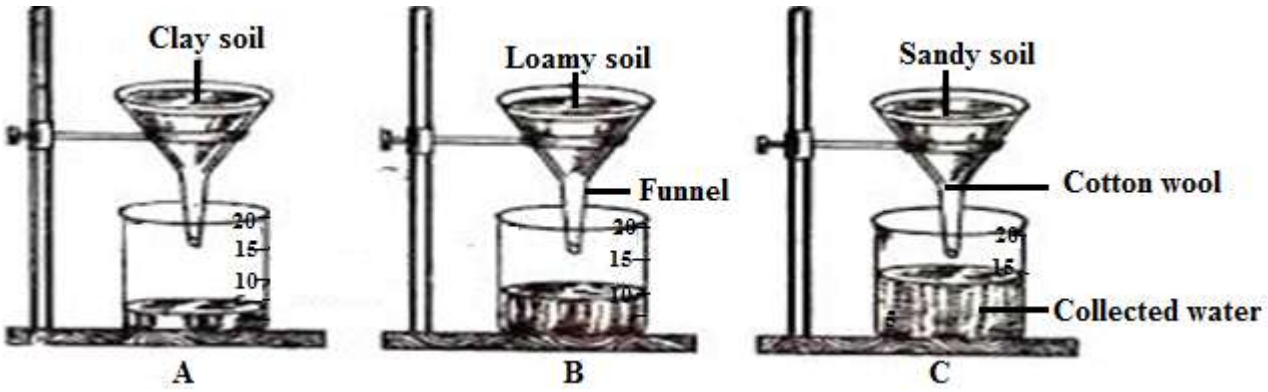

Figure 1: Investigating into water holding capacity of clay, loamy and sandy soils.

Conclusion:- The girls realised that clay soil has compact particles, so water cannot drain through it easily; hence, about 5cm^3 of water pass through it. Again, loamy soil has very good spaces in between the particles, so moderate amount of water (about 10cm^3) pass through it. Also, sandy soil has very porous particles; hence, large amount of water (about 15cm^3) pass through it easily (see water levels in containers A, B & C) in Figure 1 below).
Application:- Through the activity method intervention, the girls realised that the best soil for planting crops is loamy soil, since it has the best water holding capacity than clay and sandy soils.

Post-Intervention Stage

After the intervention, 30 minutes posttest was conducted for all the 20 girls under strict but relaxed supervision. After the 30 minutes, the papers were collected, marked, scored and recorded.

After the post-test, a face-to-face interview session was conducted for the girls in their classroom using GIS (girls' interview schedule). The interview lasted for 4-10 minutes for each girl.

Data Analysis Method

The study used both quantitative and qualitative data analysis method. Data from the tests were analysed quantitatively using descriptive statistics such as frequency and percentages. Data from interview schedule were analysed quantitatively and qualitatively.

Statistical Package for Social Sciences (SPSS) version 17.0 for windows was used for analysis and Microsoft excel program was used to present the data graphically into tables and bar-graph.

IV. RESULTS AND DISCUSSION

Analysis of the Results

Test and interview schedule were used to collect data from 20 JHS 1 girls. Data obtained from the 2 instruments were analysed and used it to answer the 2 research questions that guided the study.

Research Question 1: How does the use of activity method help in improving girls' performance in Water holding capacity of different types of soils concept using activity method?

In answering research question 1, girls' scores in both pre-test and post-test were analysed quantitatively using frequency and percentage and are presented in Table 1:

Table 1: Comparing Girls' Pre-Test and Post-Test Scores

Pre-Test Scores			**Post-Test Scores**		
Marks	Frequency	Percentage	Marks	Frequency	Percentage
0	5	25	0	0	0
1	3	15	1	1	5
2	4	20	2	1	5
3	3	15	3	2	10
4	3	15	4	0	0
5	1	5	5	2	10
6	1	5	6	2	10
7	0	0	7	2	10
8	0	0	8	5	25
9	0	0	9	3	15
10	0	0	10	2	10
Total	**20**	**100**	**Total**	**20**	**100**

Source: (Pupils' pre-test & post-test scores, 2018)

Data in Table 1 shows that as many as 18 girls representing 90% failed the pre-test by having scores below 5 marks; whiles only 2 girls representing 10% passed the pre-test by scoring above 5 marks in the same pre-test.

On the other hand, majority (16 out of 20) of the girls representing 80% passed the post-test by having scores above 5 marks; whiles only 4 girls representing 20% failed the post-test by scoring below 5 marks.

The data obtained in Table 3 have been presented in pictorially in a bar-chart as shown in Figure 2 below;

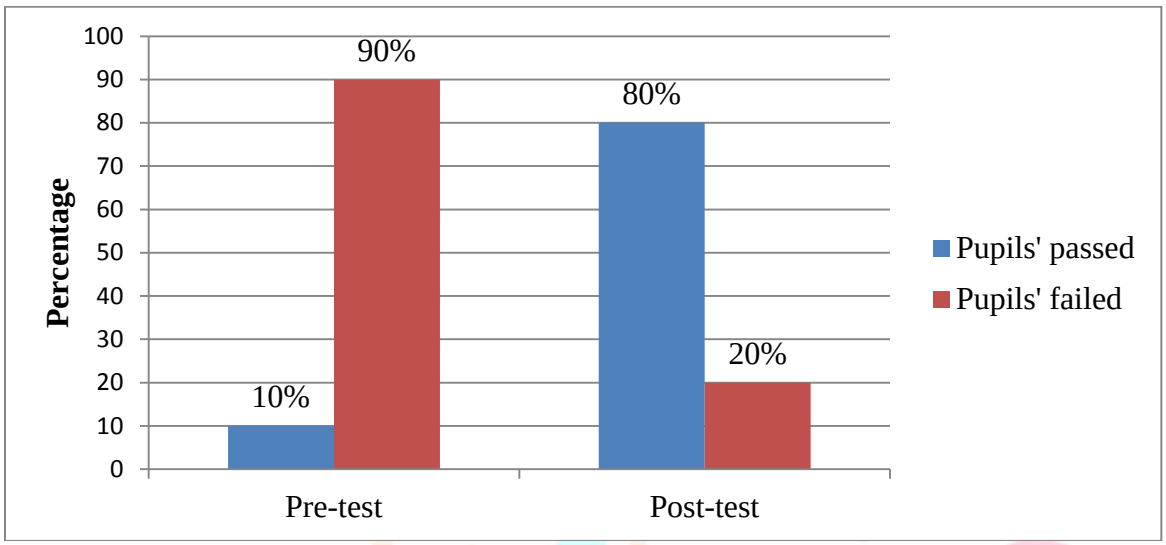

Figure 2: Comparing girls' pre-test and post-test scores in percentages.

In comparing girls' the tests scores, it was found out that the girls performed better in the post-test (after the intervention) than in the pre-test (before the intervention). This better performance might be attributed to the activity intervention that was implemented in the class for the JHS 1 girls.

Research Question 2: What are the girls' attitudes towards the learning of water holding capacity of different types of soils concept using activity method of teaching science?

In answering research question 2, the respondents' responses to girls' attitudes towards the teaching and learning of water holding capacity of different types of soils concept in the GIS were analysed and are presented in Table 2 below.

Table 2: Girls' Attitudes Towards Activity Method of Teaching Science Concept

No.	Items on attitudes	Yes (%)	No (%)	Total (%)
1).	Do you like science subject before the implementation of the activity method intervention?.	3 (15)	17 (85)	20 (100)
2).	Do you like the way activity method intervention was used in your class to teach water holding capacity of soil types?.	19 (95)	1 (5)	20 (100)
3).	Do you like science as a subject after the implementation of the activity method intervention?	20 (100)	0 (0)	20 (100)

Source: (Girls' Interview Schedule, 2018)

From the responses in Table 2, it is clear that JHS 1 girls' attitudes towards science before the implementation of the intervention were not good. For example, as many as 17 girls representing 85% indicated that they dislike science before the implementation of the activity method intervention whiles only 3 girls representing 20.0% disagreed to the same statement.

When asked whether they liked the way activity method intervention was used to teach water holding capacity of soil types; 19 girls representing 95% responded "Yes" whereas only 1 girl representing 5% responded "No". On the issue of whether they liked science after the implementation of the activity method intervention; all the 20 girls representing 100% unanimously agreed to the statement with "No" response from the girls to the same question item.

During the interview session, all the interviewees were of conviction that, the activity method intervention approach was very good because their performance and their attitudes had improved greatly. The unanimous response is captured in the words below:

> *"The activity method has helped us improved our understanding in this concept. At first, it was very difficult for us. But, our performance and attitudes towards this concept have greatly improved. Our negative attitudes towards this concept have changed for better. We now like this concept. We want our lessons to be taught with more of activity method than the usual lecture method".*

This statement confirms the positive impact of the use of activity method intervention in teaching scientific concept to girls having poor performance and negative attitudes towards science.

Discussion of the Results

It was revealed that girls performed better in the posttest than in the pretest. This better performance might be due to the activity method intervention that was implemented. The activity method intervention helped to organise the girls' conceptual structure in a particular way to aid in better conceptual understanding of the concept taught, hence the better performance in the posttest results. This finding is in support with the results of pioneer researchers (e.g. Harfield, Davies, Hede, Panko & Kenley, 2007; Shah & Rahat, 2014) that students who were exposed to the activity based teaching performed better in knowledge, comprehension, application and skills development than the control group in the same domains.

It was also observed that all the 20 girls representing 100% unanimously indicated that they liked science after the implementation of the intervention activities. This means that the girls had developed positive attitudes towards the scientific concept. This finding is in support with the result of (Churchill, 2003; Bilgin, 2006) that activity method help students to develop students' attitudes towards science positively.

Finally, one significant finding from this study was that all the girls were pleased with the activity-based teaching method intervention used to teach them the water holding capacity of different types of soils concept and that they were of the opinion that science teachers should use activity method in teaching science to them. This finding is in consonance with the results of (Hodson, 1990) that activity method was perceived by the respondents as an enjoyable and effective form of learning of almost all the major U.S science curriculum reforms of the late 1960s and early 1970s.

V. CONCLUSIONS

Based on the key findings; the following conclusions were made;

1) It can be concluded that girls exposed to the activity-based teaching (ABT) approach performed better and retained greatly the scientific concept taught. The study therefore yields considerable argument in favour of using ABT of science concept to girls.
2) It can also be concluded that girls exposed to the ABT and ABL intervention developed positive attitudes towards the concept taught. All the 20 girls unanimously stated that they liked science and that their negative attitudes towards science had changed after the implementation of the activity method intervention.
3) Lastly, it can be concluded that all the girls were pleased with the ABT intervention and they were of the opinion that science teachers should use ABT in their teaching.

Recommendations

Based on the key findings and conclusions drawn, it is recommended that: -

1) Stakeholders in science education and science teachers should use innovative and child-centered teaching strategies such as activity method intervention to help improve Basic school girls' performance and attitudes towards science in schools.
2) Basic school girls should be guided and counselled to change their negative attitudes science and thereby develop positive attitudes towards science.

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