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USING ACTIVITY METHOD TO TEACH SECOND YEAR DIPLOMA STUDENTS SELECTED TOPICS IN BIOLOGY: A CASE OF ST. MONICA'S COLLEGE OF EDUCATION, MAMPONG

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ABSTRACT: *The purpose of the study was to use the constructivist teaching and learning approach to teach Biology. Four research questions were set to guide the study and the design adopted for the study was a case study. Questionnaire was the instrument used to collect data from one hundred and twenty three students for the study. The research findings helped to conclude that the activity method of teaching Biology helps to improve learning, learning of Biology content had improved and generally the result show that student have positive attitude towards Biology. The result further indicated that activity method of teaching motivates the teacher trainees to learn science.*

KEYWORDS: Activity method, Biology, science, students, College of education

BACKGROUND TO THE STUDY

Nowadays, many research studies are based on the constructivists' teaching and learning theory of how students construct their own knowledge through activities or experiences. Social constructivists believe that knowledge construction is the basis of social interactions; such interactions include sharing ideas, comparing and debating ideas among students, and between students and teachers (Driver, Asoko, Leach, Mortimer & Scott, 1994).There are a number of constructivist-based research that illustrate the pedagogical knowledge needed to help students learn effectively and meaningfully in science context such as laboratory activities, inquiry-based learning, concept mapping and problem-based learning (Novek, 2002; Wallace, Tsoi, Calkin, & Darley, 2003). Laboratory activities are considered by many authors as important in teaching and learning science concepts (Hofstein & Lunetta, 2004). Practical work provides a wealth of benefits in learning science. Students are led to interact with material and/or with a model to observe and understand science concepts through individual and/or group learning (Hofstein & Lunneta, 2004). However, Abraham (1998) and Clark (1994) say that a hands-on laboratory experience is not enough but rather, assists students participate to have hands-on in laboratory during lessons. In addition it also help student develop science process skills and promote a positive attitude toward science (Hofstein & Lunneta, 2004). The approach to the teaching and learning of science in Ghana today does not vary from the repeated actions where the teacher is the main source of ideas, facts and information and learners are recipient of the information (Beach & Reinhats, 1989).

Statement of the Problem

Students often have difficulty in understanding the following topics; food chain, transpiration, photosynthesis and osmosis. Generally students learn these topics by rote method and perform traditional experiments by following a cookbook style laboratory manual. Hands-on activities and

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experiments can assist students to develop an understanding of these topics since they will acquire process skills through an instructional model based on the activity method. This will go a long way to help them when they embark on their teaching practice because they will obtain the needed skills and knowledge. For this reason, food chain, transpiration, Photosynthesis and osmosis are the selected topics that the researcher has decided to look at in this research.

Research Questions

This study answered the following four research questions:

1. To what extent can the activity method of teaching and learning improve the teacher trainees' performance in science?
2. How will the use of activity method of teaching and learning enhance teacher trainees' content knowledge in science?
3. How will the use of activity method of teaching and learning enhance the teacher trainees' attitude towards science?
4. To what extent will the use of activity method of teaching and learning motivate teacher trainees to learn science?

LITERATURE REVIEW

Teaching and Learning in the Science Classroom

Some science teachers teach science as lists of facts to be memorized (Pines & Leith, 1981). Students learn science content in school by studying a textbook that reports the conclusions of what scientists have learned over the decades. The focus of this kind of instruction is on what scientists know (Donovan & Branford, 1999). According to Schwab (1964), science had been taught as rhetoric of conclusions, a presentation of facts already known, so students often fail to integrate the content of one science with another. Similarly, asking students to follow the steps of the scientific method is not sufficient to help them develop the knowledge, skills, and attitudes that will enable them to understand what it means to do science and to participate in the larger scientific community (Donovan & Branford, 1999).

Learning therefore, is a purposive activity on the part of the student and requires active engagement. Individuals' existing conceptions influence the meaning they construct in a given situation (whether lecture, demonstration, or practical activity), and what is learned results from an interaction between the student's present conceptions and the various linguistic and sensory experiences provided (Scott & Driver, 1998). Appleton (1997) noted that the main tenet on constructivist theories is that existing ideas which learners may hold are used to make sense of new experiences and new information. Learning science is a dynamic process of shaping and reshaping thoughts based on new knowledge and experiences. It is the creative, ongoing synthesis of observations, reflection, and information about the physical and social world (Hammerman, 2006). Vygotsky's (1978) conceptual change pedagogy is a view of learning that recognises student's science learning as making sense of new information based on prior experiences and ideas.

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Clary and Wanderse (2007) stated that conceptual change most likely occur via students' metacognition about their activities. Educating students about science is thus considered to scaffold the fluent integration of thinking, feeling, and acting. Pedagogical strategies are important for supporting students in the process of construction, reflection on, and evaluation of ideas; in other words, instructional activities are mediated in the science classroom (Scott & Driver, 1998). Johnson (2007) mentioned that teachers should utilize effective teaching strategies to ensure conceptual understanding of science.

Good teachers' help students learn meaningfully to achieve quality over quantity, meaning over memorization, and understanding over awareness (Mintzes, Wanderse, & Novak, 1998). Donovan and Branford (1999) suggested that the science classroom should be learner- centered, knowledge-centered, assessment-centered, and community-centered which is a useful framework to employ in the design of instruction. The learner-centered classroom encourages attention to preconceptions, and offers instruction on what students think and know. The knowledge- centered classroom focuses on what is to be taught, and what mastery looks like. The assessment-centered classroom emphasizes the need to provide frequent opportunities to make students' thinking and learning visible as a guide for both the teacher and the student in instruction and learning. The community-centered classroom encourages a culture of questioning, respect, and risk taking.

Assessment is one of the key roles in teaching and learning science. Gioka (2007) mentioned that assessment for learning is any assessment for which the first priority in its design and practice is to promote learning. Assessment methods can be categorized into two major uses: Summative and formative (Branford, Brown, & Cocking, 1999). Summative assessment measures which students have learnt at the end of set of learning activities (Branford, Brown, & Cocking, 1999; Donovan & Branford, 1999). In contrast, formative assessments focus on opportunities for students and teachers to use feedback to revise their thinking (Donovan and Branford, 1999).

The central aspect of effective science teaching and learning in the twenty-first century is the activity-based teaching and learning which is based on the constructivist approach as the primary vehicle for students to develop meaningful understandings of key science concepts as well as learn about the nature and the process of science (Appleton, 1997; Dunkhase, 2003). It is generally accepted that achieving functional scientific literacy involves providing people with an understanding of science that they can use as they make decisions and engage in debate about scientific and technological issues outside formal educational settings (Irez, 2006). In addition, Matthews (1998) noted that it has been hoped that science teaching would have a beneficial impact on the quality of culture and personal life by virtue of students not only knowing science, but also by internalizing something of the scientific spirit, and knowing and appreciating something of the nature of science.

Group Learning and Cooperative Learning in Science Practical Classes

The key role of the instructional strategies based on cooperative learning is to encourage students to work together to accomplish the shared goals (Killen, 2007). Cohen (1994) points out that cooperative learning involves students learning by working together in small groups to accomplish shared goals. It is widely recognized as a teaching strategy that promotes socialization and learning among students. Lazarowitz and Hwrts-Lazarowitz (1998) indicated that cooperative learning

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methods are integrated into science classrooms and laboratories in an attempt to enhance students' learning within a peer context, based on a constructivist learning and teaching approach. Cooperative learning assists students in identifying their prior knowledge and helping to reconstruct understanding and not simply to receive information (Killen, 2007). Hufford (1991) mentioned the redesign of laboratory exercises into sets of activities help students to cooperate in their tasks and then exchange results with other groups. An activity-based learning approach is a fruitful strategy for students to learn science content by active investigation in both science classroom and practical class (Zion et al., 2004).

Constructivist learning and Teaching approach in Science Education

Matthew (1998) stated that from the 1990s, the constructivist learning and teaching approach influenced many education research studies as well as being the doctrine that underpined research programs in science education. At that time, constructivist teaching methods were beginning to be widely advocated and developed. Some educators categorized constructivism into two main areas, but they use quite different details. For example, Child (2007) describes constructivism based on Piaget's and Vygosky's work, so he divided constructivism into two main areas: constructivism and social constructivism. Similarly, Driver et al. (1994) described two major traditions in explaining the process of learning science: personal and social constructivism. From the constructivist perspective of teaching, teaching strategies in science concepts should focus on providing students with physical experiences that induce cognitive conflict and hence encourage students to develop new knowledge schemes. From this perspective, a teacher plays a critical role in student learning as a facilitator who helps students connect what they already know to a new experience or concept (Kang, 2007). In addition, a central tenet of conceptual change is how individuals make choices among competing or alternative views, models, or theories of the natural world (Duschil & Hamilton, 1998).

Constructivist classroom

A constructivist teacher is flexible and creative experiences in the classroom into the negotiation and construction of lessons with small groups and individuals. The environment is democratic, the activities are interactive and student- centered, and the students are empowered by a teacher who operates as a facilitator/consultant. Constructivist classrooms are structured so that learners are immersed in experiences within which they may engage in meaning-making inquiry, action, imagination, invention, interaction, hypothesizing and personal reflection. A constructivist classroom should be student-centered classroom. The student-centeredness of a constructivist classroom is clearly apparent in a reader response approach to literature. Recognizing the significance of the unique experiences that each reader brings to the reading of a selection of literature, the teacher in a response-centered approach should seek to explore the transaction between the student and the text to promote or extract a meaningful response (Rosenblatt, 1978). This places the student in a central position in the classroom since exploring this transaction seems unlikely to occur unless the teacher is willing to relinquish the traditional position of sole authority, thereby legitimating the unique experiences that all members of the class bring to the reading rather than just those experiences the teacher brings. The resulting perception and effect in the classroom is evident in students' recognition that the discussion is a legitimate one involving questions to which nobody knows the answer. It isn't a treasure hunting game where they are trying to guess what is in their teacher's head, but a process that creates meaning and knowledge.

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From a constructivist perspective, where the student is perceived as meaning-maker, teacher-centered, text-centered and skills-oriented approaches to literature instruction are replaced by more student-centered approaches where processes of understanding are emphasized. Applebee (1993) suggests that rather than treating the subject of Science as subject matter to be memorized, a constructivist approach treats it as a body of knowledge, skills, and strategies that must be constructed by the learner out of experiences and interactions within the social context of the classroom. A constructivist student-centered approach places more focus on students learning than on teachers teaching. A traditional perspective focuses more on teaching. From a constructivist view, knowing occurs by a process of construction by the knower. Lindfors (1984) advises that how we teach should originate from how students learn.

METHODOLOGY

Research Design

The type of research design employed is action research approach. Action research is a process in which participants examine their own educational practice systematically and carefully, using the techniques of research (Watts, 1985). This research is carried out within the context of the teacher's environment, that is, with the students and at the school in which the teacher works on questions that deal with educational matters at hand. Action research is not about learning why we do certain things, but rather how we can do things better. It is about how we can change our instruction to impact students.

Population and Sample Selection

The target population was all the teacher trainees in the Mampong Monica's College of Education. However the accessible population was the second year students of St. Monica's College of Education. The reason being that, these second years will very soon go for their teaching practice and this will help them to overcome difficulties in teaching at the basic school level. The researcher employed the purposive sampling technique. This technique did not leave out any subject in the sample. The students were put into ten groups and each group consisted of thirteen students. All the students in the class were exposed to the same sample treatment so that the effects could be examined among the students.

Research Instruments

The instruments for data collection were a teacher-made test and questionnaire. The teacher-made test was in two forms. The tests **(Pre-intervention test and Post-intervention test)** were sampled from the set of past questions for diploma students at the final year from 2006 to 2011. The tests were made up of 20 items, five items each for the four topics under study. The same questions were used for both pre-test and post-test to reveal the kind of thinking and understanding the teacher trainees have on teaching science at the basic school levels.

The questionnaire was to elicit responses from students on activity method in teaching Biology. The items on the questions were closed ended and of Likert scale type.

Validity and reliability of the instrument

In order to ensure the validity of data collected, five (5) teacher colleagues and experts scrutinized the questionnaire items for its ambiguity and items non-contribution to the questionnaires purpose

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and suggestions were offered for improvement. This helped to improve the content validity of the instrument. The questionnaire items were made clearer and unambiguous for the respondents. The length of the items were shortened and made clear so that the respondents could read the items quickly and select a response without difficulty. Ample time was given to respondents to complete the questionnaire.

Data Collection Procedure

The data collection was done in three phases. The section consists of Pre-intervention test, Intervention and Post-intervention test. This was done to determine the difference in their test scores.

Data Analysis Plan

The data collected was analyzed with the use of frequency distribution tables and charts. Each question was analyzed and generalizations made after each analysis. Responses with highest percentages were considered to be the general opinion with regards to that question. Findings were also given after the analysis.

Pre-Intervention

The students were pre-tested at the same time to determine their entry points with respect to the teaching of food chain, transpiration, photosynthesis and osmosis in the basic schools. The test questions were sampled from the set of past questions since the inception of the Diploma in basic education (DBE) programme (2006-2011) and were significantly testing critical thinking and understanding of the teacher trainees in the content knowledge and pedagogical skills in teaching the topics at the basic school level. The pre-intervention test consisted of 20 items. Five items each for the four topics to cover all the intended topics for the basic school science. The test was administered to one hundred and twenty three students during the first week of the study. The duration was 45minutes. These tests were collected and scored.

Intervention

Considering the performance of the pupils in the pre-test, an activity was designed each for the four topics as an intervention strategy to help the improve students' performance in teaching Food chain, Transpiration, Photosynthesis and Osmosis in basic schools.

Post- Intervention Activities

A post-intervention test was carried to assess the students understanding on the four topics after the various activities were used to teach the topics. The students were given tests on the topics. The items that were used as pre-intervention test items were also used in the post- test. The duration of the test was 45 minutes on both occasions. The tests were scored and analyzed.

RESULT

Out of the 130 questionnaire sent to all the second year students of St. Monica's College of Education in Ashanti Mampong, one hundred and twenty-three (123) questionnaires were returned, representing 94.6% response rates.

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Activity Method and Performance of Students

The result to help this research question has been presented in Table 1 for analysis and discussion.

Table 1- Response of students' performance in science

Response	Frequency	Percent
Strongly Agree	75	61.0
Agree	42	34.1
Disagree	6	4.6
Total	**123**	**100.0**

Table 1 shows the response of students' performance in science. The data suggests that 61% of the respondents strongly agree that activity method of teaching improves performance in science, 34.1% of them agree and 4.6% disagree that that activity method of teaching improves performance in science.

Activity Method and Enhancement of Content Knowledge

Table 2 has the result to be used to answer how activity method enhances content in Biology teaching.

Table 2- Response of students' on the activity method and the improvement of content knowledge

Response	Frequency	Percent
Strongly Agree	57	46.3
Agree	57	46.3
Disagree	9	7.3
Total	**123**	**100.0**

Table 2 shows the students response on the activity method and the improvement of content knowledge. The data indicate that 46.3% of the respondents strongly agree that activity method of teaching improves content knowledge, 46.3% of them agree and 7.3% of them disagree that that activity method of teaching improves content knowledge.

Using Activity method to motivating Students learn Science

To answer this research, the result from the field has been presented in Table 3.

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Table 3- Response of students on Activity method motivating students to learn science

Response	Frequency	Percent
Strongly Agree	60	48.8
Agree	57	46.3
Disagree	6	4.9
Total	**123**	**100.0**

Table 3 shows the response of students on the activity method motivating students to learn science. It indicates that 48.8% of the respondents strongly agreed that the activity method of teaching motivates students to learn science, 46.3% of them agreed and 4.9% of them disagree that the activity method of teaching motivates students to learn science.

Using activity method to enhance positive attitude towards Science

The response from the respondents on the activity method in how students can develop positive attitude toward science is presented in Table 4 for discussion.

Table 4- Response of students on the activity method enhancing positive attitude towards science

Response	Frequency	Percent
Strongly Agree	36	29.3
Agree	63	51.2
Disagree	18	14.6
Strongly Disagree	6	4.9
Total	**123**	**100.0**

Table 4 shows the response of students on the activity method of teaching enhancing positive attitude towards science. It indicates that 29.3% of the respondents strongly agree that activity method of teaching enhances attitude towards science, 51.2% of them agree, 14.6% of them disagree and 4.9% of them strongly disagree that activity method of teaching enhances attitude towards science.

Presentation and analysis of Pre-Intervention Test and Post-Intervention Test Scores

The result is presented for the Pre-intervention test score and the Post-intervention test score as in Table 5.

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Table 5- The table below shows the results of Pre-intervention test and post-intervention test scores

Type of test	No. of students and their scores								Total	Score diff.
Pre-intervention test	No.	15	15	12	21	24	21	15	123	
	Score	12	15	18	21	24	27	33	150	1
Post-intervention test	No.	6	12	18	21	15	24	27	123	
	score	36	39	42	45	48	51	57	315	2.1

Table 5 shows the results of pre-intervention test and post-intervention test scores. The data suggests that out of 123 students who took part in both the pre-intervention test and post-intervention test, the total score for the pre-test was 150 while the post-test was 315. This indicates about two times (200%) increase of the post-intervention test score over the pre-intervention test score.

DISCUSSIONS

Majority of the students strongly agreed that activity method of teaching improves performance in science. One possible reason for this result might be that after the intervention activities, the students had a better understanding of the topics they treated. On the other hand, a small percentage of the students disagreed that the activity method of teaching improves performance in science, which might be due to the fact that not all the students benefited from the intervention. The result indicates that most of the respondents strongly agreed that activity method of teaching should be used in the teaching of science. This is because after going through the activities, they realized it can help improve the teaching of science and their performance. According to Schwartz, Lederman, and Crawford (2004) students should develop an understanding of what science is, what science is not, what science can do and cannot do.

About 92.6% of the respondents strongly agreed that the activity method of teaching improves content knowledge. This is due to the fact that the application of the activity method of teaching and learning helps to concretize what is learned in the mind of a student, and therefore improve the content knowledge among learners. This is in agreement with Taraban, et al (2007) who reported that an active learning and teaching strategy has more advantage in learning and teaching science rather than a traditional strategy. Most of the respondents strongly agreed that the activity method of teaching helps to retain knowledge for a long time. One possible reason for this response is that the activities the students went through helped to make the content of the lessons real and therefore registered the skills and knowledge acquired permanently in the minds of the students.
A greater percentage of the respondents strongly agreed that the activity method of teaching and learning helped to develop process skills. The activity method of teaching and learning goes through a step-by-step process for acquisition of knowledge and skills, and therefore help the students to acquire skills. Skill acquisition is an attitude, so when students develop their skills

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process in science they are enhancing their attitudes towards science. Therefore, it is essential for students to be aided to acquire science process skills in educational institutions.

The result indicates that 70.8% of the respondents agreed that their science teacher uses the activity method of teaching. This is because of the intervention which introduced the use of activity method for teaching science. This therefore has not only motivated the teacher trainees to learn science but also developed interest in the study of science. Johnson (2007) mentioned that teachers should utilize effective teaching strategies to ensure conceptual understanding of science. Good teacher's help students learn meaningfully to achieve quality over quantity, meaning over memorization, and understanding over awareness (Mintzes, Wanderse, & Novak, 1998).

Majority of the respondents agreed that the activity method of teaching and learning enhances interest in the study of science. The reason for this is that the intervention involved the students in the lessons treated which aroused their interest in the lessons. Students' participation in the lesson enhances their interest and therefore motivates them to learn science. Most students agreed that the activity method of teaching helps to learn with friends in groups. The activity method of teaching and learning (as applied in the intervention) put the students in groups and so they worked together in their groups. This promotes group learning and motivates the students to learn in groups. This finding has attest to what was noted earlier by Killen (2007). Cohen (1994) points out that a cooperative learning involves students learning by working together in a small group to accomplish shared goals. From the observation in the study, 51.2% of the respondents agreed that activity method enhances attitude toward science. This is to the fact that after the activity method was used to teach them, their mental state involving their beliefs and feelings and values and also dispositions about science changed. This finding is in line with Schwartz, Lederman, and Crawford (2004) who says that students should develop an understanding of what science is, what science is not, what science can do and cannot do.

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