Journal of Education
Volume 1, Issue 1, 2011, pp-16-24
Available online at: http://www.bioinfo.in/contents.php?id=58

THE APPLICATION OF SOME CONCEPTUAL APPROACHES IN RECTIFYING TEACHERS' MISCONCEPTIONS ON SOME SCIENCE TOPICS IN THE GA SOUTH DISTRICT IN THE GREATER-ACCRA REGION OF GHANA

AMEYAW Y.* and SARPONG L.
Science Education Department, Faculty of Science Education, University of Education, P. O. Box 25, Winneba – C/R, Ghana – W/Africa
*Corresponding author. E-mail: y61ameyaw@yahoo.com

Received: June 14, 2011; Accepted: July 01, 201

Abstract- Teachers' misconceptions toward some science topics significantly alter their achievement in science teaching and students understanding. Therefore, identification and influence of misconceptions became to be an essential part of educational research. This study has been initiated by the idea that; research in teachers' misconceptions toward science often involves science in general, but particular topics have been overlooked. Thus, this study is about Ga South District Teachers' in the Greater-Accra Region of Ghana misconceptions toward some topics in science. The study used questionnaire to measure teachers' misconceptions toward the selected science topics. The data were obtained from 40 teachers drawn from the Ga South District Education. Several graphical charts expressed in percentages were used to analyze the collected data. The result shows that many teachers have misconceptions in many subject areas. One of the reasons for these misconceptions is that some teachers themselves have misconceptions about many topics. For that reason, the determination of in-service and pre-service teachers' misconceptions and educating them with the correct information is necessary. In addition to the misconceptions, it is important to find approaches to eliminate those misconceptions they possess. Hence, one of the best approaches developed for this purpose is the conceptual change approach using integration technology, group work and demonstrative experiments to investigate and eliminate misconceptions of the selected science topics.
Keywords: Misconception, conceptual change, Integration technology, Group work, Demonstrative experiments

Introduction

Misconceptions can be described as ideas that provide an incorrect understanding of ideas, objects or events that are constructed based on a person's experience (Martin *et al*., 2002) including such things as preconceived notions, nonscientific beliefs, naïve theories, mixed conceptions or conceptual misunderstandings (Hanuscin, 2005). Piaget suggests that children search for meaning as they interact with the world around them (Eggen and Kauchak, 2004), and use such experiences to test and modify existing schemas. There are many possible sources for the development of misconceptions. First, not all experiences lead to correct conclusions or result in students seeing all possible outcomes.

Misconceptions themselves can be related to such things as misunderstanding factual information or being given conflicting information from credible sources such as parents and teachers. For example, when parents or other family members are confronted with questions from their children, rather than admitting to not knowing the answer, it is common for them to give an incorrect one (Thompson and Logue, 2006; Hanuscin, 2005). Other sources of misconceptions include resource materials, the media and teachers. The main issue is that once a misconception is formed, it is extremely difficult to change (Eggen and Kauchak, 2004), and that possessing misconceptions can have serious impacts on learning (Hanuscin, 2005). Students come into the classroom with prerequisite knowledge (existing schemas) and as they progress through their education, these schemas are progressively built upon (Thompson and Logue, 2006). In order to teach science effectively, it is vital to ensure that existing schemas to modify any misconceptions that will compromise them, following the logic that misconceptions themselves can be considered to be sequential, and therefore lead to ever increasing issues with learning as students continue to build their knowledge on current understandings (Hanuscin, 2005).

Since the 1980s agitation for a shift from the traditional system of feeding learners with information to promoting intellectual development has being a subject for public discussion. The reason for advocating this is to develop the thinking skills of learners. The implication of this is that schools should have the teaching of concept formation at the core of their proceedings. In this era of technological confrontations and multicultural world, good thinking is the key to successful learning (Swartz and Parks, 1994). The development of the intellectual and psychomotor skills of learners is the responsibility of teachers.

The rationale of 2007 Ghana educational Reform focus was to inculcate in students the skills that could make them useful information searchers as well as improve students' problem solving skills so that they will be able to transfer what they have acquired in a new situation, rather than feeding them with information. Comparable to feeding students with information, it focuses on teaching students about how to ascertain relevant useful information and how to produce information of similar identifications (useful and relevant).

Unfortunately, most pre-service teacher institutions do not prepare their teachers adequately for this task (Wideen, *et al*., 1998). A pre-service teacher who is a student in collage of Education and aspiring to be a teacher, needs to be guided on how to conceptualize knowledge in order not to transmit his misconceptions to his would-be students.

It is therefore expected that learning environment will be child-centered where the teacher register as a facilitator who understands how students construct knowledge, facilitates learning process by asking some effective questions and give them support by guiding students to the right resources (Gedik, Ertepinar and Geban, 2002).

It is therefore anticipated that, the teacher should build the related core points of a subject matter in step by step approach with graphical illustrations in order to make the information meaningful and realistic to students. Unfortunately, students come to school with some acknowledge that exist in their societies about some subject matter which prevents them from reaching authentic scientifically acknowledged information making it difficult and sometimes impossible for the students to house new information.

This canker has instigated many researchers over the years to work around the clock looking for the desirable way of merging what students already know to what they are about to learn in an approach called " learning from known to unknown" with the focus been on conceptual change. Many of the instructional approaches that came out from the efforts of researchers could not effect any marginal impart on conceptual change of learners. Instead, rote learning and memorization became paramount and this brought about misconceptions of some topics within subjects, specifically the sciences: Hence, the need for conceptual change (Ertepinar, 2001) Notwithstanding, conceptual change is also a challenged that students learn from doing, therefore insightful learning where they discover relevant knowledge in capacity building approach should not be overlooked.

In order to achieve meaning and permanent learning, misconceptions are supposed to be corrected by modifying their previous knowledge to make it comparable with the new information in an approach called conceptual change process (Smith Blakeslee and Anderson, 1993). According to Chambers and Andre (1997), conceptual change is a hopeful approach that achieves evolution from unempirical information or misconception that students' have information that is accepted as scientific. Thus, conceptual change is a change process of erroneous previous knowledge to valid and reliable information through applications of analogies and explanatory models, conceptual change texts, concepts maps, hands-on activities, information processing skills and students' written answers. There are many strategies available to help teachers modify misconceptions (Thompson and Logue, 2006), but before this can be achieved, the teacher needs to have strategies for identifying exactly what misconceptions a student may have.

Group work, demonstrative experiments, discussions, team works and field trips are some of the few conceptual approaches in order to erase misconceptions of students. Teachers must be aware of students' previous knowledge and misconceptions that can likely destabilize their understanding of the subject matter so that they will employ appropriate instructional method that can either eradicate or curb misconceptions in preparation of lesion plan and delivery.

Comparatively, learning occurs when students engage themselves in co-operative learning, which involves demonstration and discussions since this exposes students' misconceptions and suggest appropriate way to conceptualize knowledge in a simpler form (Gedik, 2002; Demir, Basaran and Demir, 2007).

Posner, Strike, Hewson and Gertzog, (1982), suggested four conditions to effect conceptual change in learners:

1. Students must become dissatisfied with their existing conceptions,
2. new concept must be clear and understandable for students
3. current problems should be solved by using the new concept, and finally,
4. future problems can be solved by using the new concept.

Studies have shown that students always drag their feet when there is a need for change especially where the change opposes the already acquired knowledge. In a situation where they have to discard their prior misconception, they rather accommodate the new concept through memorization. (Pedro and Cakici, 1998; Yuruk and Cakir, 2000; Tekkaya and Balci, 2003).

Research reveals that misconception is hard to eliminate through traditional approaches because it is a permanent and continuous process, which does not permit right concepts to be sufficiently developed by students (Tekkaya and Yilmaz, 2000).

Therefore, there is a need to equip teachers with effective instructional approaches to overcome misconceptions that result in meaningful learning. In this study, group work and demonstrative experiments based on the conceptual change approach are used and evaluated with respect to its effectiveness in teachers' pedagogical skills.

Moreover, research has shown that students held a wide range of preconceptions about the dynamic physical nature of the earth, the solar system, photosynthesis and respiration, and the structure of an atom at the beginning of their course study, which may even remain after the completion of their studies (Emerson, 2008).

It is essential for teachers to realize that many people have serious misconceptions about the causes of phenomena such as seasons, lunar phases, tides, eclipses etc. For example, a common misconception is that the sun rises from the east and settles at west. Research shows that these misconceptions are held even by many teachers, so teachers should not expect their students to understand these phenomena without assistance. These misconceptions sometimes arise from a combining personal experience with poorly understood previous instruction and misinterpretation of concepts in biology, chemistry, earth science and other science related subjects. Other common misconceptions that manifest in classrooms are:

Earth; rotation and revolution

- The Earth is a perfect sphere
- The sun rises exactly in the east and sets exactly in the west every day.
- There are an exact number of days in a year.
- North, south, east and west are exact places on Earth.
- We experience seasons because of the Earth's changing distance from the Sun.
- The Earth is the center of the Solar System

Moon and its phases

- The Moon can only be seen during the night.
- The Moon does not rotate on an axis.

Constellations

- All stars are the same distance form the Earth
- Stars leave the sky during the daytime
- Stars really twinkle.

The Solar System

- The Solar System contains only the Sun, Moon, and planets.
- Meteors are falling stars.
- Comets sweep across the sky like meteors.
- The planets are always arranged in a straight line away from the Sun.

Matter

- Atom is the smallest part of an element
- Matter is anything that has weight and volume

This study therefore aims at investigating the effect of the use of group work and demonstrative experiments based on the conceptual change approach to improve the pedagogical skills of teachers in some basic schools (Primary and Junior High Schools) in the Ga South District of the Grater Accra Region of Ghana.

Again, it also aims at finding out the misconceptions that teachers have and how they can deal with the misconceptions students bring to classroom so that suggestions can be made to remedy the situation, if necessary.

Methods

The study site was Odorgonno Senior High School with a population of teachers selected from the Basic Schools within the Ga South District of which 52% were from Primary Schools whiles the remaining 48% came from the Junior High Schools. Odorgonno Senior High is located at the Ga South Municipality and very close to the Ga South District Education office. The School is a Model school with a well-resourced Science and Computer Laboratory which actually facilitated the effectiveness of the intervention strategies.

A sample size of forty (40) teachers was used for the study, and was made up of the following composition: twenty percent (20%) from the lower primary, thirty-two percent (32%) upper primary and the remaining forty-eight percent (48%) also from the Junior High Schools.

The actual composition of the sample was made up of;

a. Two teachers each, from primary one and two, and four teachers from primary three.
b. Three set of teachers each from primary four and five, and nine from primary six
c. Nineteen teachers were selected from JHS 1, 2 and 3 in the ratio of 6:5:3.

Questionnaires, interviews and observations were used to solicit information from the sampled population.

Group work and practical demonstration on the pedagogical skills of basic school science teachers were assessed as they participated in twelve carefully designed instructional activities that try to:

a. Elicit their misconception about:
   i. The solar system concept
   ii. The structure of atom, formation of ions and writing of simple chemical equations.
b. Engages them in discussions and activities on how to plan and design their own lessons in teaching propagation of light and simple electronics
c. Engages them in a discussion on how some of the scientific misconceptions can be corrected.

An interview conducted two months earlier before the commencement of this research revealed that some basic school teachers indeed had misconceptions relating to heliocentric and geocentric concepts, the concept of matter and chemical equations and basic electronics in facilitating teaching and learning.

Participating teachers were grouped and asked to prepare and present lessons on some topics like Basic electronics, the solar systems, Concepts of Matter and also how to correct some misconceptions in relation to respiration. The other participating groups acted as students while the research participants assessed presentations from the groups.

Interventional measures on how teachers use practical demonstration, discussions and integration technology to improve their teaching content skills after discussing the findings by the study participants, comments by the participating teachers and reflection by presenters on the various topics were implemented. Participating teachers were asked to do another presentation on similar topics for another assessment.

Several graphical charts expressed in percentages were used to analyze the collected data.

Results

Analysis of findings

The results of the findings have been provided below:

Item 1

Item one (1) gives the category of teachers used for this research. This has been presented in Fig. 1.

Item 2

Item two (2) was applied to identify the study participants' areas of subject specialization in their education career, and this has been expressed in Fig. 2.

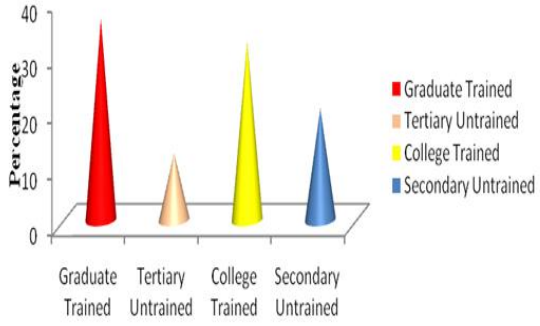

Fig. 1: The category of teachers used for the study.

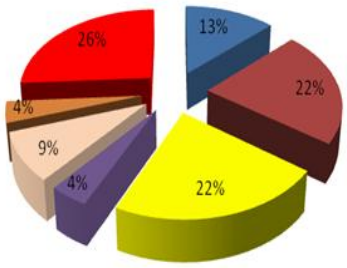

Fig. 2: Teachers' areas of subject specialization

As authenticated in fig. 1, out of the sampled population, teachers who studied education at the university level were 36%. Although 20% of the teachers went through tertiary education, they never studied education(they were not professional teachers). The teachers who went to training college(College of Education) constituted 32% whiles the remaining 20% were Senior High School graduates who have been employed to teach (Fig. 1).

The graph in fig.2 shows respondents' areas of subject specialization.Twenty-six (26%) percent of the teachers studied Science as their major course of study while 13% majored in Agriculture. Teachers who studied Mathematics and Home Economics were both 22% each. Teachers who majored in Visual Arts, Literature and Geography were 4%, 9% and 4% respectively.

Item 3

Item three (3), sought respondents' views on the difficulty nature of teaching science. Three categories of the difficulty nature of science teaching was identified by the participants (Fig. 3).

Item 4

Under this item teachers or participants were asked to identify difficult topics when it comes to the teaching of science. This has been displayed in Fig. 5.

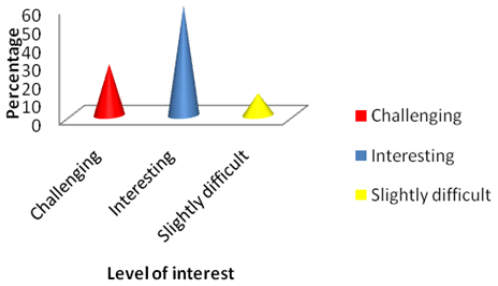

Fig.3: Views of participants on science teaching

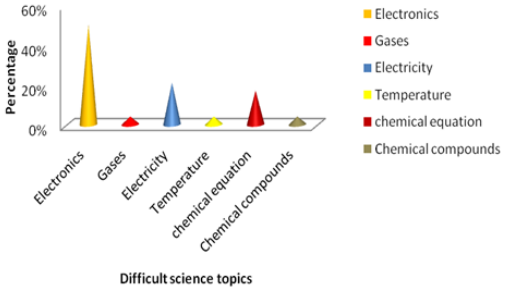

Fig. 4: Selected difficult science topics

In all, twenty-eight (28%) percent of the participants confirmed that science teaching is challenging whiles twelfth (12%) percent said science teaching is difficult. The remaining sixty (60%) percent of the sampled population said science teaching is interesting (Fig. 3).

Science topics in the syllabus that were considered to be difficult by the teachers or participants have illustrated in Fig. 4. As shown, fifty (50%) percent noted basic electronics as the difficult subject while twenty-one (21%) percent indicated electricity as the topic they consider to be difficult. Four (4%) percent each identified chemical compound, temperature and gases as their difficult topics and the remaining seventeen (17%) percent also noted chemical equation as their difficult topic.

Item 5

This item talks about the views of both teachers who had been teaching Basic Electronics and those who have not been teaching it (Fig. 5).

Item 6

The challenges the respondents are facing in teaching of Chemical equations have been expressed under this item (Fig. 6).

As shown in fig. 5, sixty-four (64%) percent of the teachers pointed out that they had not been teaching basic electronics whiles 36% confirmed their teaching of

the topic. Twelfth (12%) percent out of the sixty-four gave lack of TLM as the reason why they were not teaching basic electronics. Eight (8%) percent of them indicated that basic electronic is not found in the Science syllabus whiles sixteen (16%) percent pointed that they lacked the content knowledge. Finally, twenty-eight (28%) out of the 64% couldn't confirm yes or no.

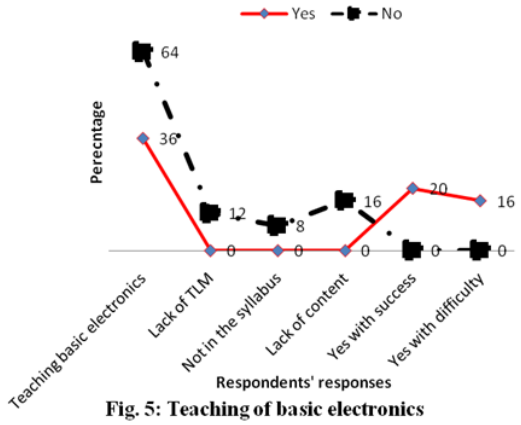

Fig. 5: Teaching of basic electronics

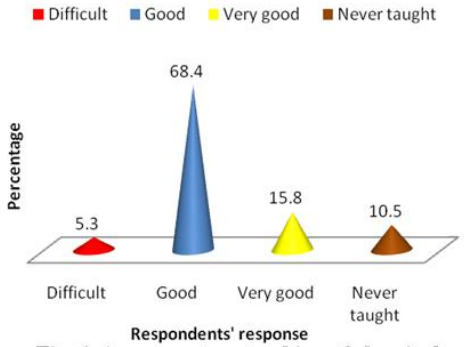

Fig. 6: Assessment on teaching of chemical equation

Teachers who indicated they were teaching basic electronics were thirty-six (36%) percent. Twenty (20%) percent out the thirty-six percent pointed out that they had been teaching it with success but sixteen (16%) percent also indicated, they had been teaching but encountered difficulties (Fig. 5).

The challenges the respondents have been facing in teaching of chemical equations have been captured under fig. 6. Roughly eighty-four point two (84.2%) percent indicated they never faced any problem with the topic but ten point five (10.5%) percent of the remaining respondents indicated they never taught the topic whereas five point three (5.3) percent said they had been teaching with difficulties.

Item 7

Skills exhibited by teachers or respondents in the teaching of science in the classroom have been displayed in fig. 7.

Item 8

This item looks at some of the misconceptions conceived by the teachers or respondents when teaching some science topics (Fig. 8).

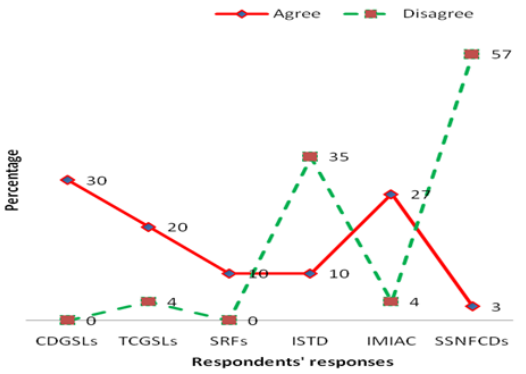

Fig. 7: Teachers teaching techniques

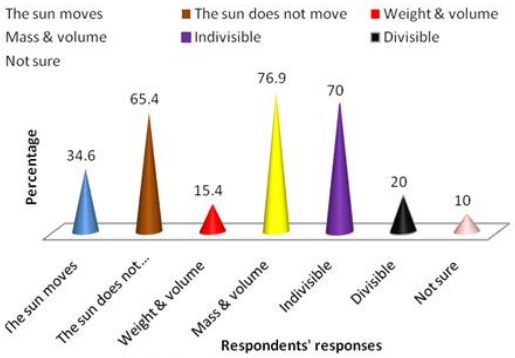

Fig. 8: Teachers' misconceptions 1

CDGSLs – Class Discussion is Good for Science Lessons
TCGSLs – Teacher Centred is Good for Science Lessons
SRFs – Students must Read for their Facts
ISTD-I find Science Teaching Difficult
IMIAC - I Make every Information Available to the Child
SSNFCDs - Students have No Facts for Class

Discussion

Fig. 7 describes the skills teachers use and how they find the teaching of science lessons in the classrooms. As to whether class discussion (**CDGSLs**) is good way of presenting science lessons, 30% of the respondents agree, but the remaining population did pass any comment. Forty-seven (47%) per cent of the teachers agreed that teachers should be the pivotal point of teaching (**TCGSLs)** and they should also give information to the students to copy and read (**IMIAC)**, whiles 8% disagreed. Ten percent of the respondents agreed that learners must read for their facts after the teacher has explained some points to them (**SRFs)** and rest did not give any response (disagree). On the issue about the difficulty nature of science teaching, 10% agreed to the statement but 35% disagreed to the difficult nature of science teaching (**ISTD)**. Finally, 3% of the respondents agreed to the statement whiles 57% of them disagreed that students have no facts for class discussions (**SSNFCDs**).

As reflected in fig.8, there were some misconceptions that were conceived by the respondents. The graph

shows that thirty-four (34%) percent of the sampled population expressed their views that "the Sun really moves from one position to another" whiles sixty (60%) percent said the "Sun does not move at all". On matter, seventy-six point nine (76.9%) percent expressed that "Matter is anything that has mass and volume" whereas 15.4% said "matter has weight and volume". The remaining 7.7% expressed that, "matter has volume and can occupy space". As to whether atom is divisible or not, 10% were not sure. While 70 % indicated that atom is indivisible and the remaining 20% said that atom is divisible.

Item 9

Whether teachers or respondents have misconceptions about basic electronics was also assessed as displayed under fig. 9.

Item 10

This item sought for information on where acid can be obtained with ease (Fig. 10).

According to fig. 9, 70% of the teachers defined basic electronics as the design and application of electronic circuits and 4% classified it as arrangement of electrons on their shells (electronic configuration). A portion of them that is 26% defined basic electronics as the study of transistors.

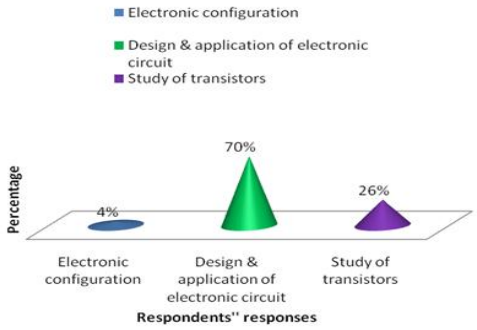

Fig. 9: Misconceptions about electronics

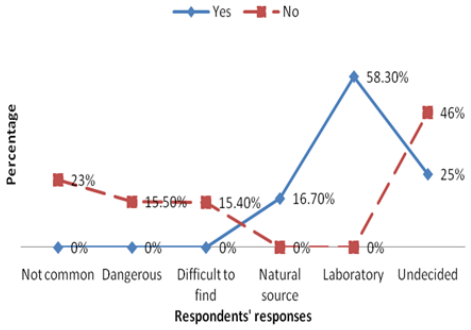

Fig. 10: Misconceptions about acids

A fraction of the sampled population representing 46% was undecided on where to get acids from whereas 25% knew that acids are available but could not identify their sources. Again, 58.3% proved that acids can easily be obtained from the laboratory. Among those who said acids cannot easily be obtained, 23% said acid is not common in our environment, 15.5% affirmed that acid is a dangerous substance with the remaining 15.4% saying acid is very difficult to obtain. Finally, sixteen point seven (16.7%) said acid can be found from fruits and natural sources (Fig. 10).

After identifying the respondents' or teachers' misconceptions, **group activities** (Plate 1 & 2), **demonstrative experiments** (Plate 3, 4, 5 & 6) and **integration technology** (7, 8 & 9) using CD-ROMs covering the topics of misconceptions were screened and explained. These helped to erase their earlier misconceptions on the topics treated.

Group activities

Plate 1- Groups ready to discussion the misconceptions

Plate 2- Participants brainstroming in a group activity

Demonstrative experiments

Plate 3- Participants examining an electronic circuit

Plate 4- The two viewing a constructed circuit using dry cell battaries.

Plate 5- Participants preparing some basic acids

Plate 6: A sample of acid being shown to the participants to remove their misconceptions about acids.

Integrating technology

Plate 7- Observing the earth and other solar bodies from the CD-ROM on the monitor.

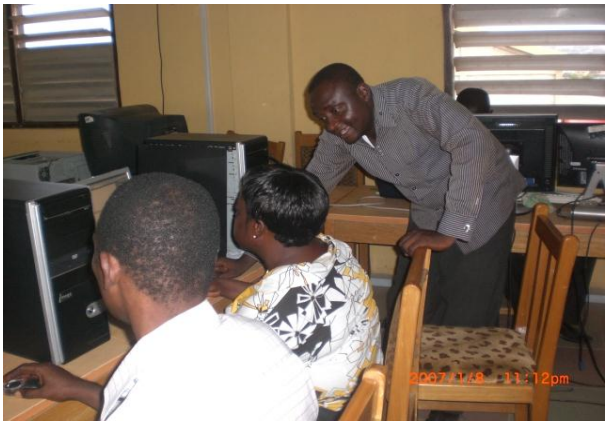

Plate 8- Explaining how to use the internet to search for teaching and learning materials.

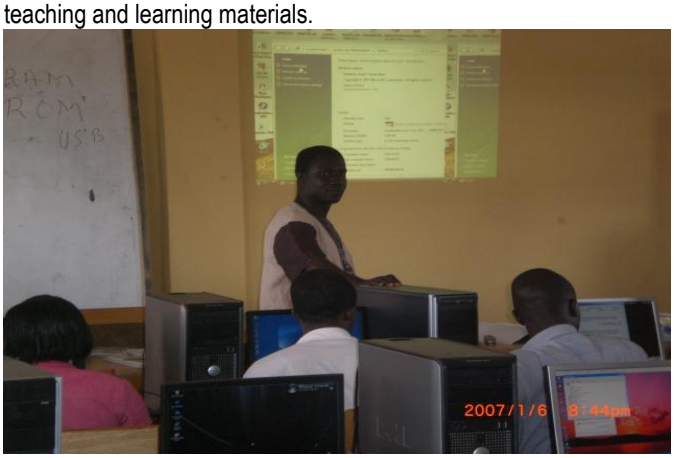

Plate 9- A power presentation on some of the misconceptions

Discussion

It is important for in-service teachers to be educated on contemporary learning methods and techniques (integration technology, group work and demonstrative experiments) in order to investigate how these methods make learning easier and how to obtain skills (Ekici, 1996; Saka and Akdeniz, 2001). In science education, the application of these methods and techniques are very essential. The essential rationale of science education is to offer ways for students to learn concepts meaningfully. One of the obstacles behind meaningful and permanent learning is misconceptions. A study conducted shows that many science education students have misconceptions in many subject areas (Pfundt and Duit, 2000; Taber, 2002). One of the reasons for these misconceptions is that some teachers themselves have misconceptions about many topics (Yip, 1998; Sanders, 1993). For that reason, the determination of in-service and pre-service teachers' misconceptions and educating them with the correct information is necessary (Köse, 2004). In addition to the misconceptions, it is important to find approaches to eliminate those misconceptions they possess (Özmen and Demircioğlu, 2003). Hence, one of the best approaches developed for this purpose is the conceptual change approach.

In this study, integration technology, group work and demonstrative experiments based on the conceptual change approach in science education for in-service

teachers were used to investigate the elimination of misconceptions in some selected science topics.

After analyzing the results of this study, it was observed that there were quite a number of misconceptions that exist among teachers who took part in the programme. For instance, about 35% of the participants were of the view that the sun moves gradually from east during the mornings and settle at west in the evenings. The issue of Heliocentricity (the sun is the center of the universe) and Geocentric (having earth at the center of the universe) became a subject of debate in the early 16th century where the cosmology that was eventually replaced by Copernican theory postulated a geocentric universe in which the earth was stationary and motionless at the center of several concentric, rotating spheres. These spheres bore (in order from the earth outward) the following celestial bodies: the moon, Mercury, Venus, the sun, Mars, Jupiter, and Saturn. Others also buttress their geocentric views with the story in the bible where Joshua prayed for the sun to stand still (Joshua 10: 13). Perhaps, those who are saying that the earth really moves from the east to west have been influenced by these stories (Yip, 1998; Sanders, 1993).

Although, 65% of the teachers indicated that the sun does not move, they could not demonstrate with appropriate teaching and learning materials. Those who tried to demonstrate it used a flash light and a globe but the globe never went round the flash light.

The improper way of presenting lessons on solar systems couple with the story in the book of Joshua may be the prime factors that have generated the misconception that the earth does not move but rather the sun.

A power point presentation was used to correct the above misconception. Thus, during one of the skills in integration technology, participants were taught about the use of the computer in presenting the revolution of the earth, and its movement around the sun. After follow ups to some of the schools where the participant teach, it was evident that majority of the learners have adopted the idea that the earth moves around the sun.

A significant number of misconceptions were recorded on the definition for matter, while some say matter is anything that has weight and volume, others believe that matter has volume and can occupy space. This may be due to the fact that some of the teachers have little knowledge about the concept of volume, mass and weight. This is obvious since some indicated that matter has volume and can occupy space forgotten that the amount of space occupy by a substance is its volume.

The misconception was very significant when the results on whether atom is divisible were analyzed. About 70% of the teachers indicated that atom is indivisible. This misconception may be due to some of the definitions people have about atom that "it is the smallest indivisible part of an element". Those who defines atom this way may be compelled to say that atom is indivisible. These teachers may definitely have problems with formation of ion and ionic compound formation. No wonder, 21% of the teachers indicated that they have problems with the teaching of chemical equation and formation of chemical compounds.

According to Özmen and Demircioğlu (2003), in the mist of misconceptions, it is important to find approaches to eliminate them so teachers were engaged in group activity where each group was asked to describe an atom using a well labeled diagram. Participants were also engaged in lessons on formation of ions where a CD-ROM labeled essential study partner was used to demonstrate how atoms loses or accept electrons to become ions. The misconception was remedied by their own diagrams after labeling the various parts of the atom. Participants were more relaxed and convinced when they saw electrons moving from one atom to the other. The question that arouse was 'Is it possible for something that is not divisible to give out a portion (electron) of it? Or how is it possible for something that is not divisible has parts? As said earlier, the diagrams and the presentation from the CD-ROM were able to convince the teachers that atom is divisible.

The results also exposed some misconceptions teachers have about acid. Some of the participants considered acid as something that cannot be obtained easily, since, it is dangerous and also difficult to obtain. These participants may be harboring this misconception mainly because they had perception about the corrosive nature of acid. Many people associate acid to something that is highly corrosive and may not want to even go near it when they hear the name. This misconception has influenced the perceptions people have about acid.

The difficulty nature about the teaching of basic electronics which is a new topic in the science syllabus also exposed misconception about the idea of what the basic electronics is all about. Teachers who thought basic electronics and transistors might have linked the two since the study of transistors is a sub-topic under basic electronics. Others who linked it to the study of electronic configuration might have coined the meaning of the basic electronics from the word electronic which qualifies the word configuration. They based their facts on what they have already heard.

In attempt to agree with Orphan 2004, contemporary learning process experimentation, application, and observations of circuit boards were used to encourage teachers to conceptualize knowledge about basic electronics. Teachers were taken through a course on the functions of the electronic components using the internet, since some of the participants argued that teaching materials on the subject matter are not available. Participants were also engaged in group activity where they were asked to go to Ministry of Education website and downloaded the science syllabus for their studies since some were of the view that basic electronics were not part of the syllabus.

Integration technology, Group work and demonstrative experiments based on the conceptual change approach seem to be very effective in eliminating the teachers' misconceptions of the topics discussed above. The underlying reason is that the strategies applied in the conceptual change approach explain misconceptions

between scientific information and existing information. These misconceptions are highlighted exactly and clearly. Moreover, in this approach, the concepts were presented to make them in a more concrete way. The results of this study are in line with the previous studies by Köse and Uşak (2006), and Başer and Geban, (2007).

Acknowledgement
The authors would like to show appreciation to the study participants and other resource persons who were involved in this study, by saying *Ayekoo!* (*Thank you! or merci!*).

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