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Effects of Analogy Instructional Strategy on Students' Performance in Wave Concept

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Abstract
The study investigated effect of analogy instructional strategy on SHS student's performance on wave concept. The study involved one class of form two physics students in Navrongo Senior High School, selected through purposive and convenience sampling technique, totalling 52 students (12 female and 40 males). The individual teacher research strategy was adopted for the study in which the 52 students were taken through analogies. Data was collected using both qualitative and quantitative methods through pre intervention test and post intervention test items and unstructured interview. The students wrote a pre intervention test after which the analogies were used to teach the lesson. The students then wrote a similar test as a post intervention test. A change or otherwise in their performance was ascertained through gain analysis adopted from Richard Hake. The findings from the average normalised gain of the post and pre intervention test scores showed a gain of 0.66, indicating that an effectiveness of the analogy lessons in enhancing performance. A dependent sample t-test conducted showed that there was a significant difference in the pre intervention test and post intervention test score, $p= 0.000$ ($\alpha=0.05$). The study therefore recommends the use of analogy instructional strategy in physics lessons at the SHS level.
Keywords: analogy, physics, teaching, conceptual content

INTRODUCTION

Physics is a fundamental science which is concerned with the basic principles of the universe and therefore its objective is limited to a number of fundamental laws that govern natural phenomena (Serway and Jewett, 2004). According to Serway and Jewett (2004), physics use these laws to develop theories that can predict the results of future experiments and that these laws are expressed in the language of mathematics. However, Physics is considered to be in crisis not only Ghana but globally. The cause of this is identified as the fall in number of students taking Physical sciences especially Physics and Chemistry, because while the numbers taking Physics and or Chemistry are falling at higher levels of education, numbers taking Biology are much higher and fairly steady (Taale, 2010). Physics is widely recognized to be the most fundamental of all the sciences and has also been recognized as the foundation of our society (Pravica, 2005), and indispensable in many professions and for economic development (Stokking, 2000). Taale (2011) also emphasized that, of all the sciences, physics is at the heart of the technology driving the world economy and is present in almost every facet of modern life. Physics as one of the core science subjects is peculiar having been identified by experts as abstract or difficult in nature and demanding high quantitative aptitude in explicating most of its principles and concepts (Bassock, 1990; Franz, 1983; NERDC, 1994; Ogunsola-Bandele, 2001; Okoronka, 2004; Toews, 1988). According to Ogunsola-Bandele (2001) and Toews (1988), most high school and college students recoil from physics because they feel it contains too many facts or technical terms to learn, the textbooks are too difficult to read and has the reputation as an applied mathematics course. These might have resulted in decreased enrolments in physics at a time when our society desperately needs scientifically literate citizens.

According to Dean (1980), the concept of wave is one of fundamental and important topics in physics however students appear to lack the understanding of the fundamental ideas because it has more conceptual contents than it is usually accorded in teaching schemes. Okoronka (2004) also emphasized that, any instructional intervention must be directed to address this trend and should help the learner in making meaning and creating understanding of the various 'tagged' difficult concepts. One of such instructional intervention is the use of analogies as instructional strategy to address the trend of students' difficulties in understanding of wave concept.

Analogies use are common in science teaching, and more so in physics. This is because of the many abstract concepts that physics embodies. Analogies are teaching tools that compare structures of two domains by indicating the similarities of the parts of the structures (Duit, 1991). Everyday use of the term analogy includes metaphors, models and to some extent examples, though there are important differences between these terms.

Many studies have been done on the use of analogies in teaching science concepts worldwide however, only a few of these studies are done in Africa, most of which are in the area of biology (Lagoke, Jegede & Oyebanji, 1997).

According to a study conducted by US Embassy in 2012 the current high school curriculum in Ghana puts emphasis on science subjects and yet students' performance in the science subjects in national examinations has been consistently poor over the years (United States Embassy, 2012). Students, parents and other stakeholders in education yearn for good grades in physics as a subject for further education and other physics related

occupation. Entry into science related courses in the higher institutions require a grade of C6 or better. This is likely to put pressure on the students as well as the teachers to produce such results. It is perceived that a successful teacher in Ghana is one who produces better results by having many students do well in WASSCE and one who has many students joining higher institutions. This teacher is even more recognized and respected by having many of his/her students join the "best" courses at the universities. At present, the "best courses" are science related. This is because with qualification in any of these courses, one is almost certain of getting a job.

Selection of subjects to take for WASSCE is done in SHS two. The Ghanaian system requires a student to have passes in at least three elective subjects of any combination of biology, physics, chemistry and or mathematics. This makes the selection of any of the subjects to be based on a student's high chances of making the required grade for tertiary level. This therefore invites to explore best teaching strategies in physics that can help raise the understanding and performance of wave concept so as to influence the choice of selection of physics as a first option for students. However, how the subject is taught and learned may inform a student's choice of selecting it or otherwise for their final examination, hence, a need for a detailed study of one of the important teaching strategies in physics; use of analogy on the grounds that better teaching will attract many students to select the subject.

The Problem Statement

Students tend to perceive physics as a difficult subject due to some abstract nature of some topics, in particular the concept of waves. This perception must be eliminated through the introduction of some better teaching strategies. The focus of this study is the use of analogy instructional strategy to help students have better knowledge of concept of wave.

The purpose of the study was therefore to explore modern instructional strategies in physics that can help raise the academic performance of students in physics. The purpose of the study was to determine the effects of analogy instructional strategy on students' performance of wave concepts. Specifically, the objectives of the study were to determine

1. Students' knowledge of the concept of wave prior to the analogy instructional strategy.
2. Students' knowledge of the concept of wave after the analogy instructional strategy.

Research Questions

The following research questions guided the study

1. What knowledge do students have about wave concept before the analogy instructional strategy?
2. What knowledge do students have about wave concept after the analogy instructional strategy?

METHODOLOGY

The study employed mixed methods, where both quantitative and qualitative approaches were followed. According to Johnson and Onwuegbuzie (2004), mixed method research involves combining in single study techniques, methods, approaches and language of both quantitative and qualitative traditions. Burns and Groove (1993) define quantitative research as a formal, objective and systematic process to describe and test relationships and examine cause and effect interaction among variables using mathematical means or statistical analysis of data. Qualitative research on the other hand seeks to discover the meaning that participants attach to their behaviour, how they interpret situations and what their perspectives are on particular issues (Measor & Woods, 1984).

To gather the quantitative data, a pre intervention test and post intervention test were conducted to assess student's performance before and after the intervention, so as to check the effective gain in students' performance. Researchers have deployed a variety of tools to perform the average effectiveness of the courses in promoting conceptual understanding. One of such tools, most commonly associated with the work of Richard Hake is called the normalised gain;<g> (Hake, 1998). Since its introduction, the normalised gain has been widely used in assessing students' performance in pre intervention tests and post intervention tests (Bao, 2006). It is defined as the change in score divided by the maximum possible increase, or the ratio of percentage post intervention test score minus percentage pre intervention test score to 100 minus the percentage pre intervention test score.

The normalised gain is calculated using the following mathematical relations:

$$<g> = \frac{\textbf{post intervention test score – pre intervention test}}{\textit{maximum score} - \textit{pre intervention test score}}$$

$$<g> = \frac{\textbf{\% post intervention test score – \% pre intervention test score}}{\textbf{100 – \% pre intervention test score}}$$

The three test scores (maximum, post intervention test and pre intervention test) could be defined for an individual student or as an average measure for a population. In this study, the average normalised gain for the entire class will be calculated to express the effectiveness of the lessons in promoting conceptual understanding. Using the gain score, Hake classified interactive and traditional lecture courses into one of the three groups:

High gain; <g> greater than 0.7
Medium gain; <g> between 0.3 and 0.7
Low gain; <g> less than 0.3 (Hake, 1998)

Hake concluded that instructions that are based on traditional lecture approach usually have a low gain of <g> less than 0.3. However, instructions that depend on moderately used and highly used interactive engagement approaches usually have a medium gain (between 0.3 and 0.7) respectively. In gathering qualitative data, an unstructured questionnaire was used to record the preference of students in relation to analogy instructional strategy and traditional instructional strategy. Thus in investigating the effect of analogy instructional strategy on students' performance on wave concept in physics, both quantitative and qualitative approaches were used.

The study area

The study area was the Kassena-Nankana Municipality in the Upper East Region of Ghana. It is one of the thirteen (13) Administrative Districts in the Upper East Region. It shares boundaries to the North with Kassena-Nankana West District and Burkina Faso, to the East with Kassena-Nankana West District and Bolgatanga Districts, West with the Builsa North District and South with West Mamprusi District in the Northern Region.

Population

The entire group of interest for a research forms a population (Gravetter & Forzano, 2006). The population of this study was all Senior High School (SHS) elective science students offering physics. However, due to a number of constraints such as financial, time, resources and accessibility not all of the population was used for the study. The target population however, was one of the form two (2) science (science B) students of Navrongo Senior High School studying physics.

The second year class was chosen because they were free from examination stress as they were not examination class. They had also experienced physics teaching at the Senior High School, hence would be able to appreciate effect of the new approach to teaching.

Sample and Sample Size

A sample offers more detailed information and a high degree of accuracy because it deals with relatively small number units (Sarantakos, 1998; Gravetter & Forzano, 2006).

The sample for the study was one intact elective physics science class randomly selected from form two (2) elective science classes. Since it was an intact class, the entire subjects were involved in the research. The sample chosen was the second year elective physics students who were in the form two science class (Science B). They numbered fifty two (52) students which consisted of 12 females representing 23 percent and 40 males representing 77 percent. The average age of the students was 18 years.

The sample was selected because most topics for WAEC examinations are mostly chosen from second year topics in which the perceived difficult topic of wave concept is inclusive. Additionally, the third years were also preparing for the May/June West Africa Senior Secondary Certificate Examination (WASSCE) and so would not get enough time to respond to the questionnaire.

Sample Technique

The sample technique used was purposive sampling to select the class level for the study. In the purposive sampling, Orodho (2009) states that this method is typically used when focusing on a limited number of informants, whom we select strategically so that their in-depth information will give optimal insight into an issue about which little is known.

Finally at the class level, a simple random sampling was used to select one of the four physics offering classes (Agric classes A and B, Science classes A and B). According to Orodho (2009), simple random sampling is a procedure in which all the individuals in the defined population have an equal and independent chance of being selected as a member. The sampled class was then assigned to both pre and post treatment.

Variables for the study

The independent variable in this study was an eight (8) week teaching instructional strategy that was administered to an intact second year elective physics class. The dependent variable in this study was the student's scores obtained in the traditional method of teaching and the analogy method of teaching on the wave concept topic in physics.

Research Instruments

With the purpose of the study, there was the need to gather data on students' outcomes of the analogy instructional strategy and traditional instructional strategy. Due to these, a form of formative assessment was used to collect data on students' performance. A close-ended objective test item adapted from Conceptual

Physics and Prentice Hall Science Explorer – Wave concept and wave phenomenon textbooks were given to the students as pre intervention test and post intervention test to assess the gain in performance. From Smith (1987) view, the closed ended questions were appropriate for this study since it allowed respondents to choose between options provided by the researcher and have increasingly become popular compared with open-ended questions.

Intervention Activities

The instructional strategy was implemented through teacher centred and analogy instructional strategy. The samples were subjected to the same treatment for four weeks each.

The samples were first taken through an identified and usual teaching and learning strategy which is teacher-centred instructional approach on wave concept. This was where the teacher transmitted information via the lecture method with little teaching and learning material involved. After using the teacher-centred approach for four weeks, a class test (pre intervention test) was conducted to assess the performance of the students on the lesson taught. The class test consisted of 20 test items of objective questions with multiple answers. The students' responses were collected, marked and recorded.

For another four weeks, the sample was taught using the analogy approach. This was where the teacher transmitted the same information via the analogy tools. Analogy (TWA) model was used to teach the wave concept where some analogies were shown directly to students in the classroom by using the required tools. However, the pictures of other analogies were drawn on the board and presented to the students. During the presentation of the analogies in the classroom, students were assisted to both join the lesson and make a connection between basic wave concepts and analogies with the help of a few questions. In this way, it contributed to the maximum participation of students in the lessons. At the end of the presented analogies (after the discussion between the students) the teacher explained the similarities and differences between the analogue and actual concepts again. Therefore, the students who made an incorrect connection between the analogue and actual concepts were able to re-organise their opinions. After the four weeks, a class test (post intervention test) was conducted to assess the performance of the subjects on the lesson taught.

The class test consisted of 20 test items of objective questions with multiple answers. The students' responses were collected, marked and recorded.

Validity of the Instrument

Validity in quantitative research determines whether the research truly measures that which it was intended to measure or what it was set out to measure how truthfully the research results are (Joppe, 2000). To ensure that the test items for the study were valid, it was given to a university lecturer for thorough examination to ensure that it measures the total content area (content validity) of the study.

According to Merriam (1998), to ensure internal validity, two physics experts were employed to study the items and comment on it.

Reliability of the instrument

Reliability is a measure of the degree to which an instrument yields consistent results or data after repeated trial. (Mugenda & Mugenda, 1999)To ensure the reliability of the research instrument, a pilot test was carried out on a sample of SHS 2 elective physics science students at Awe SHS. The SHS 2 elective physics students of Awe SHS were used in the study because they had the same characteristics as the actual participants of the study in terms of the learning environment.

These students used for the pilot test did not form part of the sample for the study. Data from the pilot test were statistically analysed to determine the reliability of the test instruments using Spearman-Brown prophecy formula since all items on both pre intervention test and post intervention test were dichotomously scored. The analysis yielded reliability co-efficient of 0.58 and 0.63 for the pre intervention test and post intervention test respectively as shown in Table 1.

Table 1 The Reliability Co-efficient of the Research Instrument

Types of research instrument test	Number of student	Reliability co-efficient
Pre intervention test	52	0.58
Post intervention test	52	0.63

Source: field data, April 2015

According to Miles & Huberman (1994), if the measurement results are to be used for making a decision about a group or for research purposes, or if an erroneous initial decision can be easily corrected, then the scores with modest reliability co-efficient in the range 0.50 to 0.60 may be acceptable. The above reliability co-efficient for the pre intervention test and post intervention test therefore, signifies that both test instruments are considerably reliable.

Data Collection Procedure

The test items were administered personally by the researcher to the form two elective physics (Science B) students of Navrongo Senior High School after seeking permission from the headmistress and the head of department of science.

The mode used for administering the test items was the investigator-administered mode.

This mode of administration ensured a 100% collection of the test item response. Also respondents were not allowed to communicate among themselves to ensure that response was not affected by other respondent's views. Again for respondents to be candid about their responses they were made aware of the fact that the test was for academic purpose only and that the information they were providing would be kept strictly confidential and that no name was to be written on the test items.

Data Analysis

The data collected was examined for consistency and accuracy by reading through all the responses that were provided by the respondents. The responses from the test items were analysed using SPSS. Coding schemes were developed to organise the data into meaningful and manageable categories. The SPSS was chosen for the data analysis because it was reasonably user friendly and does most of the data analysis one needs as far as quantitative and qualitative analyses are concerned (Muijs, 2004)

The researcher did the raw data entries in order to ensure accuracy of entry of the data. Descriptive statistics such as means, standard deviation, and percentage scores were calculated.

RESULTS AND DISCUSSION

In this part, the data generated from students' pre-intervention test and post-intervention test results, improvement gained, questionnaire were analysed to reflect on the research questions for this study. Detailed discussion has been made on the findings with related literature.

Research Question 1: What knowledge do students have about the concept of wave before the use of analogy instructional strategy?

A twenty (20) test items on wave concept was administered after the topic was taught through traditional method of teaching. The results are presented in Table 2:

Table 2: Grades Obtained by the Students during the Pre intervention test

Expected performance scale By GES & WAEC	Grade	Remarks	Frequency	Percentages (%)
'0 – 39	F9	Fail	15	28
40-54	D7-E8	Pass	24	46
55 -69	C4-C6	Credit	9	18
70-74	B3	Good	2	4
75-79	B2	V. Good	1	2
80-100	A1	Excellent	1	2
Total			52	100

Source: field data, April 2015

Each raw score was giving a weight of 5% which implies that a total score of 20 is a 100% on the percentile. The raw scores obtained ranged from 6 to 16 which were converted from 30% to 80% on a percentile scale. Gravetter and Wallnau (2004) define a raw score as a single score that is derived from a test or an observation whilst cumulative percentages determine placement among a group of scores. Converting raw scores into cumulative percentages allows for meaningful comparisons. (Gravetter & Wallnau, 2004)

The table therefore presents the percentile score of 0 to 39 which was obtained by fifteen (15) students representing 28% of the respondents. Also one (1) student obtained the highest percentile score of 80 to 100 representing 2% of the sample.

In the table, the percentile score of 40 to 54 was recorded as the highest frequency mark for the twenty-four (24) students representing 46% of the sample obtained.

Table 2 further showed how the students would have performed on the WAEC and GES grading standard. The best was grade 'A1' which had a frequency of 1 thus representing 2%, followed by grade 'B2' with a frequency of 1 representing 2%, then grade 'B3' with frequency of 2 representing 4%, grade 'C4' to C6 with frequency of 9 representing 18%, also grade D7 to E8 had frequency of 24 with its corresponding percentage of 46 and finally grade 'F9' representing 28% of the sample obtained. These data suggest the best grade obtained during the Pre intervention test was 'A1' and the least was 'F9', whiles the grade obtained by majority of the student (26 students) was 'D7' to 'E8' which represented 46%. The results showed that majority of the students would have had pass remark according to the Ghana Education Service (GES) and West Africa Examination Council (WAEC) grading system. This implies that more than two-third of the sample obtained a pass, which on

the WAEC was rated as a very poor remark.

According to Hatim (2011), the elaborates that enhanced learning and increased performance is not only found in the social constructivist classroom but the traditional lecture classroom can also enhance learning and increase students' performance once there is appropriate content and design of teaching or learning. Cullen *et al* (2004) also revealed in their study that there was a positive influence in students' research abilities when the traditional instructional strategy was employed. However findings of Clinton and kohlmeyer (2005) proved that during the instruction with traditional method, there was no change in the students' results of the concept taught. Therefore in this study, students' results at pre intervention test were compared to their usual performance before the intervention activities and the results showed that there was no significant change. In line with this, Arquero-Montano (2004) in their study conducted in UK did not affect students' results and performance during the use of traditional method of instruction.

Research Question 2: What knowledge do students have about the concept of wave after the use of analogy instructional strategy?

This question sought to find out the knowledge students had on wave concept during the analogy instructional strategy. Table 3 below shows scores obtained when a 20 test items on wave concept was administered after the topic was taught through analogy method of teaching.

Table 3 Grades obtained by the students during the Post intervention test

Marks	Grade	Remarks	Frequency	Percentage
40-54	D7-E8	Pass	4	8
55 -69	C6 –C4	Credit	13	25
70-74	B3	Good	4	8
75-79	B2	V. Good	7	13
80-100	A1	Excellent	24	46
Total			52	100

Source: field data, April 2015

Each raw score was also giving a weight of 5%. As shown in Table 3, the raw scores obtained ranged from 10 to 20 which was converted to percentile marking scale of 50% to 100% during the Post intervention test.

The table depicts that four (4) of the students obtained the least percentile marks of 40 to 50 representing 8% of the sample. Also twenty four (24) students obtained the highest percentile marks of 80 to 100 representing 46% of the sample which was recorded as the highest.

Table 3 further shows the best grade obtained by students would have been grade 'A1' based on GES and WAEC grading system which had a frequency of 24 representing 46%, followed by grade 'B2' which had a frequency of 7 representing 13%, then grade 'B3' with frequency 4 representing 8%, then grade 'C4-C6' with frequency of 13 representing 25%, and finally grade 'D7-E8' of frequency 4 representing 8%.

The study of Hosal-Akman and Sigma-Mugan (2010) in Turkey explores the effect of teaching methods on the academic performance of students in some selected concept which revealed that there was no statistically significant difference in their results during the exposure to a conceptual approach. However when content is difficult to relate to and the teacher wants to develop critical thinking skills in a didactic lecture Cardoso, Cristiano and Arent (2009) recommend the need for the development and implementation of new educational practices to make classrooms more interesting and interactive even in a lecture format. Therefore Gujarathi (2005), Marriott (2004), Hoffjan (2005) adopted a contemporary teaching format including analogy which their findings showed that there was an improvement in students' performance when they were exposed to contemporary.

In this study, the data collected on the post intervention test was in support of Zohreh et al (2010) study, which showed students' performance score in the post intervention test increased when compared to their usual performance before the intervention activities.

T-test Analysis

With the administration of the test items, the researcher was interested in finding out whether the analogy instructional strategy had any effect on the performance of the students as against the traditional method of teaching. Therefore T – test analysis was performed on the mean scores for pre intervention test and post intervention test. This was done to determine whether significant difference exist between the mean scores.

Table 4: T–test Analysis of Pre intervention test and Post intervention test

Test	N	Mean	D F	S D	T –value	P-value	Hake Gain
Pre intervention test	52	9.154	51	2.484	-36.931	.000	0.67
Post intervention test	52	15.154	51	3.077			
Difference		6.000		1.172			

Significance at 0.05; $p < 0.05$

Table 4 above presents the mean score for Pre intervention test of subjects in traditional method of teaching

and the mean score for Post intervention test of subjects in analogy instructional strategy. It is observed in the table that the means of the scores for pre intervention test and post intervention test indicates that the mean scores increased from (M = 9.154, SD = 2.484) to (M=15.154, SD = 3.077). The normalized gain (g) for the pre intervention test and post intervention test was 0.7 indicating that student's marks on post intervention test as compared to the pre intervention test shows a medium gain in improvement in performance during the post intervention test where analogy instructional method was employed. Also total performance scores of the entire sample put together on the post intervention test (788) was higher than the total scores at pre intervention test (476). This implies that there was an improvement in performance of 39.6% during the post intervention test. This finding supports that of Elvis (2013), whose study proved that when analogy instructional strategy was compared to that of traditional method of instruction, achievement was improved by over 38%.

Conducting a dependent t-test to evaluate whether a significant change occurred between the pre intervention test and post intervention test, results showed that the difference between the mean scores was significant at p value of 0.00 which the significant difference was set at alpha (α) value of 0.05 hence there was a significant difference. The researcher therefore concludes with 95% confidence that the samples performed better at the post intervention test. The researcher therefore had sufficient information to conclude that there was a significant difference between the analogy instructional method of teaching and the traditional instructional method of teaching.

Difference in the mean values of the pre intervention test 9.154 and post intervention test 15.154 was 6.00 indicating that there was a moderate effect. This implies that there was appreciable improvement in the post intervention test as compared to the pre intervention test. In line with this, Okoronka and Taale (2014) in their research findings supported that superior academic performance was achieved when analogy forms of instruction were utilised.

CONCLUSION AND RECOMMENDATIONS

The purpose of the study was to find out if there was any difference in the application of the traditional method in teaching wave concept and that of analogy method of teaching wave concept in Physics.

The results showed that the average normalised gain of the post and pre intervention test scores was a gain of 0.66, indicating that there was a medium gain in students' performance. A dependent sample t-test conducted also showed a significant difference in the pre intervention test and post intervention test scores, p= 0.000 (α=0.05). Hence there was a significant difference between the pre intervention test and post intervention test scores indicating that students performed better when taught using the analogy method of teaching than the traditional method of teaching. Finding from interviews with the sample indicated that students prefer the analogy method of teaching to the traditional method of teaching.

Thus, the analogy learning activities enhanced performance and conceptual understanding of the concepts taught. .

Results from this study also indicated that majority of the students participated actively in the interactive lessons with analogy and thus, they were motivated more to participate actively in the lessons therefore they preferred analogy instructional strategy to traditional strategy of instruction.

Finally, it was concluded that the analogy method of teaching was the effective way of improving student's performance in the teaching and learning of wave concept in physics. Analogy also made it easier for teachers to communicate the lesson or topic to the students and also help teacher to improvise in the absence of an actual material.

From the study, the following guidelines are recommended to schools and teachers who would like to include analogy instructional strategy in the teaching and learning of physics.

- Science teachers should be encouraged to employ the use of analogy method of teaching in the delivery of their lesson so that student can perform better.
- Science teachers are encouraged to improvise in the absence of real material to make their science lesson practically oriented. The Ministry of Education through Ghana Education Service (GES) should organise workshops, in-service training frequently for science teachers on the practical use of analogy in their teaching.

REFERENCES

Arquero-Montano, J.L., Cardoso, S.M.J., & Joyce, J. (2004). Skills development, motivation and learning in financial statement analysis: An evaluation of alternative types of case studies. *Accounting Education, 13*(2), 191–212

Bao, L. (2006). *Theoretical comparisons of average normalised gain calculations.* Woodruff Avenue, Columbus, Ohio: The Ohio State University

Bassock, M. (1990). Transfer of domain specific problem solving procedure. *Journal of experimental Psychology, Learning Memory and Cognition, 16* (3), 522-533.

Burns, N., & Groove, S. (1993). *The practice of nursing research: conduct, critique and utilisation* (2nd ed.). Pennsylvania: W. B. Saunders Philadelphia.

Cardoso, D. C., Cristiano, M. P., & Arent, C. O. (2009). Development of new didactic materials for teaching science and biology: The importance of new education practices. *Journal of Biological Sciences*, 9(1), 1-5

Clinton, B.D., & Kohlmeyer, J.M. (2005). The effects of group quizzes on performance and motivation to learn: Two experiments in cooperative learning. *Journal of Accounting Education, 23*(2), 96–116.

Cullen, J., Richardson, S., & O'Brien, R. (2004). Exploring the teaching potential of empirically-based case studies. *Accounting Education, 13*(2), 251–266.

Duit, R. (1991). The role of analogies and metaphors in learning science. *Science Education*, 75 (6), 649-672

Elvis, M. G. (2013). Teaching Methods and Students' Academic Performance. *International Journal of Humanities and Social Science Invention*. *2* (9), 29-35

Franz, H. (1983). The crisis in high school physics teaching, path to a solution. *Physics Today, 36*, 44-49.

Ghana Education Service. (2009). *Register of programmes for senior high schools.* Accra: Ghana Education Service.

Gravetter, F. J., & Forzano, L. B. (2006). *Research Methods for Behavioural Sciences.* (2nd Ed.). Belmont, CA: wadsworth

Gravetter, F. J., & Wallnau, L. B. (2004). *Statistics for the Social Sciences* (6th Ed.). Belmont, CA: Wadsworth.

Gujarathi, M. (2005). Use of ERP software in accounting: A teaching note. *Advances in Accounting Education, 7*, 207–220.

Hake, R. R. (1998). Interactive engagement versus traditional methods: A six thousand student survey of mechanics test data for introductory physics courses. *American Journal of Physics, 66*, 64-67

Hatim, A. (2011). A comparison of cooperative learning and traditional lecture methods in the project management department of a tertiary level institution in Trinidad and Tobago. *Caribbean Teaching Scholar, 1* (1), 49-64

Hoffjan, A. (2005). Calvados-A business game for your cost accounting course. *Issues in Accounting Education, 20*(1), 63–80.

Hosal-Akman, N., & Simga-Mukan, C. (2010). An assessment of the effects of teaching methods on academic performance of students in accounting courses. *Innovations in Education and Teaching International, 47*(3), 251-260.

Johnson, R. B., & Onwuegbuzie, A. J. (2004). Mixed Methods Research: A research paradigm whose time whose time has come in: *Educational Researcher, 33*(7), 14-26.

Joppe, M. (2000).*The Research Process.* Retreived July 25, 2015, from http:/www.ryerson.ca/-mjoppe/rp.htm

Lagoke, B. A., Jegede, O. J., & Oyebanji, P. K. (1997). Towards an elimination of the gender gulf in science concept attainment through the use of environmental analogues. *International Journal of Science Education*, *19*(4), 365 - 380.

Maesor, L., & Woods, P. (1984). *Changing schools: pupil perspective on Transfer to a Comprehensive*. Milton Keynes: Open University Press.

Marriott, N. (2004). Using computerized business simulations and spreadsheet models in accounting education: a case study. *Accounting Education, 13* (1), 55–70.

Merriam, S. B. (1998). *Qualitative Research and Case and Case Study Application in Education*. San Francisco: Jossy-Bass.

Miles, M. B., & Huberman, M. (1994). *Qualitative Data Analysis: A Source Book of New Methods*. Bervely Hills, CA: Sage publications.

Mugenda O.M. & Mugenda A.G. (1999). *Research methods qualitative and quantitative approaches.* Nairobi: Acts Press.

Muijs, D. (2004). *Doing Quantitative Research in Education with SPSS.* London: Sage publications.

Ogunshola-Bandele, M.F. (2001). *Mathematics in Physics which way forward: The influence mathematics on students Attitude towards the teaching and learning of physics*. International Conference proceedings on STME for Human Development, Goa, India.

Okoronka, A. U. & Taale, D. K. (2014). Analogies, Problem-Solving and Concept Mapping Instructional Strategies as Determinants of Senior Secondary School Students' Achievement in Physics in Adamawa State, Nigeria. *International Journal of Humanities and Social Sciences (IJHSS).* 3(3), 33-46

Okoronka, U.A. (2004). Model-based Instructional Strategies as Determinants of students' Learning Outcomes in secondary school Physics in Lagos State, Nigeria. Unpublished Ph.D Thesis, University of Ibadan, Nigeria.

Orodho, J.A. (2009). *Elements of Education and Social Science Research Methods.* (Ed.). Maseno: Kanezja Publisher.

Pravica, M. (2005). *The importance of physics: breakthroughs drive economy, quality of life*. Retrieved from: http://www.reviewjournal.com/lvrj home/2005/Mar-06-Sun 2005/opinion/682710.html.

Sarantakos, S. (1998). *Social Research.* (2nd Ed). China: Macmillan Publishers.

Serway, R.A., & Jewett, S. (2004). *Physics for scientists and engineers: With modern physics* (3rd Ed.). Englewood Cliffs, NJ: Prentice-Hall International, Inc.

Smith, L.Z. (1987). *The Practical Tutor*. New York: Oxford University Press.

Stokking, K. M. (2000). Predicting the choice of physics in secondary education. *International Journal of Science Education, 22*(12), 1261-1283.

Taale, K.D. (2010). Factors influencing students' physical science enrolment decision at the University of Education, Winneba. *African Journal of Educational Studies in Mathematics and Sciences, 8*(3), 63-80.

Taale, K.D. (2011). Improving physics problem solving skills of students of Somanya Senior High Secondary Technical School in the Yilo Krobo District of Eastern Region of Ghana. *Journal of Education and Practice 2* (6), 31-35

Toews, W. (1988). Why take physics in high school why plan to teach physics? *The Physics Teacher,* 26 (7), 458-460.

Zohreh, G., Zeinab, H., Marziyeh, H., & Ramin, I. (2010). Assessing the effect of high school students' training program on peers performance suffering from asthma *Iranian Journal of Nursing and Midwifery Research. 15*(l1), 278–282.