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# THE EFFECTS OF COMPUTER ANIMATION INSTRUCTIONAL STRATEGY ON STUDENTS' INTEREST AND ACHIEVEMENT IN CHEMICAL BONDING IN SHENDAM, PLATEAU STATE, NIGERIA

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***ABSTRACT:***The study examined the effects of animation instructional strategy (ANIS) on senior secondary one chemistry students' interest and achievement in chemical bonding in Shendam - Nigeria. It adopted a pretest – posttest – control group design. A student sample of 74 was drawn from two coeducational schools from a population of 2550 students. Two instruments – the chemistry achievement test (CAT, r =0.899) and interest inventory test (IIT, r =0.755) were used for data collection. Four research questions and hypotheses guided the study. The research questions were answered using mean and standard deviation while the hypotheses were tested at 0.05 level of significance using t-test. The study revealed a significant difference between the mean interest scores of experimental and control groups in favor of the experimental group. It also revealed a significant difference between the achievement of students in the experimental group and the control group. There was neither a significant difference between the interest mean scores of male and female students taught using ANIS nor between the achievements of male and female students taught using ANIS. The study recommended the use of ANIS for teaching chemistry concepts involving movement of particles and the training of chemistry teachers to produce suitable animation packages.

***Keywords:****achievement, animation, chemical bonding,interest, strategy*

## I. INTRODUCTION

Science and technology education is a driving force for the development of nations. It is the pivot on which the wheel of scientific and technological development rotates. Science has been seen as an organized system of explanations of nature through the process of experimentation [1]. Such experimentations may be modified based on light shed by further empirical evidences by the practitioners of science. Technology on the other hand, is the practical application of scientific knowledge to improve the living standards of mankind in its entire ramification. The development of a nation depends largely on the level of scientific and technological advancement of that nation. Therefore, proper attention should be giving to the teaching and learning of science at all levels. It is interesting to know that several products of technology are also being used to enhance and improve the learning of sciences at different levels of study.

[2] defined chemistry as a pure science subject that deals with the composition, properties and uses of matter. It probes into the principles governing the changes that matter undergoes. [3] opined that chemistry has helped in the development of modem technology through the application of its principles to modem inventions. The study of chemistry has been and will remain of paramount importance to mankind because chemistry is capable of explaining natural phenomena and everyday occurrences such as burning of firewood, cooking, rusting of nails, fermentation and the spontaneous emission of radiation by elements. It has also contributed to the development and growth of Nigeria and the world at large [4]. Chemistry has made food more abundant by improving agricultural production, provided us with shelter for protection and clothes to cover our nakedness. It also provides us with medicine for health care and fuel for transportation.

Despite the importance of chemistry in science and technological development, students' achievement in the subject at Senior School Certificate Examination (SSCE) has not been encouraging [5], [1]. Most of the weaknesses are attributed to lack of knowledge on balancing of chemical equation, inability to answer questions in electrolysis, lack of understanding of oxidation and reduction reactions, lack of knowledge of I.U.P.A.C

system of nomenclature, inadequate practical exposure such as redox titration, lack of understanding of basic concepts and principles which includes chemical bonding and poor knowledge of factors affecting rates of chemical reactions.Chemical bonding is a topic in Senior Secondary One (SS1) revised chemistry curriculum. It is an important concept in the teaching and learning of chemistry at all levels of schooling. It is the process of bond formation, whereas the term bond refers to the attractive force that holds ions or atoms or molecules together. There are two main types of bonding namely ionic and covalent bonding. According to [2] covalent bonding refers to the sharing of electrons by atoms of non-metallic elements, which result in a noble gas electronic structure in the valence shell of the atoms involved. In contrast, the term covalent bond refers to the electrostatic force of attraction between positively charged nuclei involved and the shared electrons. On the other hand, ionic bonding refers to the transfer of electrons from metallic atom to the non-metallic atom which results in a noble gas electronic structure in the valence shells of the ions formed while the ionic bond refers to the electrostatic force of attraction existing between the two opposite charged ions formed as a result of the process of electron transfer. Therefore, a proper understanding of such concept is of paramount importance for understanding almost every other areas of chemistry such as electrolysis, oxidation and reduction reaction, acid and bases, carbon compounds and balancing of chemical reactions [6]**.** As noted by Robinson [7] and [8] chemical bonding is considered by teachers, students and chemists to be a complicated and abstract concept such as ionic bonding, covalent bonding and hydrogen bonding are abstract. [9] also agreed that chemical bonding is an abstract topic something far removed from the daily experiences of secondary school students.

Lack of interest by students towards learning chemistry has been one of the major problems confronting the learning of chemistry in schools [1], [10]. Consequently, learning of chemistry concepts suffers and the result is poor achievement in chemistry examinations. In order to make this concept chemical bonding more simpler and understandable, there is the need to arouse students' interest in the teaching and learning of the concept. [11] observed that the poor achievement of students in chemistry can be improved if students' interest is secured and sustained throughout the three years of senior secondary school.The use of the traditional lecture method for teaching all topics in chemistry has been found to be counter-productive and resulting in poor achievement in chemistry in external examination, [5], [12]. [13] observed that some methods of teaching, like use of advanced organizer and concept maps in teaching are more effective than others in a given circumstance. Lectures method when used alone has been proved inadequate to improve achievement. Chemistry teachers need to be made to consider alternative teaching strategies to enable the chemistry students to construct ideas of chemical bonding that will make them to understand chemical bonding. One of such strategies developed through research is the animation instructional strategy (ANIS).

Computer animation is a product of modern technologies. It involves the use of computer-generated graphics to produce moving images. Computer animation produces special effects and stimulates images that would be impossible to show with non-animation techniques. Prior to the advent of computer, animation was achieved by filming hand-drawn or painted sequences on plastics or papers. Animation means liveliness as it involves objects and things in humorous motion. In chemical bonding computer animation can be used to visualize the movement of electrons since the electrons cannot be seen with the naked eyes in the laboratory. Considering the benefits that animation strategy seem to present, there is need for teachers who are professional well trained, to use more effective and scientifically aligned strategies such as animation instructional strategy to teach senior secondary one students offering chemistry the key concepts and principles of chemical bonding or else other topics mentioned before will not be understood if the students did not conceptualize the concept of chemical bonding. This can lead to poor achievement in chemistry. Students' lack of deep conceptual understanding of the key concepts regarding chemical bonding and how to integrate their mental models into a coherent conceptual framework will surely affect their achievements in chemistry examination.

Another factor that determines the outcome of learning is gender. Gender issues in chemistry and science in general is still controversial. [14] and [15] found out in their various studies that there is no significant difference in achievement in chemistry of boys and girls. [16] discovered that girls achieved higher than their male counterparts in sciences contrary to this, [17] found outthat male students achieved higher than female students. Therefore, further studies are required to clarify the effect of different instructional strategies on academic achievement of boys and girls.

**1.1 Statement of the problem**

Chemistry has helped in the development of modem technology through the application of its principle to modem invention. The role of chemistry notwithstanding in national development and the current analysis of students' achievement in chemistry revealed that students' achievement has remained poor over the years in spite of efforts to improve the learning of chemistry at the secondary school level Some researchers have lamented and blamed the poor achievement on a number of factors such as ineffective instructional strategies adopted by chemistry teachers and difficulty in understanding some basic concepts in chemistry such as chemical bonding. Lack of interest in the chemical bonding is because the concept is complex and abstract which makes it difficult for students to retain what they were taught after some times. The traditional approaches have not enhanced

students' interest and achievement in chemical bonding and chemistry in general, hence the need to find out whether animation instructional strategy can enhance male and female students' interest and achievement in chemical bonding. What would be the effects of ANIS on the interest and achievement of males and females students in chemistry concept such as chemical bonding?

**1.2 Objectives of the Study**

The aim of the study is to investigate the effect of animation instructional strategy on male and female students' interest and achievement in chemical bonding. The specific objectives include the determination of:

i. The difference in interest between students taught chemical bonding using animation instructional strategy and those taught using lecture method.
ii. The difference in achievement between students taught chemical bonding using animation instructional strategy and those taught using lecture method.
iii. The difference in interest between male and female students taught chemical bonding using animation instructional strategy.
iv. The difference in achievement between male and female students taught chemical bonding using animation instructional strategy.

**1.3 Research Questions**

i. What are the interest mean scores of the senior secondary one students' in chemical bonding using animation instructional strategy and lecture method?
ii. What are the achievement mean scores of the senior secondary one students' in chemical bonding using animation instructional strategy and lecture method?
iii. What is the effect of animation instructional strategy on male and female students' interest mean scores in chemical bonding?
iv. What is the effect of animation instructional strategy on male and female students' achievement mean scores in chemical bonding?

**1.4 Research Hypotheses**

$Ho_1$: There is no significant difference between the interests mean scores of chemistry students taught chemical bonding using animation instructional strategy and those taught using lecture method.

$Ho_2$: There is no significant difference between the achievements mean scores of chemistry students taught chemical bonding using animation instructional strategy and those taught using lecture method.

$Ho_3$: There is no significance difference between the interest mean scores of male and female chemistry students taught chemical bonding using animation instructional strategy.

$Ho_4$: There is no significance difference between the achievement mean scores of male and female chemistry students taught chemical bonding using animation instructional strategy.

## II. MATERIALS AND METHOD

The study was a quasi-experimental research involving pre-test, post-test non-equivalent control group design. This design is used when there is non-randomized assignment of subject to a group [18]. The population for the study consisted of all the Senior Secondary one (SSI) chemistry students in all the sixteen secondary schools in Shendam town of Plateau State totaling two thousand five hundred and fifty (2550) as at the 2017/2018session. The sample consisted of seventy-four (74) SSI chemistry students from two schools with forty-two (42) students assigned to experimental class while thirty-two (32) were assigned to the control groups. Purposive sampling method was used to identify the two out of the sixteenth co-educational secondary schools that have laptops, projector and electric power supply. Random sampling method was used to assign the two schools (intact classes) into experimental and control groups.

Two instruments were used for the collection of data for the study. These are: Chemistry Achievement Test (CAT) and Interest Inventory Test (IIT). The researcher developed Chemistry Achievement Test (CAT) based on standard examinations such as WAEC and NECO to ensure that questions are from the topics covered by the study. The CAT comprises of 40 multiple choice questions based on Chemical Bonding. The researcher adapted and modified some 25 items on Interest Inventory developed by [19] for use as the Interest Inventory Test (IIT) in chemical bonding. The instruments were validated appropriately and the reliability of the CAT and IIT found to be 0.899 and 0.755 respectively.

The researcher administered a pretest (CAT and IIT) to both the control and experimental groups. Thereafter the students were taught the concept chemical bonding. The control class was taught using the conventional lecture method while the experimental group was taught using a combination of lecture and animated instructional strategy (ANIS). The researcher used animated software in a laptop and projected on the wall to teach the experimental class. The software shows how electrons are transferred from one atom to the other. It also shows how electrons are shared between atoms in covalent bonding. Altogether, the teaching lasted a period of three weeks. Thereafter, the items in the CAT and IIT were reshuffled to make them appear different at a glance and were administered to both control and experimental groups as posttest at the end of the

treatment. The pretest and posttest scores of the groups were used for analyses.

The data collected from the study was analyzed using descriptive statistics. The research questions were answered using mean and standard deviations of the test scores. The research hypotheses were tested at 0.05% level of significance using t-test statistical tool.

## III. RESULTS

The data collected using the research instruments were analyzed and used to answer the research questions. The same data were also used to test the hypotheses and the results presented.

3.1 Answering Research Questions

Research Question One: What are the interest mean scores of the senior secondary one students' in chemical bonding using animation instructional strategy and lecture method?

Table 1: Students Interest Mean Scores and Standard Deviation Scores on Chemical Bonding

| Group | Pre-Interest Score | | | Post-Interest Score | | |
|---|---|---|---|---|---|---|
| | N | $\bar{X}$ | SD | $\bar{X}$ | SD | Mean Gain Score |
| Experimental | 42 | 48.90 | 5.68 | 89.90 | 4.00 | 41.00 |
| Control | 32 | 49.20 | 5.33 | 59.20 | 5.00 | 10.00 |

The pre- interest mean scores of experimental group is 48.90 with a standard deviation of 5.68 while the post-interest mean score is 89.90 with a standard deviation of 4.00. The control group had mean pre-interest score of 49.20 (SD = 5.33) while the post-interest mean score is 59.20 (SD = 5.00). TABLE 1 shows that the experimental group had higher mean gain score of 41.00 than the control group with mean gain score of 10.00. Higher mean interest score and low standard deviation by experimental group shows that the students gained higher interest in chemical bonding by the use of ANIS than the use of lecture method.

Research Question Two: What are the achievement mean scores of the senior secondary one students in chemical bonding using animation instructional strategy and lecture method?

The results are presented in Table 2.

Table 2: Students Achievement Mean Scores and Standard Deviation Scores on Chemical Bonding

| Group | Pre-Interest Score | | | Post-Interest Score | | |
|---|---|---|---|---|---|---|
| | N | $\bar{X}$ | SD | $\bar{X}$ | SD | Mean Gain Score |
| Experimental | 42 | 47.80 | 10.00 | 84.50 | 5.00 | 36.70 |
| Control | 32 | 48.20 | 9.27 | 60.20 | 6.37 | 12.00 |

TABLE 2 shows that experimental group had pretest achievement mean score of 47.80 (SD = 10.00) and a posttest mean score of 84.50 (SD = 5.00). The mean gain score of the experimental group is 36.70. The control group had a pretest mean achievement score of 48.20 (SD = 9.27) and a posttest mean achievement score of 60.20 (SD = 12.00). The mean gain score of control group is 12.00. The experimental group had higher mean gain score than the control group. This shows that ANIS has a profitable effect on students' achievement in chemical bonding.

Research Question Three: What is the effect of animation instructional strategy on male and female students' interest mean scores in chemical bonding?

This is answered by the data presented in Table 3.

Table 3: Interest Mean Scores and Standard Deviation Scores of Male and Female Students in Chemical Bonding ANIS

| **Group** | | **Pre-test Score** | | | **Post-test Score** | | |
|---|---|---|---|---|---|---|---|
| | Sex | N | $\bar{X}$ | SD | $\bar{X}$ | SD | Mean Gain Score |
| Experimental | Male | 21 | 48.99 | 5.00 | 89.82 | 4.90 | 40.83 |
| | Female | 18 | 48.79 | 5.60 | 89.98 | 4.10 | 41.19 |

TABLE 3 shows that the female students in the experimental group had a pretest interest mean score of 48.79 (SD = 5.60) and a posttest interest mean score of 89.98 (SD = 4.10). The male students in the same experimental group had a pretest interest mean score of 48.99 (SD = 5.00) and a posttest interest mean score of 89.82 (SD = 4.92). The mean interest gain of the female students is 41.19 while that of the male students is 40.83. This means that both male and female students in the experimental group developed higher interest in learning the concepts of chemical bonding through the use of ANIS. Both benefitted from ANIS.

Research Question Four: What is the effect of animation instructional strategy on male and female students' achievement mean scores in chemical bonding?

Table 4: Achievement Mean Scores and Standard Deviation Scores of Male and Female Students in Chemical Bonding

| Group | | Pre-test Score | | | Post-test Score | | |
|---|---|---|---|---|---|---|---|
| | Sex | N | $\overline{X}$ | SD | $\overline{X}$ | SD | Mean Gain Score |
| Experimental | Male | 24 | 47.90 | 9.20 | 84.49 | 5.20 | 36.59 |
| | Female | 18 | 47.70 | 10.00 | 84.51 | 5.90 | 36.81 |

TABLE 4 shows that the female students in the experimental group had a pretest mean achievement score of 47.70 (SD =10.00) and a posttest mean score of 84.51 (SD = 5.90). The male students in the experimental group had a pretest mean achievement score of 47.90 (SD =9.20 and a posttest mean score of 84.49 (SD = 5.20). The female students had a mean achievement gain score of 36.81 and male had mean achievement gain score of 36.59. The difference in their mean achievement score is negligible (0.02). This shows that the ANIS had similar effects on both male and female students' achievement in chemical bonding.

**3.2 Testing Hypotheses**

**Hypothesis One:**

There is no significant difference between the interests mean scores of chemistry students taught chemical bonding using animation instructional strategy and those taught using lecture method.

The result for testing hypothesis one is displayed in table 5.

Table 5: T-test Analysis on Hypothesis One

| Group | Pre-Interest Score | | | | | | |
|---|---|---|---|---|---|---|---|
| | N | $\overline{X}$ | SD | *t-cal* | t-tab | df | L |
| Experimental | 42 | 89.90 | 4.00 | | | | |
| | | | | 27.54 | 2.00 | 72 | 0.05 |
| Control | 32 | 59.20 | 5.00 | | | | |

TABLE 5 indicates that the calculated t-value at 0.05 level of significance is 27.54 and is greater than the critical t-value of 2.00. Therefore the null hypothesis was rejected. This means that there is significant difference between the mean interest scores of chemistry students taught chemical bonding using ANIS and those taught using lecture method. This implies that there is a significant difference between the mean interest scores of experimental and control groups in interest inventory in favor of the experimental group.

**Hypothesis two:**

There is no significant difference between the achievements mean scores of chemistry students taught chemical bonding using animation instructional strategy and those taught using lecture method.

The result for testing hypothesis two is presented in Table 6.

Table 6: T-test Analysis on Hypothesis Two

| Group | Post-test Score | | | | | | |
|---|---|---|---|---|---|---|---|
| | N | $\overline{X}$ | SD | *t-cal* | t-tab | df | L |
| Experimental | 42 | 84.50 | 5.00 | | | | |
| | | | | 15.67 | 2.00 | 72 | 0.05 |
| Control | 32 | 60.20 | 6.37 | | | | |

Results presented in TABLE 6 indicates that the calculated t-value of 15.67 at 0.05 level of significance is greater that the critical t- value of 2.00. The null hypothesis two failed to be accepted and the alternative hypothesis accepted. Therefore there is a significant difference between the achievement mean scores of chemistry students taught chemical bonding using ANIS and those taught using lecture method. ANIS significantly improved the achievement of students in chemical bonding.

Hypothesis Three:

There is no significance difference between the interest mean scores of male and female chemistry students taught chemical bonding using animation instructional strategy.

Table 7: T-test Analysis on Hypothesis Three with Reference to Gender

| Group | | N | $\overline{X}$ | SD | *t-cal* | t-tab | df | L |
|---|---|---|---|---|---|---|---|---|
| Experimental | Male | 24 | 89.82 | 4.90 | | | | |
| | | | | | 0.177 | 2.021 | 40 | 0.05 |
| | Female | 18 | 89.98 | 4.10 | | | | |

TABLE 7 shows that calculated t-value is 0.177 while the critical t-value is 2.021 at 0.05 level of significance. The t-calculated is less than the critical value. This means the null hypothesis three is accepted. Therefore there is no significant difference between the interest mean scores of male and female chemistry students taught chemical bonding using animation instructional strategy. This implies that ANIS improves male and female students' interest in chemical bonding in similar manner. It doesn't favor male students at the expense of the female students.

**Hypothesis Four:**

There is no significance difference between the achievement mean scores of male and female chemistry students taught chemical bonding using animation instructional strategy.

Table 8: T-test Analysis on Hypotheses Four with Reference to Gender

| Group | | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| | | N | $\overline{X}$ | SD | *t-cal* | t-tab | df | L |
| Experimental | Male | 24 | 84.49 | 5.30 | | | | |
| | | | | | 0.120 | 2.021 | 40 | 0.05 |
| | Female | 18 | 84.51 | 5.10 | | | | |

The t-test result in TABLE 8 indicates that the calculated t-test of 0.120 at 0.05 level of significance is less than the critical t-value of 2.021 from the table. This means that the null hypothesis is accepted. Therefore there is no significance difference between the achievement mean scores of male and female chemistry students taught chemical bonding using animation instructional strategy. ANIS equally influences both male and female students' achievement in chemical bonding.

## IV. DISCUSSION OF RESULTS

The study examines the effects of animation instructional strategy on senior secondary one-chemistry students' interest and achievement in chemical bonding in Shendam, Plateau State Nigeria. The findings revealed a significant difference in the students' interest and achievements in favor of the group taught with animation instructional strategy (ANIS). The study established that there is a significant difference between the mean interest scores of experimental and control groups in interest inventory in favor of the experimental group. The result agrees with [20] who reported that the use of films, clips, photos, slides and animation can make learners more interested in chemistry and helps them understand those concepts by making them more tangible and less abstract. The result also agrees with that of [21] who found that students taught using animated media strategy had a significantly higher positive interest in geography.

The study also established that there is a significant difference between the achievements mean scores of chemistry students taught chemical bonding using animation instructional strategy and those taught using lecture method. The students taught using ANIS achieved higher in a chemistry achievement test involving chemical bonding. This result agreed with that of [22] who carried a study on the effects of computer animations on high school students' performance in biology. They found out that computer animations accompanied by traditional teaching increase the performance of high school biology students. The result is also consistent with that of [23] who found out that the use of computer animation resulted to significantly higher conceptual understanding in tests involving particulate nature of matter evaluation. The study established the effectiveness of computer animation instructional strategy over the lecture method. The result is inconsistent with the findings of [24] who reported that students taught electrochemistry with lecture method supplemented with music had higher achievement scores than those taught with animation instructional strategy.

Another finding of the study is that there is no significant difference between the interest mean scores of male and female chemistry students taught chemical bonding using animation instructional strategy. Both male and female students in the same group developed higher interest in chemical bonding. This is in consonance with [25], who found that gender had no significant influence on the interest demonstrated by the students towards chemistry. It also agrees with the finding of [26] who long ago, found out that student' interest can be aroused and sustained by the use of a better and more interactive strategy used in teaching chemistry.

Finally, the study found that there is no significance difference between the achievement mean scores

of male and female chemistry students taught chemical bonding using animation instructional strategy. Both male and female students taught using ANIS had higher achievement mean scores in chemical bonding. This is in line with [27] who found that gender had no significant difference on the achievement demonstrated by the students in chemistry and reported that male and female students compete favorably in science subjects. [28] also established that gender has no effect on the achievement of students taught geography with computer animation package. However the result is contrary to the findings of [16] and [14] who found in their various studies that there is a significant difference in the achievement of male and female students in chemistry and science examinations.

## V. CONCLUSION AND RECOMMENDATIONS

This study established the usefulness of computer animation instructional strategy to improve the achievement and interest of senior secondary one-chemistry students in chemical bonding. The strategy also improves the interest and achievement of male and female students equally. This means that computer animation instructional strategy is gender friendly when used to teach chemical bonding. This further confirms the importance of technology in science, technology and mathematics teaching and learning. Technology can no doubt be used to improve every field of study and human endeavor. It is advisable therefore, that chemistry (and indeed science) teachers explore the use of technologies such as the use of computer animation instructional strategies for teaching in their classrooms. Chemistry teachers can particularly use ANIS to teach concepts involving motions of particles, transfer and sharing of electrons. Chemistry teachers should be trained in the production of suitable animation instructional strategy packages through in-service training, workshops, symposia and seminars. Computer educators in should be involved in developing software that will enhance the teaching and learning of science.

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