# Innovations

## Effect of Activity, Students, Experiment and Improvisation (ASEI) Teaching Strategy on Students' Attitude in Chemistry in Federal Capital Territory, FCT, Abuja

**Dr. Sunday Ade. Adeniran**

Department of Science Education,
Faculty of Education,
Federal University, Oye-Ekiti, Ekiti State, Nigeria.
ORCID: 0000-0001-5906-6045

**Dr. Kemilola Stella Ekundayo**

Department of Science Education,
Faculty of Education,
Federal University, Oye-Ekiti, Ekiti State, Nigeria.
ORCID: 0000-0002-3937-9252

**Emmanuel Omale**

Department of Science Education
Federal University of Agriculture, Makurdi, Benue State, Nigeria
ORCID: 0000-0002-9524-9436

**Corresponding author:** **Dr. Sunday Ade. Adeniran**

*Abstract*

*The researchers investigated the effect of Activity, Students, Experiment and Improvisation(ASEI) teaching strategy on chemistry students' attitude in senior secondary schools in Federal Capital Territory, Abuja. The study had two research objectives which were translated into research questions and hypotheses. 160 students were sampled through purposive sampling out of 1,680 SS1 Chemistry students. The study was planned up using a semi-experimental qualitative research. Chemistry students' attitude surveys provided the data for the study (CSAI).Simple percentage analysis was used to examine the research questions, and Analysis of Covariance was used to analyze the hypotheses (ANCOVA).According to the study, using the ASEI instructional strategies improves participants' attitudes toward chemistry more than using traditional techniques. The application of the ASEI classroom instruction revealed that sex had no appreciable impact on the learners' attitudes toward chemistry. It was recommended that educational institutions should emphasize the need to arouse and sustain students' attitude through the use of ASEI teaching strategy. Teachers' trainees should be given the opportunities to master the principles behind the use of ASEI teaching strategy. Teachers should adopt the use of fascinating or attractive instructional materials that will enhance the attitude of students positively.*

*Keywords: 1.Activity, 2.Students, 3.Experiment, 4.Improvisation,5. Attitude*

## 1.        Introduction

Science and technology education has been regarded as the universal foundation for economicprogress stability in a number of countries. Previously, only the most gifted students were encouragedto pursue scien related courses as science was regarded as a form of knowledge only available to aselect few (Abdullahi, 2 Because of its importance in economic stability, chemistry is one of themost significant topics.

Chemistry is at the heart of global economic development that is both sustainable and long-term.Food (fertilizers and pesticides), clothing (textile fibers), buildings (cement, concrete, steel, bricks),medicine (drugs), and transportation all benefit from it (fuel, alloy materials). Man is currently living in aperiod of scientific and technical growth that has an impact on his existence in some way. Because of itsnature, chemistry is a popular topic among Nigerian senior secondary school students. It satisfies themajority's demands by being relevant and functional in terms of both substance and utilization.

A lot of countries, like Nigeria, are in desperate desires of an operational Chemistry as a subjectthat can aid their growth. The process of bringing manufacturing inventories and sculpturing,among other things, is influenced by chemistry (Hornby, 2019). The attitude of studentsdetermines their academic progress. In the teaching and learning of chemistry, attitude is a powerfulcomponent that can motivate students to participate in classroom experiments and improve their grades.Outward behavior expresses an internal sensation called attitude. It has ramifications for thestudent, the teacher, and the social group with which the student interacts. A person's attitude is created asa result of a variety of learning experiences. They can also be learned by simply following a parents,teachers, or friend's example or advice. This is mimicry or imitation, which has a place in the teachingand learning process. In this way, the student draws from his teachers; attitudes to build his own, whichmay have an impact on his performance (Balozi&Njunge, 2018).

The Federal Government of Nigeria, through the Ministry of Education, Science and Technology (MOEST), in collaboration with the Japanese government, launched the Strengthening of Mathematics and Science in Secondary Education (SMASSE) project in Nigeria to improve chemistry students' learning and achievement.SMASSE is for Strengthening of Mathematics and Science in Secondary Education, and it is an educational program whose main goal is to help Nigerian secondary schools enhance their science and mathematics achievement.It's a collaboration between the Nigerian Government's Ministry of Education and the Japanese government's Japan International Cooperation Agency (JICA).

SMASSE was founded after persistently low accomplishment in mathematics and science (biology, chemistry, and physics) became a severe problem.Broad curricula, a lack of facilities, and insufficient staffing have all been mentioned as important causes of students' low achievement in Chemistry (CEMASTEA, 2018).The Ministry of Education and other stakeholders recognized the need for action, which led to the Secondary School Mathematics and Science Strengthening Initiative (Nui &Wahome, 2019).

This was accomplished through teacher in-service education and training (INSET).It is a seminar designed to teach teachers how to employ the Activity, Students, Experimentation, and Improvisation teaching methods in their classrooms.The proposal appears to be an ideal solution for Nigeria's situation, as the country has traditionally struggled with limited educational resources.The SMASSE initiative employs the ASEI teaching strategy as a method of instruction (Nui &Wahome, 2019).Activity, Student-centered, Experiment, and Improvisation (ASEI) is an acronym for Activity, Student-centered, Experiment, and Improvisation.

It is a teaching method that tries to make classroom instruction more student-centered.As a result, the paradigm shifts from "banning style and chalk and talk" to "activity-based/student-centered approach" is taking place. As an intervention method, ASEI considers how children develop their own meanings for words rather than merely copying them.They must be provided the opportunity to develop their knowledge of science through the combination of experience, material from the past, and ways of thinking.

As a methodological fundamental shift, the classroom ASEI teaching approach is already attracting considerable interest.        Different authors appear to define student centered teaching differently, with some equating it with active learning and others interpreting it more broadly to include active learning, choice in learning, and a shift in authority from the teacher to the student (Nui &Wahome, 2019).The procedures for the ASEI teaching

strategy, according to the Centre for Mathematics, Science and Technology Education in Africa (CEMASTEA) 2018, are as follows: the teacher divides the students into groups as soon as he enters the classroom to teach; he divides the entire class into various groups with the goal of doing the practical or activities together.

The instructor divides the students into groups based on their abilities and traits; the teacher asks the students to name the materials on the tables before the lesson begins; the teacher places instructional materials on the tables for each group before the lesson begins.He will ask the students to identify these resources in their groups; the teacher will instruct the students on how to carry out the activities: the teacher will instruct the students on how to carry out the activities during class.He instructs the pupils by outlining the steps they must take to complete the exercise successfully.As the activity progresses, students who are perplexed are welcome to ask questions.The teacher instructs the students to submit their results or observations in groups, the group leaders read their findings or observations to the entire class, and the teacher then thoroughly explains the contents:

After the presentations, the teacher begins to teach based on the lesson's goals or behavioral objectives; he then evaluates the lesson based on the behavioral objectives, which is done by the teacher asking the students oral questions to see if the lesson's objectives are met; and finally, he concludes the lesson by assigning homework to be turned in the following class.It was revealed that pupils exhibit a negative attitude toward chemistry learning.Low student accomplishment and a negative attitude have been related to a variety of variables, including instructors' qualifications, instructional methods, teachers' competency, student attitude, and teachers' lack of improvisational abilities, among others.Despite the multiple elements cited as contributing to the negative attitude about the subject, the issue remains with the teaching approach employed in lesson delivery.One of the most common solutions used to address the problem outlined above is the ASEI strategy.The initiative has received a significant amount of financial and material resources.However, little is known about how well students performed when the ASEI method was employed to teach chemistry.As a result, the question becomes: to what extent does the technique improve students' chemical achievement?As a result, the researcher was inspired to look into the impact of the ASEI approach on students' attitudes about chemistry in the Federal Capital Territory of Abuja.

## 2. Objectives of the Study

The primary goal of this research was to determine the impact of the ASEI teaching technique on students' achievement and attitudes in Senior Secondary School chemistry in the Federal Capital Territory of Abuja.
The study's objectives are as follows:
   a. determine the Mean difference between students who learned chemistry utilizing the ASEI teaching style and those who learned it the traditional way.
   b. calculate the average difference between male and female learners' attitudes about chemistry after applying the ASEI teaching technique.

## 3. Research Questions

The study gives responses to the research questions.
   a. What is the mean attitude rating difference between learners taught chemistry by using ASEI teaching strategy and those instructed using the conventional process?
   b. What is the mean difference between the attitude ratings of male and female students towards chemistry after being taught Chemistry using the ASEI teaching strategy?

## 4. Hypotheses

The following null hypotheses were formulated and tested at 0.05 level of significance.
$H0_1$: there is no significant difference between the mean attitude ratings of students taught chemistry using the ASEI teaching strategy and conventional method.
$H0_2$: there is no significant difference between the mean attitude ratings of male and female students towards Chemistry after being taught using ASEI teaching strategy.

### 5. Methods and Materials

A quasi, pre-test, post-test control group design was applied in this research. The research design for this study is a non-equivalent group quasi-experimental design.There are 1,680 SS 1 chemistry students in 18 Government Senior Secondary Schools in Abuja's Federal Capital Territory.The study used 160 SS1 science students, 95 of whom were male and 65 of whom were female, in entire classes from the four schools studied.The experimental group consisted of 74 pupils, while the control group consisted of 86 kids from two urban and two rural schools, respectively.In the experimental group, 42 students were males and 32 students were females, with 32 students from urban schools and 42 from rural schools.

In the control group, 53 pupils were boys and 33 were females, with 44 students attending urban schools and 42 attending rural schools. The Chemistry Student Attitude Inventory is a questionnaire that asks students about their attitudes toward (CSAI).An educational psychologist from the University of Abuja's department of educational psychology validated the CSAI items.The items from the Chemistry Students' Attitude Inventory (CSAI) were tested on 30 students from a government secondary school in Okpo, Kogi state.Cronbach Alpha was used to assess CSAI's dependability.The reliability co-efficient was found to be 0.88.Descriptive statistical analysis like Mean and Standard Deviations were used to provide answers to all of the research topics. 0.05 significant values were used to test each hypothesis using statistical techniques from Analysis of Covariance (ANCOVA).

## 6. Results

### 6.1 Research Question 1

What is the mean difference between the attitude ratings of students taught using the ASEI teaching strategy and the conventional method towards chemistry?

**Table 1: Mean Attitude Ratings and Standard Deviation of Students in Experimental and Control Groups**

| Groups | N | Pre-attitude | | Post-attitude | | Mean Gain |
|---|---|---|---|---|---|---|
| | | Mean | SD | Mean | SD | |
| Experimental | 74 | 1.38 | 0.30 | 2.76 | 0.61 | 1.38 |
| Control | 86 | 1.37 | 0.31 | 1.93 | 0.34 | 0.56 |
| Mean Difference | | 0.01 | | 0.83 | | |
| **Total** | **160** | | | | | |

Prior to the procedure, the experimental team's mean attitude rating was 1.38 with a standard deviation of 0.30, while the control team's was 1.37 with a standard deviation of 0.31.

Following therapy, the experimental group's mean attitude rating was 2.76, with a 0.61 standard deviation, as opposed to 1.93 and 0.34 in the normal control.

The control group gained 0.56, whereas the experimental group experienced a mean increase of 1.38 then during therapy.

When comparing the attitude ratings of the experimental and control groups prior to the procedure, the mean difference was 0.01; however, following treatment, it was 0.83.

### 6.2 Research Question 2

What is the mean difference between the attitude ratings of male and female students towards chemistry after being taught using the ASEI teaching strategy?

**Table 2: Mean Attitude Ratings and Standard Deviation of Male and Female Students in Experimental Group**

| Groups | N | Pre-attitude | | Post-attitude | | Mean Gain |
|---|---|---|---|---|---|---|
| | | Mean | SD | Mean | SD | |
| **Male** | 42 | 1.34 | 0.30 | 2.76 | 0.58 | 1.42 |
| **Female** | 32 | 1.42 | 0.30 | 2.61 | 0.66 | 1.19 |
| **Mean Difference** | | -0.08 | | 0.15 | | |
| **Total** | 74 | | | | | |

Table 2 shows that just before pretreatment, male participants in the experimental group had a mean attitude rating of 1.34 and a standard deviation of 0.30, whereas female students had a mean attitude rating of 1.42 and a standard deviation of 0.30.

After treatment, the mean attitude rating for male experimental class was 2.76, with a standard deviation of 0.58, while the mean attitude rating for female students was 2.61, with a standard deviation of 0.66.

According on the attitude ratings and during treatment, the mean attitude gain for men was 1.42, while the mean gain for women was 1.19.

## 6.3 Research Hypotheses

### 6.4 Research Hypothesis 1

There is no significant difference between the mean attitude ratings of students taught using the ASEI teaching strategy and the conventional method towards chemistry?

**Table 3: Summary of Analysis of Covariance (ANCOVA) of Experimental and Control Groups' Attitude Ratings towards Chemistry**

| Source of Variance | Sum of Squares | Df | Mean Square | F | Sig |
|---|---|---|---|---|---|
| Corrected Mode | 11058.311[a] | 2 | 5529.155 | 222.121 | .000 |
| Intercept | 17057.523 | 1 | 17057.523 | 685.246 | .000 |
| Pre-Attitude | 10.672 | 1 | 10.672 | .429 | .514 |
| Group | 11055.688 | 1 | 11055.688 | 444.136 | .000 |
| Error | 3908.133 | 157 | 24.893 | | |
| Total | 356939.000 | 160 | | | |
| Corrected Total | 14966.444 | 159 | | | |

Table 3 shows the results of an ANCOVA analysis of data from the attitude inventory of students taught chemistry using the ASEI teaching technique against those taught using the traditional teaching method.

The null hypothesis was rejected based on the results of the study, $F(1,157) = 444.136$, p0.05.

This suggests that there is a statistically significant difference in the mean attitude evaluations of students taught using the ASEI teaching approach against those taught using the traditional method toward chemistry, favoring the ASEI teaching strategy. This also suggests that the experimental group's attitude rating was higher than the control groups.

### 6.5 Research Hypothesis 2

There is no significant difference between the attitude ratings of male and female students towards chemistry after being taught using the ASEI teaching strategy?

**Table 4: Summary of Analysis of Covariance (ANCOVA) of Male and Female Students' Attitude Ratings in Chemistry**

| Source of Variance | Sum of Squares | Df | Mean Square | F | Sig |
|---|---|---|---|---|---|
| Corrected Model | $1.962^a$ | 2 | .981 | 2.744 | .071 |
| Intercept | 9544.085 | 1 | 9544.085 | 26689.825 | .000 |
| Pre-attitude | 1.913 | 1 | 1.913 | 5.350 | .024 |
| Gender | .002 | 1 | .002 | .005 | .945 |
| Error | 25.389 | 71 | .358 | | |
| Total | 225420.000 | 74 | | | |
| Corrected Total | 27.351 | 73 | | | |

Table 4 illustrates the results of an ANCOVA analysis of data obtained from male and female students who were taught chemistry using the ASEI teaching technique. The null hypothesis was accepted since $F(1,71) = 0.005$, $p>0.05$, according to the analysis. This suggests that after being taught utilizing the ASEI teaching technique, there is no statistically significant difference in male and female senior secondary school students' attitudes toward chemistry. This also suggests that after being taught utilizing the ASEI teaching technique, male and female students' views about chemistry improved practically equally.

### 7. Summary of Findings

The following conclusions were drawn from the study's data analysis:

a. Students in the experimental group who were taught chemistry using the ASEI teaching approach had higher attitude ratings (2.76) than students in the control group who were taught chemistry using the traditional teaching method (1.93).This was noteworthy from a statistical standpoint.
b. The attitude ratings of male and female students taught chemistry utilizing the ASEI teaching technique showed no statistically significant differences. In terms of attitude, they experienced nearly similar improvements.

### 8.0 Discussion of Findings

According to the study, ASEI teaching methods significantly improved learners' attitudes about chemistry. According to Table 1, pupils in the experimental class and control class had mean attitude ratings of 1.38 and 1.37, which is between, before therapies, with corresponding standard deviations of 0.30 and 0.30. However, following treatment, these pupils' mean attitude ratings were 2.76 and 1.93, including both, with commensurate standard

deviations of 0.61 and 0.34. Before and after treatment, there was a 0.01 and 0.83 difference in the attitude ratings between the experimental and control groups. This clearly reveals that students in the experimental group improved more than students in the control group in terms of attitude ratings. In addition, the p value of.00 in Table 3's test of hypothesis results indicated that there was a significant difference in the attitude evaluations of students in the experimental and control groups in chemistry. This demonstrates that employing the ASEI teaching technique dramatically improves students' attitudes toward chemistry. This finding is consistent with Lawal,(2019) findings from a study titled "attitude toward learning and performance in chemistry among students in selected secondary schools in Bureti district, Kenya," which found that students who are taught using the ASEI teaching strategy develop a positive attitude toward chemistry.

Table 2 also shows that before treatment, male and female students had mean attitude ratings of 1.34 and 1.42, respectively, with corresponding standard deviations of 0.30 and 0.30, whereas after treatment, male and female students had mean attitude ratings of 2.76 and 2.61, respectively, with corresponding standard deviations of 0.58 and 0.66.The difference in male and female students' mean attitude ratings before and after treatment was -0.08 and 0.15, respectively, demonstrating that male and female students' attitudes do not change significantly after being taught chemistry using the ASEI teaching technique. This was further verified by Table 4's test of analysis, which had a p-value of 0.94.This confirms that there was no statistically significant difference in male and female students taught chemistry utilizing the ASEI teaching technique in terms of attitude evaluations.

**9.0    Conclusion**

From the study which is titled the "effect of Activity, Students, Experiment and Improvisation (ASEI) teaching strategy on students' attitude in chemistry in Federal Capital Territory, Abuja, it was firstly concluded that students that were taught chemistry using ASEI teaching method had positive attitude when exposed to the treatment as compared to those in the control group.

Secondly, the application of the Activity, Students, Experiment and Improvisation (ASEI) teaching strategy revealed that gender had no significant impact on students' attitude and achievement in chemistry. When students were exposed to the treatment, it was concluded that both genders (males and females) had almost the same scores. This means that, there is no significant impact of Activity, Students, Experiment and Improvisation (ASEI) teaching strategy on students' attitude and achievement.

**10.0    Recommendations**

a. Educational institutions should emphasize the importance of using the ASEI teaching technique to arouse and maintain students' attitudes.
b. Teachers should be given opportunities to learn the ideas behind using the ASEI teaching strategy.
c. Teachers should employ exciting or appealing educational resources that will positively affect students' attitudes.

**References**

1. *Abulude, O. F. (2019). Students' attitude towards chemistry in some selected Secondaryschools in Akure south local government area, Ondo state, unpublished Thesis of PGD in Education, Retrieved from www.scribd.com.*

2. *Abdullahi, U.A.(2018). Science, technology and mathematics education and professionalism. A Keynote Address Presented at the 1st Annual conference of the Science Teacher Association of Nigeria (STAN), (on Thursday4th May, 2006). Kano Educational Resource Centre. Kano, Nigeria.*

3. *Abdullahi H.I.(2018). The effect of experiment and improvisation strategy on students' achievement in biology.Unpublished Doctoral Thesis, University of Yobe, Nigeria. .*

4. Adewale, D .A. (2019).The relationship between changes in attitude towards a course and final achievement. An International Journal of Applied Psychology, 46, 15-28.

5. Adesoji, A.O. (2018). Managing students towards science through problem-solving instructional strategy.Anthropologist, 10(1).

6. Aduda, D. (2018, April 23). News Report Spells out the Future of Education. Retrieved from www.kaeam.or.ke

7. Ahiaba, J. &Igweonwu, R.N. (2017).A comparative study of the performance of boys and girls    in SSCE science subjects in Dekina L.G.A. of Kogi State. Unpublished   Bachelor of     Science  Education (B.Sc. Ed) project. Department of Science Education, Faculty of     Education, University of Nigeria, Nsukka.

8. Ajayi, I.A. (2018). Unit cost of secondary education and Students' Academic Achievement in    Ondo State. ( UnpublishedPh.D Thesis), Ibadan, University of Ibadan.

9. Akinola, E.M. (2018). The impact of self assessment on achievement.Journal of Educational Research, 87, 60-75.

10. Babu K. (2019). Improvised aids for effective science education in rural schools. Retrieved from www.Geocities.com

11. Ballone, L. M. &Zerniak C. (2017).Teachers' beliefs about accommodating students' learning styles in science classes.Journal of Science Education, 6(2).

12. Balozi, C. &Njunge, J. (2018).Trends in Teaching approaches and methods in Science and Mathematics Education SMASSE project, Kenya.

13. Jerome, B. (1986). Towards a Theory of Instruction: Cambridge, M.A. Havard University Press.

14. Dangpe, A.K.D (2019). Effect of experiment and improvisation model on students' achievement and interest in circle theorem.Unpublished Doctoral Thesis, University of Nigeria, Usukka.

15. Dulton, C. (2017). Coalition for the development of a performance measurement system.Educational Research, 50(3), 11-17.

16. Ezike, B.U. (2018). The Effect of Resource Distribution and utilization on the 167 performers of students in chemistry (Unpublished M.Ed Dissertation)University of Ibadan, Ibadan

17. Gbamanja, S.P.T. (2018). Essentials of curriculum and instruction: Theory and practice. Portharcout, Nigeria.

18. Gituthu M.M (2018). Influence of Learner-centred Strategies on Students' Biology Performance in Kenya certificate of Secondary Education in Kinangop sub-County, Nyandarua County, Kenya. A Research Project Submitted in Partial Fulfillment of   the Requirements for the Degree of Master of Education in Curriculum Studies University of Nairobi.

19. Hornby A.S (2019). *Oxford Advanced Learners Dictionary of current English.* Oxford: University press.

20. Iliyasu, G. B. (2016). *Relationship between students performance in chemistry and qualifying examination and senior secondary certificate examination in Dala Local Government Area Kano State, PGDE, Thesis: Federal College of Education Kano.*

21. Japan International Cooperative Agency (2018).*Partners in development.* Nairobi. JICA Newsletter, 81.

22. Jegede, O.J. (2017). *An evaluation of the Nigerian integrated science project, after decade of use in the classroom.International Review of Education,* (28), 321-336.

23. Kibe, O. &Ogwel (2018).*Impact of SMASSE INSET on students' capacity through improved teaching and learning in the classrooms, a paper presented at the 8th Regional conference for SMASSE WECSA, Nairobi.*

24. Koballa, T. R. (2015). *Children's attitudes towards learning science in schools.Research reforming practice.Matiwah, Eilbaum.*

25. Lawal, F.K. (2019).*Effectiveness of conceptual change instructional strategy in remediatingmisconceptions in genetics concepts among senior secondary school students inKanoState.An Unpublished Ph.DThesis.Faculty of Education AhmaduBelloUniversity, Zaria.*

26. Neill, O. (2017). *The impact of school facilities on student achievement, behavior, attendance and teacher turn over at selected Texas middle schools in region XIII ESC. Unpublished doctoral dissertation, Texas A and M University College, TX of Education in Nigeria (UNESCO) Lagos Office Nigeria,* 84-102.

27. Njiru, Z.W. (2016). *Teaching and Learning Biology by SMASSE project among Secondary Schools in Mbeere South District, Embu County, Kenya. Masters Thesis. Unpublished. Kenyatta University.*

28. Njuguna, B.M. (2019). *The Findings from Baseline Studies by SMASSE project.Unpublished. . Thesis on Masters Degree, University of Nairobi.*

29. Obe, S. C. (2018). *Spatial Distribution and Locational Planning of Secondary Education reform in Imo Sate of Nigeria 1980-1990. Unpublished Ph.D Thesis University of Ibadan.Paper Presented at the Faculty of Education, University of Ibadan.*

30. Onchong'a O.B (2018). *Implementation of ASEI/PDSI approach in Mathematics Lessons in Nyamaiya Division, Nyamira County, Kenya. A thesis submitted in partial fulfilment of the requirements for the award of the Degree of Master of Education in the School of Education of Kenyatta University*

31. Ojoawo, A.O. (2019). *A study of factors Responsible for negative Academic achievement in Secondary Schools in Oyo State.AJEM.6 (1 and 2),* 180-188.

32. Okeke, E. A. C. (2019). *Women in science, technology and mathematics in Nigeria: Key note address. Women in science technology in Nigeria.42 nd Annual Conference Proceedings of the Science Teachers Association of Nigeria (STAN),* 3-13.

33. *Onamu K.N (2017). The impact of ASEI movement on students' Achievement in Secondary School Biology in Nakuru County, Kenya. A Research Project Report Submitted to the School of Education in Partial Fulfilment of the Requirements for the Award of M.Ed Degree of Kenyatta University.*

34. *Onekutu, P. O. (2019). Gender differences in achievements in junior secondary school examination in integrated science: Implications for national development. Review of Gender Studies in Nigeria, 1(3), 4-12.*

35. *Orado, G.J. (2018). Analysis of learning and Assessment Objectives for Mathematics and Science in secondary education in Africa, Unplublished Paper presented at the SMASSE-WECSA Conference, at KCCT Africa: Bagarthi, Nairobi.*

36. *Jean, P. (1967). Quoted in piagets' theory on intellectual development: An introduction by Ginsberg, H and Opper S. (eds), Presenter Hall, London.*

37. *Sanders, M & Rivers C. (2018). Statewide class size studies. Prime Time and stars, tennessee's project Stars. Dallas Texas.*

38. *Sogomo, B.K. (2017). Keynote address on SMASSE project 2001. Report on the Regional Conference on Science and Mathematics in Eastern, Central and South Africa. SMASSE unpublished.*

39. *Voss, E. B. (2018). Students' characteristics: attitudes and interests. Science Education Journal, (67), 3.*

40. *Yara, P. O. (2019). Students attitude towards mathematics and academic achievement in some selected secondary schools in south-western Nigeria. European Journal of scientific research,36(3),336-341.*

41. *Zernaiak, C. M, (2018). Teachers' beliefs about using educational technology in the Science Classroom. International Journal of Educational technology,1(2).*

***Corresponding Email****: godwin.nwogu@fuoye.edu.ng*