



Effects of Target Task and Learning Activity Package Approaches on Secondary School Chemistry Students' Academic Achievement in the Mole Concept in Ohafia Educational Zone of Abia State

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Abstract

This study investigated effects of target task and learning activity package approaches on secondary school Chemistry students' academic achievement in the mole concept in Ohafia Educational zone of Abia State. Three research questions and three hypotheses were stated. Quasi-Experimental non-equivalent pretest, posttest design was adopted for the study. The sample comprised 63 (35 males and 28 females) SS2 chemistry students selected from three schools out of the 26 co-educational secondary school in Ohafia LGA. The sampling was conducted in multiple stages making use of simple random sampling and purposive sampling. Instrument for data collection is mole concept achievement test (MAT). Kuder- Richardson formula-20 (K-20) was used to determine the reliability coefficient of MAT as 0.88. Data collected were analysed using mean, standard deviation and Analysis of Covariance. It was found out that there is a significant difference in the mean achievement scores of students taught mole concept using target task, learning activity package and those taught using lecture method in favour of students taught with target task strategy. There is no significant difference between the mean achievement scores of male and female students taught mole concept using target task approach and there is no significant difference between the mean achievement scores of male and female students taught mole concept using learning activity approach. Based on the findings it was recommended that Target task strategy should be used in teaching and learning of chemistry in secondary schools since it enhances students' achievement in Chemistry than learning activity and lecture method. Workshop/ conferences should be organized by science teacher association to Chemistry teacher on the use of target task in teaching and learning of Chemistry and Target task and Learning activity package should be recommended for teaching of science based course since it is gender friendly.

Key words: Academic Achievement, Chemistry Students', Learning Activity, Target Task

Introduction

Chemistry is one of the important science subjects offered in secondary schools in Nigeria. It is concerned with the study of matter; its structure, composition, properties and changes it undergoes (Ojokuku, 2019). Since almost everything around us is an example of matter including human beings, it means that chemistry is involved in everything we do, is found everywhere we go and is all around us. Chemistry is one of the core sciences subjects in secondary schools and it serves as a veritable tool for growth and development of the society. For instance, it has contributed greatly towards providing our basic needs and improving the quality of our lives such as food, housing, medicine, transportation, textile. Chemistry can be regarded as one of the sciences on which technological breakthrough is built. For example, in the

exploitation of natural resources such as petroleum, natural gas etc. It is the pivot on which the wheel of science rotates. Chemistry offers students a gateway to numerous exciting careers such as medicine, veterinary medicine, nursing, pharmacy, industrial chemistry among others.

Chemistry plays a vital role in the establishment of industries such as fertilizer, glass, cosmetics, pharmaceutical, cement and the improvement of the lives of its citizen. Most of these industries rely on the mole concept in chemistry for their operations. The Mole concept is a fundamental idea that defines the amount of a substance. Mole concept is essential in mass-mole calculations of chemical reactions because it concentrates on the number of particles and uses quantity that connects the mass unit of gases involved in chemical reactions (Petrucci,

Herring, Madura & Bissonnette, 2017). This concept helps chemist to estimate the quantities of chemical substance that are too small to be seen or counted by weighing them rather than counting. Knowledge of the mole concepts and its application is essential in various fields such as pharmaceutical industries, chemical reactions, and stoichiometry etc.

Despite the importance of chemistry in personal and national development students' achievement in both internal and external examinations has been consistently poor (Aniodoh & Eze, 2014; Eze & Okorie, 2019). The West African Examination Council (WAEC) analysis of chemistry students' achievement in WASSCE (2018-2021) shows that only 61.95%, 54%, 59% 61.5% passed chemistry at credit level in 2018, 2019, 2020 and 2021 respectively. These have become a major cause of concern to the government, curriculum planners, teachers and other stakeholders in education. Efforts are now being made to identify the causes of poor achievement in chemistry with a bid to finding a lasting solution. The Chief examiner's report for the West African Senior School Certificate Examination (WASSCE 2022), pointed out some of the reasons for candidates poor achievement as candidates; did not understand the demands of the questions; exhibited poor communication skill; wrote trivial names instead of formulae; lacked adequate knowledge of chemical concepts; could not write simple half equations; could not recognize redox reactions; could not write the correct formula of a compound among others in chemistry which indicates lack of understanding of the questions, poor expression in the use of nomenclature, lack of adequate knowledge of chemical concepts, could not write simple half reactions, not being able to recognize redox reactions and could not write formula of a compound. Interestingly each of these concepts pointed out are rooted in the mole concepts.

The mole concept is defined as the amount of a substance that contains as many particles (atoms, molecules, ions or electrons) as there are atoms in 12grams of carbon-12. This number is known as Avogadro's number, which is 6.022×10^{23} particles. Its importance in chemistry cannot be over emphasized; knowledge of it helps in quantitative measurement, balancing of chemical reaction, calculations of molar mass and stoichiometry. Observations from researchers showed that most Nigerian schools still use the lecture method of teaching to teach chemistry than interactive and investigative approaches (Efe & Abamba, 2019). According to Achor and Shaibu (2023), stated that innovative teaching strategies and increased practical engagement are essential to rekindle interest and improve their achievement in the

mole concept. Thus, various research findings have associated the cause of student's low achievement in chemistry to teacher's use of ineffective traditional methods of teaching which do not make room for active learning (Anyanime & Abasifreke, 2019) and also the difficulties students have in the mole concept and chemistry in general can be attributed to the use of ineffective and inappropriate instructional strategies used by chemistry teachers (Abdulwahab et al. in Mandina & Dube, 2018).

There is need for chemistry educators to use alternative instructional strategies that can solve the problem of student difficulties and misconception resulting in overall improvement in students' performance. Some of these instructional strategies that can help to solve this problem are target task approach, learning activity package, jigsaw and inquiry based instructional strategies among others, these strategies or approaches emphasize active learning, self-paced instruction and real-life applications, thereby making learning engaging for students (Okoli & Anene, 2020; Yusuf & Afolabi, 2010).

Instructional strategies also known as teaching strategies are methods that teachers use to deliver course material in ways that keep students engaged and practicing different skills thereby achieving the desired outcome. Teaching strategies can be classified into teacher-centered and student-centered approach. Teacher-centered teaching approach focus on the teacher as the authority that is being in charge of the class while the students are the recipients of the teacher's knowledge for example, the lecture method. In lecture method, the teacher is able to teach a large number of students at the same time. Here, students are passively involved. Student-centered approach involves teaching methods that places students at the center of the learning and it is based on the idea that students should be actively involved in their learning. According to Jacinta in Geoffrey (2018) students achieve better when teachers utilize student centered strategies. Students participate more in variety of independently undertaken activities. Student-centered approach includes; target task approach, learning activity package, jigsaw, and inquiry based instructional strategy etc (Mc millian, 2020). In order to improve students' achievement in chemistry, researchers stress on the need for the use of student-centered approach, activity-based approach and minds on approach that takes care of individual needs and differences, learning styles, interest and abilities. According to Udu and Eze (2018), learning activity package allows the student a wide variety of choices on how to achieve behavioural objectives and allowing for differences in styles of learning.

However, this study adopts the use of target task approach and learning activity package approach in comparison to the lecture method for this present study, to find out whether or not their application will improve students' academic achievement in the mole concept in chemistry.

Target task approach (TTA) is a student-centered, problem solving approach. It is a guided discovery method of teaching. Target task approach is geared towards identifying major problems (target task) and solving them through rules and principles which the learner may not be familiar with. The problem may not be easy for the student to solve immediately. The teacher then presents some graded problems similar to the task and guides the students to solve them by providing some hints. Olaniyan and Omosewo (2015) assert that, at the initial stage of instruction, the teacher offers substantial guidance by providing hints for solving the first two or three problems. However, as the students' progress and engage with similar task, the level of teacher support is gradually withdrawn. The knowledge and experience gained from the solution of the graded questions transfer positively to the target task, making the task easy for the students to solve, thereby accomplishing the major objectives of the lesson. Eze (2002) and Nnorom (2019) suggest that target task method is a constructive based teaching approach because it is learner-centered. It is an activity-based learning approach that requires knowledge transfer from a source task to another targeted task (Efe & Ajaja, 2023). It helps to teach both content and language and involves breaking down of skills into smaller manageable components (Efe 2015). The target task approach (TTA) involves six major stages which includes; pre-task, task, planning, report, analysis and practice (British council, 2015; Olaniyan and Omosewo, 2015). Studies have revealed the effects of TTA on students' achievement in chemistry. Mandina and Eshiret (2018) revealed that there is a significant difference between target task group and lecture group in the favour of target task. Nabina (2011) found a significant difference in achievement between students taught physical chemistry using target task approach performed better than their counterparts, therefore is more effective in students' achievement in physical chemistry, Danlami et al. (2020) found out that students taught algebra using target task approach performed significantly better than those taught using lecture method. Consequently, it can be concluded that students taught using target task approach performed better than those taught using lecture method. Further studies by Olaniyan and Omosewo (2015), Efe and Ajaja (2023) among others all confirmed a significant difference between target task

approach and lecture method in favour of target task. While these studies provide valuable insights into target task approach, limited research has focused on the application of target task approach in the mole concept in chemistry; a fundamental yet challenging topic to students in Ohafia education zone. According to Efe and Ajaja (2023), target task approach supports fluency, develops appropriate orientation to learning, creates avenue for students to evaluate their performance themselves, make way for progress and activeness and improves collaboration among the students. Unlike learning activity package approach which allows students work independently at his/ her own pace and accommodates learners of different styles and ability.

Learning activity package (LAP) approach is a student-centered activity-oriented teaching strategy where the teacher acts as a facilitator of learning, guiding the students through a series of activities and the problem which may help learners to achieve highly (Njoku & Akamobi, 2015; Attamah & Udu, 2020). In learning activity package, instructional materials are broken into small steps that are arranged orderly from simple to complex or from known to unknown and in an increasing order of difficulty. In solving the students' problem in chemistry, there is need for a shift from lecture method to an innovative method such as learning activity package that makes teaching simple and at the same time adjust both objectives and methods of learning to the needs and characteristics of the individual learners. It involves a number of instructional strategies depending on the instructional objectives of the unit. According to Njoku and Akamobi (2015) learning activity package consists of the following component: topic, behavioural objectives, pretest, learning activities, post-test. Learning activity package instructional strategy (LAP) is a learner centered activity that leads to individualization of instruction which leads to higher academic achievement (Akpokinioro, 2020). Learning activity package instructional strategy is a program of study in printed form which covers a particular aspect of a subject that follows a logical sequence of instructional objectives and activities for implementing the objectives. The student continues with the objectives and activities in the learning activity package at his / her own pace (Udu & Eze, 2018). Learning activity package as an innovative strategy, acts as a vehicle that makes for individualization in learning. Individualized instructions can be seen in many ways such as computer assisted instruction, programmed instruction, among others. Some of these individualized teaching has been investigated and found to be effective improving achievement but their

application in Nigeria public schools is difficult due to lack of computer systems, electricity, conducive classrooms in those schools. This is why this study is centered on learning activity package which is another type of individualized learning which is readily available and affordable. This approach differs from target task approach in that it allows learners work independently at their own pace. Studies from literature suggest that learning activity package instructional strategy could have positive impact on students learning outcome across various subjects. For instance, Udu and Eze (2018) revealed learning activity package approach significantly improved students' academic achievement in organic chemistry. However, it was done in organic chemistry and not mole concept. Similarly, Shittu, Omoniwa & Michael (2024) found out that students taught using learning activity package showed significantly higher academic achievement compared to those taught using lecture method but their research lacked focus in chemistry or the mole concept specifically. Afuwape and Olugbuyi (2019) also confirmed the benefit of learning activity package approach in teaching Basic Science & Technology but did not compare learning activity package approach's effectiveness across diverse students. The present study, therefore, aims to bridge these gaps by investigating the effect of target task and learning activity package approaches on secondary school students' achievement in mole concept in Ohafia Education zone.

Achievements refers to the extent to which a student, teacher or institution has attained their short or long-term educational goals. It may mean the completion of both secondary and tertiary education. Academic achievement can be measured through examination or continuous assessments, but there is no general agreement on how it is best evaluated or which aspects are most important- procedural knowledge such as skills or declarative knowledge such as facts (wikipedia). It also refers to outcomes in intellectual domains covered within instructional environments at different academic levels (Ruffing, Wach, Spinath & Karbach 2015). Some chemical concepts are often referred to as being difficult both to teach and to learn, this is evident in the learners' phobia and poor achievement in both internal assessment and external examination in such concepts (WAEC, 2015-2018). Students' low achievement in chemistry which is traceable to pedagogical issues (WAEC, 2017) is a serious concern to teachers, parents and other stakeholders. Achievement could be promoted in the mole concept in chemistry, if the instructional strategies employed by the teacher in teaching the mole concept in chemistry are effective. Researchers

and policy makers are ever increasingly turning to social and emotional factors, as well as the relationships among them, as indicators of student well-being and psychological development (Chernyshenko, Kankaras & Drasgow, 2018). The unstable achievement of students in the mole concept in chemistry can be attributed to many factors such as abstract nature of chemistry, poor mathematical ability of students, teaching methodology, lack of adequate instructional material, poor instructional delivery approaches as well as some teacher factors and instructional strategies. The instructional strategies employed by the teacher are therefore essential in the implementation of the curriculum contents. Different instructional strategies have been seen by the researcher to be influenced by gender. Gender includes the social, psychological, cultural and behavioral aspects of being a man, women or other gender identity. It refers to the characteristics of women, men, girls and boys that are socially constructed. This includes norms, behaviors and roles associated with being a woman, man, boy or girl as well as relationships with each other, state of being male or female. Studies have shown that there are distinguishing differences in the chemistry students' achievement with respect to gender. Eze, Egbo, and Omeje (2018) found a significant difference in favour of female students when taught kinetic theory and gas laws using programme instruction approach. However, Okereke and Onwukwe (2011) found that female counterparts do better than their males in chemistry. On the other hand, Ezendu and Obi (2013) found that male students achieved significantly better than their female students in both rural schools, also there was no significant difference in the academic achievement of students in urban and rural schools. According to Nworgu (2014) there is an acknowledged problem of female achievement when compared with their male counterparts apparently under equivalent condition and this problem of female under achievement appear to be more obvious in mathematics and science. This tends to suggest that there is need to examine gender influence in teaching approaches as one of the moderator variables in this study. This study investigates effects of gender and academic achievement in mole concept when taught using target task and learning activity package approaches.

Statement of the problem

In spite of the vital role chemistry plays as a science subject in the economy of Nigeria and the efforts of researchers to improve on students' achievement in the subject, the achievements of students in chemistry remains low with many students struggling to grasp

abstract concepts. The difficulty in comprehending this concept has also been attributed to the ineffective teaching strategies, which emphasizes rote learning rather than conceptual understanding. The use of teacher-centered method is high due to large class size as well as teachers not being used to the current innovative teaching technique for effective learning of the mole concept. The lecture method seems not to be effective in fostering learning and enhancing achievement. The lecture method lacks student's cooperation and as such results in student's lack of interest and poor achievement in the mole concept.

In the classroom, adequate students' cooperation and interaction are required to help learners complete their task and be independent learners in the mole concept. Such cooperation and interaction may be found in innovative teaching strategies. Researchers and chemistry educators continue to search for innovative student-centered teaching strategies that can enhance the achievement of students in the mole concept in chemistry, like target task and learning activity package strategies. However, despite their potential, there is limited empirical evidence on the comparative effectiveness of these methods in improving students' achievement in the mole concept at the secondary school level. This gap necessitates the present study

Research Questions

The following research questions are raised to guide the study:

1. What are the mean achievement scores of students taught the mole concept using learning activity package, target task approach and lecture method?
2. What are the mean achievement scores of male and female students taught the mole concept using target task approach?
3. What are the mean achievement scores of male and female students taught the mole concept using learning activity package approach?

Hypotheses

To further guide the researcher in the conduct of this study, the following null hypotheses were tested at 0.05 level of significance.

H₀₁: There is no significant difference among the mean achievement score of students taught the mole concept using learning activity package (LAP), target task approach (TTA) and lecture method.

H₀₂: There is no significant difference between the mean achievement scores of male and female

students taught the mole concept using target task approach.

H₀₃: There is no significant difference between the mean achievement scores of male and female students taught the mole concept using learning activity package approach.

Method

This study employed a quasi-experimental research design, specifically, a pre-test, posttest non-equivalent control design was used. Quasi-experimental research design is the type of research design in which there is no randomization of the subject to experimental and control groups. The study was carried out in Ohafia Education Zone of Abia State. The population comprises 852 SS2 chemistry students (460 males and 392 females) from public co-educational secondary schools in Ohafia Education zone of Abia State, Nigeria, (SEMB, Ohafia Zone, 2024). The sample comprised 63 (35 males and 28 females) SS2 chemistry students selected from three schools out of the 26 co-educational secondary school in Ohafia LGA. The sampling was conducted in multiple stages. In the first stage, Ohafia LGA was drawn from Ohafia Education Zone using a simple random sampling technique. In the second stage, three schools were purposively sampled from the 26 co-educational secondary school in Ohafia LGA to ensure that each selected secondary school had both male and female students in their science classes, as gender is a variable in the study. Each of the selected schools had one intact science class, and these intact classes were used for the study. Instrument for data collection is mole concept achievement test (MAT). This instrument was used for collecting pretest and posttest achievement scores. The test consists of fifty (50) multiple choice questions developed from the content of the study taught as well as past questions from WAEC and NECO that are related to the topics treated. The fifty (50) multiple choice questions have four (4) options (A-D) and each correctly answered question was awarded one mark. Incorrect answer attracted no mark. The Mole Concept Achievement Test (MAT) was subjected to face and content validation by two Science Education experts and one expert in Measurement and Evaluation all in the Department of Science Education, Michael Okpara University of Agriculture, Umudike. The MAT was content validated by using test blueprints that weighed the content areas by objective levels to be covered in the tests. A trial test was conducted to ascertain the reliability and suitability of the mole concept achievement test (MAT). Kuder-Richardson formula -20 (K-20) was used to determine the reliability coefficient of MAT as 0.88. The researcher

used research assistants (chemistry teacher) for data collection. The research assistant administered the pre-test, posttest and the questionnaire to the students. At the end of the test, the test script was collected from the students by the research assistant. At the end of the treatment, the instrument was reshuffled and re-administered to the students as posttest. The reshuffling acted as a distractor to the students. One hour 30 minutes was allowed for the posttest as in the pre-test. The test was marked by the researcher using marking guide, scores was collated. Prior to the study, the researcher visited the schools to obtain permission from principals of the study schools and to enable the researcher get acquainted with the chemistry teacher. The researcher trained the research assistants (chemistry teacher) of various schools. The training lasted for one week. After the training teachers (research assistants) was given the lesson plan for each teaching method prepared by the researcher. Before the experiment, pre-test was administered in the three schools by the research assistants. After the treatment of the groups for the period of 4 weeks, the posttest and the questionnaire were administered. Hence, the treatment and test lasted for six weeks. Target task approach was used for the first Experimental group. The approach involves the completion of a task to drive the learning process. It focuses on setting clear, defined task that students are expected to accomplish. It is designed to improve student engagement, critical thinking and skill development by having learners work towards a concrete outcome. The teacher introduces the task and provides similar tasks with clear explanation; students practice the task in small groups, gather information on their task and work on creating their presentation. The teacher provides resources and

feedback during the process. The students deliver their final presentation to the class after which the teacher provides feedback. On the

Other hand, learning activity package approach was used for the second Experimental group. In LAP, the teacher distributes the LAP material to the student. Each student is to carry out the required activities as contained in the material. The students' thereafter carryout the learning activities expected of them individually. At the end of the learning activities, each student engages in self-assessment to test for understanding. They proceed to posttest if they answered the self- test correctly. Each student completed the manual at their own pace. The teacher used the posttest to ascertain each student progress to know whether a student can proceed to the next lesson or needed to be drilled more on the particular lesson. At the end of the four weeks a posttest (which is a reshuffled version of the pre-test) was administered to the students and the score recorded. And the third group was taught using the lecture method (control group).

The pre-test is first administered to the students. The teacher thereafter taught the students four weeks lesson on mole concept using the lecture method. The students were given assignment which the teacher marked and wrote corrections. The initial group difference was controlled by using Analysis of covariance (ANCOVA). The ANCOVA enabled the researcher to eliminate any further imbalances between the students and provide a base line from which the effects of the treatment were measured. The three research questions were answered using mean scores and standard deviation scores. While the three null hypotheses were tested using Analysis of covariance at 0.05 level of significance.

Results

Research Question One:

Table1: Mean achievement scores and standard deviations of students taught mole concept using target task, learning activity package (LAP) methods of teaching and those taught with lecture method.

Methods	N	Pre-test \bar{X}	SD	Post-test \bar{X}	SD	Mean Achievement Gain
Target Task	12	26.75	4.31	45.75	4.96	19.00
Learning Activity Package	25	29.00	9.83	41.32	4.42	12.32
Control	26	23.00	3.36	27.77	6.77	4.77

Table1 shows the mean pre-test scores of students taught mole concept with target task, learning activity package (LAP) and those taught with lecture methods of teaching to be 26.75, 29.00 and 23.00 respectively with standard deviations of 4.31, 9.83 and 3.36

respectively; Then post-test scores of 45.75, 41.32 and 27.77 with standard deviations of 4.96, 4.42 and 6.77 respectively. A lower standard deviation scores of students taught mole concept using target task and learning activity package (LAP) methods in post-test

shows that their scores are clustered around them. The summary on Table 1 reveals that the mean achievement gain scores of students with the methods are 19.00, 12.32 and 4.77 respectively. The control group (lecture method) students had post-test and

mean gain lower than the students taught with target task and learning activity package. This indicates that target task method was the highest in enhancing students' achievement in mole concept followed by learning activity Package and then lecture method.

Hypothesis One:

Table 2: Analysis of covariance (ANCOVA) on the mean achievement scores of students taught mole concept using target task, learning activity package (LAP) and those taught with lecture method.

Source	Type III Sum of Squares	Df	Mean Square	F	Sig.
Corrected Model	3167.879 ^a	3	1055.960	43.056	.000
Intercept	4117.051	1	4117.051	167.871	.000
Pretest	437.327	1	437.327	17.832	.000
Method	2098.688	2	1049.344	42.787	.000
Error	1446.978	59	24.525		
Total	84544.000	63			
Corrected Total	4614.857	62			

a. R Squared = .686 (Adjusted R Squared = .671)

Table 2 has shown that F-ratio (42.787) is significant at .000 for the methods, at 2 and 62 degrees of freedom (df). This is because, .000 is less than .05 significant level earlier set for the hypothesis. Hence the hypothesis is rejected, therefore, there is a significant difference in the mean achievement scores

of students taught mole concept using target task, learning activity package and those taught using lecture method. In order to ascertain the direction of the significance, the scores were subjected to post hoc analysis as shown in Table 3.

Table 3 LSD Post hoc Analysis of Student' Post-test Classified by Instructional Methods

(I) Method	(J) Method	Mean Difference (I - J)	Std. Error	Sig.
Target Task	Learning Activity Package	4.43	1.97	.000
	Control	17.98*	1.96	.000
Learning Activity Package (LAP)	Target Task	-4.43	1.97	.000
	Control	13.55*	1.57	.000
Control	Target Task	-17.98*	1.96	.000
	Learning Activity Package	-13.55*	1.57	.000

- * = significant at .05 level of Significance

Table 3 shows the post hoc analysis scores of students taught mole concept using target task, learning activity package and those taught using lecture method. Students taught mole concept with target task had significant higher achievement scores than those taught with learning activity package and lecture approach. A significant difference also existed

between the achievement scores of students using learning activity package and those taught using lecture approach favoring learning activity package. Target task approach is the most facilitating, followed by learning activity package and lastly lecture method.



Research Question Two:

Table 4: Mean achievement scores and standard deviations of male and female students taught mole concept using target task approach.

Gender	N	Pretest	SD	Posttest	SD	Mean Achievement Gain
Male	8	26.63	3.34	45.00	5.63	18.37
Female	4	27.00	6.48	44.25	3.95	17.24

Table 4. shows that male students taught with target task method had mean pre-test and post-test scores of 26.63 and 45.00 with standard deviation scores of 3.34 and 5.63 respectively while their female counterpart had mean pretest and post-test scores of 27.00 and 44.25 with standard deviation scores of

6.48 and 3.95 respectively. Males had mean achievement gain scores of 18.37 as against 17.24 of their female counterparts showing their superiority over females when taught mole concept using target task approach.

Hypothesis Two:

Table 5: ANCOVA for testing significant difference between male and female students taught the concept of mole with target task approach.

Source	Type III Sum of Square	df	Mean Square	F	Sig.
Corrected Model	4.325 ^a	2	2.163	.073	.930
Intercept	1008.994	1	1008.994	34.149	.000
Pretest	2.825	1	2.825	.096	.764
Gender	1.679	1	1.679	.057	.817
Error	265.925	9	29.547		
Total	20197.000	12			
Corrected Total	270.250	11			

a. R Squared = .016 (Adjusted R Squared = .203)

Table 5 shows that F (.057) is not significant at .817 for gender at 1 and 11 degrees of freedom (df). This is because .817 is more than .05 significant level earlier set for the hypothesis. Hence, the hypothesis is

upheld. Therefore, there is no significant difference between the mean achievement scores of male and female students taught mole concept using target task approach.

Research Question 3:

Table 6: Mean achievement scores and standard deviations of male and female students taught mole concept using learning activity approach.

Gender	N	Pretest	SD	Posttest	SD	Mean Achievement Gain
Male	15	30.07	9.06	42.07	4.30	12.00
Female	10	27.40	11.20	40.20	4.52	12.80

Table 6, shows that male students taught with learning activity approach had mean pre-test and post-test scores of 30.07 and 42.07 with standard deviation scores of 9.06 and 4.30 respectively while their female counterparts had mean pretest and post-test scores of 27.40 and 40.20 with standard deviation

scores of 11.20 and 4.52 respectively. Females had mean achievement gain scores of 12.80 as against 12.00 of the male counterparts showing their slight superiority over females when taught mole concept using learning activity approach.



Hypothesis three:

Table 7: ANCOVA for testing significant difference between male and female students taught the concept of mole with learning activity approach.

Source	Type III Sum of Square	df	Mean Square	F	Sig.
Corrected Model	242.345 ^a	2	121.173	11.739	.000
Intercept	2560.961	1	2560.961	248.095	.000
Pretest	221.439	1	221.439	21.452	.000
Gender	6.311	1	6.311	.611	.443
Error	227.095	22	10.322		
Total	43153.000	25			
Corrected Total	469.440	24			

a. R Squared = .516 (Adjusted R Squared = .472)

Table 7 shows that F (.611) is not significant at .443 for gender at 1 and 24 degrees of freedom (df). This is because .443 is more than .05 significant level earlier set for the hypothesis. Hence, the hypothesis is upheld. Therefore, there is no significant difference between the mean achievement scores of male and female students taught mole concept using learning activity approach.

Discussion of findings

The discussions of the results are based on the research questions that guided the study and hypotheses

The result of this study showed that there is a significant difference in the mean achievement scores of students taught mole concept using target task, learning activity package and those taught using lecture method. The post hoc test also showed that Students taught mole concept with target task had significant higher achievement scores than those taught with learning activity package and lecture approach. A significant difference also existed between the achievement scores of students using learning activity package and those taught using lecture approach favoring learning activity package. This finding is in agreement with Danlami et al. (2020) that found out that students taught algebra using target task approach performed significantly better than those taught using lecture method. Efe, & Ajaja, (2023) that also conducted study on effect of task approach on students' ability in senior secondary school chemistry in Delta State confirmed a significant difference between target task approach and lecture method in favour of target task. This outcome is as a result that target task approach supports fluency, develops appropriate orientation to learning, creates avenue for students to evaluate their performance themselves, make way for progress and activeness and improves collaboration among the students.

The result of the study further showed that there is no significant difference between the mean achievement scores of male and female students taught mole concept using target task approach. This finding is also in disagreement with Omeje (2018) that found a significant difference in favour of female students when taught kinetic theory and gas laws using programme instruction approach. This finding is as a result that target task creates avenue for students to evaluate their performance themselves, make way for progress and activeness and improves collaboration among the students irrespective of gender.

The finding of this study also showed that there is no significant difference between the mean achievement scores of male and female students taught mole concept using learning activity approach. The finding of this seem to base on Akpokiniro, (2020) that asserted that learning activity package instructional strategy (LAP) is a learner centered activity that leads to individualization of instruction which leads to higher academic achievement. This finding is also in agreement with Omoniwa & Michael (2024) that found out that students taught using learning activity package showed significantly higher academic achievement compared to those taught using lecture method and there is no significant difference in the mean achievement of male and female students taught with learning activity package. This finding is as a result that learning activity package makes teaching simple and at the same time adjusts both objectives and methods of learning to the needs and characteristics of the individual learners.

Conclusion

Based on the findings, there is a significant difference in the mean achievement scores of students taught mole concept using target task, learning activity package and those taught using lecture method in favour of students taught with target task strategy. There is no significant difference between the mean achievement scores of male and female students

taught mole concept using target task approach and there is no significant difference between the mean achievement scores of male and female students taught mole concept using learning activity approach.

Recommendations

The following recommendations were made based on the findings of the study.

1. Target task strategy should be used by chemistry teachers in teaching and learning of chemistry in secondary schools since it enhances students' achievement in Chemistry than learning activity and lecture method.
2. Workshop/ conferences should be organized by science teacher association to Chemistry teacher on the use of target task in teaching and learning of Chemistry.
3. Learning activity package should be recommended by Science teachers association of Nigeria (STAN) for teaching of science based course since it is gender friendly.

References

- Akpokinioro, S. R. (2020). Effects of learning activity package and teachers' motivation on students' academic achievement in physics. *JOSR Journal of Research and Method in Education*, 5(1), 67–78.
- Achor, E., & Shaibu, J. (2023). Impacts on chemistry education and students' interest. *Journal of Science, Technology, Mathematics and Education*. Retrieved from <https://journals.unizik.edu.ng/jstme/article/view/4406>
- Afuwape, M. O., & Olugbuyi, A. L. (2019). Eradicating poor achievement in basic science and technology through learning activity package: How do students behave in Nigeria? *Journal of Education in Black Sea Region*, 5(1), 15–25. <https://doi.org/10.31578/jeds.v5i1.184>
- Aniodoh, H. C. O., & Eze, G. N. (2014). Effect of programme instruction on male students' achievement in secondary school chemistry. *Journal of Education*, 3(2) 43-52
- Anyanime, O. A., & Abasifreke, N. E. (2019). Effect of constructivist and jigsaw models instructional strategies on the academic achievement of students in chemistry. *60th Annual Conference Proceedings of STAN*, 409–415.
- Attamah, E. U., & Udu, S. U. (2020). Effects of learning activity package on secondary school students' academic achievement in technical drawing. *European Journal of Education Studies*.
- Ajayi, O. V., & Ogbaba, J. (2017). Effect of gender on senior secondary chemistry students' achievements in stoichiometry using hands-on activities. *American Journal of Education Research*, 5(8), 839–842. <https://doi.org/10.12691/education-5-8-11>
- Chernyshenko, O. S., Kankaras, M., & Drasgow, F. (2018). Social and emotional skills for student success and well-being: Conceptual framework for the OECD study on social and emotional skills. <https://doi.org/10.1787/d>
- Danlami, K. B., Aliyu, Z., Aliyu, A. S., Balaraba, B., Istisfanus, A., & Akissani, I. (2020). Effects of target task model on students' performance in algebra among secondary school students in Kaduna, Nigeria. *ATBU Journal of Science, Technology & Education*, 12(1), 28–34.
- Efe, A. H., & Abamba, (2019). Effects of analogy and target task approach on students' achievement in gas laws in senior secondary school in Delta State. *JOSR Journal of Research and Method in Education*, 5(1), 30–40.
- Efe, A. H., & Ajaja, O. P. (2023). Effect of task approach on students' ability in senior secondary school chemistry in Delta State. *JOSR Journal of Research and Method in Education*, 5(1), 15–20.
- Efe, M. O. (2015). Analyses of students' error in learning of mole concept among selected secondary school chemistry students in Zaria, Metropolis, Nigeria. *International Journal of Science Education*, 40(1), 76–84.
- Ezendu, O., & Obi, T. N. (2013). Effect of gender and location on students' achievement in chemistry in secondary schools in Enugu State, Nigeria. *Research on Humanities and Social Science*, 3(15), 200. Retrieved from <http://www.meser.org/mjss/articles>
- Geoffrey, U. (2018). Utilization of innovative teaching strategies for biology teaching in senior secondary school. *International Journal of Science Education*, 40(1), 1–23.
- McMillan, A. (2020). Student-centered learning strategies.
- Mandina, S., & Eshiwet, D. (2018). Implementing a target task problem-solving approach in teaching electrochemistry to advanced level chemistry learners. *Cypriot Journal of Educational Science*, 13(4), 451–460.
- Nnorom, N. R. (2019). Effect of target task instructional model on secondary school students' acquisition of science process skills in biology: Implication for quality studentship in tertiary education for sustainable development. *International Journal of Advanced Research in Science, Engineering and Technology*, 6(3).
- Nnorom, N. R., & Odukwe, I. L. (2021). Effect of target task instructional strategy on students' academic achievement in selected biology topics.
- Njoku, C. O., & Akamobi, I. (2015). Effect of learning activity package on students' academic achievement in agricultural science. *Journal of Pristine*, 2(2) 45-52
- Nworgu, B. G. (2014). Problem-centered investigative approach to science practical in secondary schools: Pilot study. *Journal of Creativity in Teaching*, 2(5), 155–157.



- Olaniyan, A. O., & Omosewo, E. O. (2015). Effects of target task problem-solving models on senior secondary school students' performance in physics. *Science Education International*, 25(4), 522–538.
- Okereke, C., & Onwukwe, E. O. (2011). Influence of gender, school location, and the use of play-stimulation on school achievement in chemistry. *Journal of Research in National Development*, 9(10), 381–387.
- Okunade, A. I., Akinwumi, I. O., & Okeya, A. E. (2022). Effectiveness of learning activity package on students' performance in biology in Ekiti State secondary schools, Nigeria.
- Ojokuku, O. G. (2019). *Understanding chemistry for senior secondary school*. Chempress.
- Petrucchi, R. H., Herring, F. G., Madura, J. D., & Bissonnette, C. (2017). *General chemistry principles and modern applications* (11th ed.). Pearson Canada Inc.
- Mandina, S., & Eshiwet, D. (2018). Effects of target task problem-solving model in teaching electrochemistry to advanced level chemistry learners. *Cypriot Journal of Educational Science*, 13(4), 451–460.
- Ruffing, S., Wach, S. F., Spinath, F. M., & Karbach, J. (2015). Learning strategies and general cognitive ability as predictors of gender-specific academic achievement.
- Shittu, A. M., Omoniwa, O. O., & Michael, J. D. (2024). Efficacy of learning activity package on academic achievement and retention among biology students in Federal College of Education, Zaria. *Ilorin Journal of Education*, 44(1), 139–148. <https://ije.unilorinedu.sch.ng/index.php/ije/article/view/117>
- Udu, D. A., & Eze, C. U. (2018). Utilization of learning activity package in the classroom: Impact on senior secondary school students' academic achievement in organic chemistry. *African Journal of Chemical Education*, 8(2), 49–92. <https://www.ajol.info/index.php/ajce/article/view/176074>
- West African Examinations Council. (2017). *Chief Examiners' Report: May/June 2017 West African Senior School Certificate Examination*. Lagos, Nigeria.
- West African Examinations Council. (2018). *Chief Examiners' Report: May/June 2018 West African Senior School Certificate Examination*. Lagos, Nigeria.
- West African Examinations Council. (2022). *Chief Examiners' Report: May/June 2022 West African Senior School Certificate Examination*. Lagos, Nigeria.