

Effects of Component Task Analysis Teaching Strategy on Secondary School Students' Achievement in Chemistry for Attainable Goals

¹DR. A. M. KENNI, ²DR. M.A. DARAMOLA, ³DR. A.D OYENIYI & ⁴R. O. JEGEDE

^{1,2,3,4}Department of Science Education, Bamidele Olumilua University of Education, Science and Technology, Ikere -Ekiti (BOUESTI), Ekiti State, Nigeria.

¹Phone No: +2349156306434 , E-Mail: kenni.amoke@bouesti.edu.ng.

²Phone No: +2347014302862, E-Mail: daramola.mercy@bouesti.edu.ng

³Pone No: +2347037867160, E-Mail: oyeniyi.ajoke@bouesti.edu.ng

⁴Pone No: +2348034843781, E-Mail: jegede.rufus@bouesti.edu.ng

Abstract

This study investigated the effects of component task analysis teaching strategy on secondary school students' achievement in chemistry for attainable goals. The design of this study was the quasi-experimental research design. The population of the study was the entire senior secondary school two (SSS2) Chemistry students in all the public secondary schools in Ikere local government area of Ekiti State, Nigeria. The sample size for the study is forty (40) students in two (2) intact classes in the senior secondary school two (SSS2) class. The schools were randomly drawn from the ten (10) schools using simple random sampling by balloting without replacement. One instrument was used for data collection. This instrument was Chemistry Achievement Test (CAT). The reliability index obtained was 0.79 at 0.05 significance level. The research hypotheses were tested using the t-test and ANOVA at 0.05 level of significance. The findings of the study indicated that there was significant difference in the students' performance who were taught with component task analysis as they performed better than their counterparts in conventional group. It was also revealed that male students in component task analysis group performed better than their counterparts in conventional group. It was further revealed that female students taught by component task analysis outperformed their female counterparts who were exposed to conventional method. Based on the findings, appropriate conclusion and recommendations were made.

Keywords: Component, task analysis, teaching strategy, achievement, attainable goals.

Introduction

Science has been accorded a prime position worldwide within the context of science education. Science subjects constitute a major part of the subjects being offered in most post-primary institutions in Nigeria today. These subjects are so important that the Federal Government National Policy on Education stated in specific terms that the secondary school education shall provide trained manpower in the applied science and technology (Omwirhiren & Ibrahim, 2016). Science subjects constitute part of the core subjects at both junior and senior secondary school levels. The importance attached to science by the Federal Government could be due to the general belief that science is capable of improving and changing skills, attitudes and cognition by increasing students' store of knowledge's about themselves, their environment and their world. One of the objectives of science education is to develop students' interest in science and technology, as today's society depends largely on development in science and technology (Adekunle, 2020).

No doubt, chemistry has developed over the years to a viable tool and with strong influence on human everyday lives. With this Chemistry can be considered and described to be an essential and a vital portion and process of education for the past, present and future population. It has developed the past to the present and linking the present to the future for brighter and ever competitive world. Chemistry gives power to students to have understanding that is needed to provide explanations for almost all natural phenomena they have and will encounter in their daily life or school scientific activities (Woldeamanuel & Selassie, 2019). Experts have argued consistently that science education with chemistry as very important aspect of science education should be a compulsory part of the education of all children. As many of the noble discipline that are mostly loved by students make chemistry as one of their requirement. This include pharmacy, medicine, environmental science, chemical engineering, geology, biology, agriculture, science education and among others. Meanwhile,

the reality of potentialities of chemistry cannot be fulfilled without the personality and character of the teacher to facilitate the teaching of the subject (Adekunle, 2020).

Teachers are expected to devise ways of making their students to develop positive attitudes towards science (chemistry) and science-related disciplines. Teachers should be involved in formulating the goals and objectives for teaching procedures that will best achieve those objectives, carrying out procedures, evaluating the successes and failures (Omwirhiren & Ibrahim, 2016). Teaching can be described as the act of disseminating a well-planned and clear instruction to the learners by trained, qualified and certified personnel within the organized four walls of classroom. Teaching as a process is aimed at facilitating learning to bring about change in behaviour.

Teaching strategy is a generalized plan for a lesson(s) which include structure desired learner behaviour in terms of goals of instructions and an outline of planned tactics necessary to implement the strategy. Teaching strategy refer to methods used by teachers to help preschoolers learn the desired lesson contents and be able to develop achievable goals in the future. According to Sarode (2018), teaching strategy identify the different available learning methods to enable the teacher develop the right strategy to deal with the learning needs of preschool children. Teaching effectively involves not only the use of tools, techniques, and strategy to optimize learners learning but an understanding of context, in particular how the preschoolers learn, how they process information, what motivates them to learn more, and what impedes the learning process. An effective teaching strategy helps learners to achieve their goals and success in life. In preschool classroom, there are many teaching strategy that can be adopted in enhancing learning outcome of the pupils such include play, game, storytelling among others.

Chemistry teaching should develop in the students manipulative and experimental skills to make him or her competent and confident in conducting experiments and/or researches. Students should do practical work of conducting experiments, reporting their observations and making inferences or conclusions, thus, developing their scientific knowledge and experimental skills and at the same time arousing and maintaining interest of the students in the subject. Furo, Abdullahi & Badgal (2014) suggested that demonstration method could be appropriate for teaching the students of primary and secondary schools because it encourages adequate participation of students in the learning process. The demonstration method has the advantage of being a good way of motivating students to learn and also believed to save time and materials as well as shows how to avoid breakages and accidents. However, it does not allow pupils/students to develop manipulation demands for carrying out activities on their own.

Task component analysis is a process in which broad goals are broken down into small objectives or parts and sequenced for instruction. Task component analysis is the process of developing a training sequence by breaking down a task into small steps that a child can master more easily. Tasks, skills, assignments, or jobs in the classroom become manageable for all children, which allows them to participate fully in the teaching and learning process. In secondary schools settings, teachers focus task analysis on activities necessary for successful participation in the environment. Four ways to develop the steps needed for a task analysis include watching a master, self-monitoring, brainstorming, and goal analysis (Lynch, 2020). Chemistry teachers can use each of these approaches to identify and record the four incremental steps. These are watching a master which involves to know how to help children walk the balance beam, watch someone who is doing this task well. Self-monitoring involves to know how to help learners make a simple learning materials, review the steps that you follow in accomplishing the task. Brainstorming which helps teachers to help children have a plan of how learning is to take place, ask all the children to give ideas. Goal analysis isto know how to help students develop conflict resolution strategy, review the observable and non-observable aspects of this task, and identify ways to see how it is accomplished (Daniel, 2021).

A lot of reports have been made on the seriousness of the deplorable performance of secondary school students in chemistry and identified teaching strategy as one problem leading to this poor performance. The Chief WAEC Examiner Report (2018) noted that the rush over the topics to be covered could be responsible for the poor performance in chemistry. It is observed by the researcher that the quality of teaching method used by the secondary school chemistry teachers is a key determinant of students' achievement. In view of the foregoing, this study examined the effects of

component task analysis teaching strategy on secondary school students' achievement in chemistry for sustainable goals.

The main purpose of this study is to examine the effects of component task analysis teaching strategy on secondary school students' achievement in chemistry for attainable goals.

Hypotheses

The following hypotheses were tested:

1. There is no significant difference in the academic achievement of students taught by component task analysis and conventional strategy.
2. There is no significant difference in the academic achievement of male students taught using component task analysis and conventional strategy.
3. There is no significant difference in the academic achievement of female students taught by component task analysis and those taught by conventional strategy.
4. There is no significant difference in the academic achievement between male and female students taught using component task analysis and those taught using conventional strategy.

Literature Review

Concept of Teaching

Teaching is a very important and a must activities for achieving and enhancing sustainability of educational programme. Phambili (2022) defined teaching as an engagement with learners to enable their understanding and application of knowledge, concepts and processes. It includes design, content selection, delivery, assessment and reflection. To teach is to engage students in learning; thus teaching consists of getting students involved in the active construction of knowledge. A teacher requires not only knowledge of subject matter, but knowledge of how students learn and how to transform them into active learners. Adekunle (2019) also asserted that teaching is a process in which one individual teaches or instruct another individual. Teaching is considered as the act of imparting instructions to the learners in the classroom situation. It is watching systematically.

Good teaching, then, requires a commitment to systematic understanding of learning. The aim of teaching is not only to transmit information, but also to transform students from passive recipients of other people's knowledge into active constructors of their own and others' knowledge. The teacher cannot transform without the student's active participation, of course. Teaching is fundamentally about creating the pedagogical, social, and ethical conditions under which students agree to take charge of their own learning, individually and collectively (Phambili, 2022). Teaching is one of the instruments of education and is a special function to impart understanding and skill in learners. The main function of teaching is to make learning effective. The learning process would get completed as a result of teaching (Adekunle, 2019). So, teaching and learning are very closely related.

Teaching is the act of imparting instructions to the learners in the classroom situation. Chourasiya (2022) stated that teaching is a social process. The meaning of teaching is 'to teach'. Teaching is a three-dimensional process in which the teacher and the student realize their nature through the curriculum. That is, by making a subject matter a medium, teaching is referred to as the exchange of ideas or mutual interaction between the teacher and the learner. Education was teacher-centred, that is, the teacher used to teach the learners according to his own accord, in this the interests and aptitudes of the learners were not taken into account. However, in the present time education has become learner-centred. That is, at present, education is given according to the interests and aptitudes of the learner (Chourasiya, 2022).

Concept of Teaching Strategy

Armstrong (2020) stated that teaching strategy refer to methods used to help students learn the desired course contents and be able to develop achievable goals in the future. Teaching strategy identify the different available learning methods to enable them to develop the right strategy to deal with the target group identified. Assessment of the learning capabilities of students provides a key pillar in development of a successful teaching strategy. Kathy (2020) stated that teaching strategy, also known as instructional strategy, are methods that teachers use to deliver course material in ways

that keep students engaged and practicing different skill sets. An instructor may select different teaching strategy according to unit topic, grade level, class size, and classroom resources. Many kinds of instructional strategy are employed to achieve teaching and learning goals and support different kinds of students.

Concept of Component Task Analysis

Component task analysis is a process in which broad goals are broken down into small objectives or parts and sequenced for instruction. Component task analysis is the process of developing a training sequence by breaking down a task into small steps that a child can master more easily. Tasks, skills, assignments, or lessons in the classroom become manageable for all learners, which allows them to participate fully in the teaching and learning process (Lynch, 2020). Component task analysis could be a very essential teaching techniques in teaching Chemistry science subject and all other science subjects in senior secondary schools. Component task analysis is made systematically (from simple to complex). Component task analysis can be defined as the study of what a user is required to do in terms of actions and or cognitive processes. To achieve a task objective, the idea of task analysis provides some structure for the description of task or activities, which then make it easier to describe how activities fit together, and to explore what implication of this may be for the design of products (Opayinka, *et al.*, 2019).

For the students under study, tasks included studying, doing assignments, and homework relating to learning. Schmid, *et al.* (2010) and Nasriyan *et al.* (2011) defined task analysis as an imaginable or objectively measured worth of a task for completion project. Schmid *et al.* (2010) identified component task analysis as an important variable towards predicting or determining academic performances of students. However, Al-Harthy & Aldhafri (2014) noted that component task analysis coupled with self-efficacy are some of the variable combinations that would easily predict academic performances of students.

Task analysis technique can be described as the studies of what a user is require doing in terms of actions and or cognitive processes to achieve an objective. Szidon & Franzone (2009) defined task analysis as the process of breaking a skill down into smaller, more manageable component. Yahaya *et al.* (2017) asserted that component task analysis refers to disintegration of a complex or compound tasks into sub tasks and more manageable steps in order to teach and learn the task. As learners become master of a sub task, the learners get increasingly independent in his or her ability to perform the next and larger subtasks. Component task analysis technique is an extension of hierarchical/ traditional task analysis technique to yield information about knowledge, thought processes and goal structures that underline observable task performance.

Concept of Conventional Method

The conventional method is a teaching method where the teacher as instructor acts as the primary information giver. The instructor typically stands in front of the students and may use a visual aid, such as a Power Point presentation, chalkboard or handout. Students are expected to listen and take notes during conventional, and there is limited interaction and exchange between teacher and student. The lecture method is common in tertiary institutions classes due to its convenience and ability to pass on information to a large group at once. Paris (2019) stated that the conventional method is just one of several teaching methods, though in schools it is usually considered the primary one.

Paris (2019) stated further that the conventional method is convenient and usually makes the most sense, especially with larger classroom sizes. This is why lecturing is the standard for most tertiary institutions courses, when there can be several of hundred students in the classroom at once; in the most general manner, while still conveying the information that he or she feels is most important, according to the lesson plan. Students who are not auditory learners or who lack note taking skills may struggle with the conventional method of teaching.

Conventional can be said to be a form of interaction through illumination and oral narratives from teachers to students (Suseno, 2013 & Rizki, 2014). Very simply, a conventional is an organized verbal presentation of subject matter often augmented by visual aids. A conventional is a period of

more or less uninterrupted talk from a teacher. The conventional method can also be said to be the delivery of lessons by the teacher by speaking or oral explanation directly in front of students. The conventional begins by explaining the objectives to be achieved, discussing the outlines to be discussed, and connecting the material to be presented with the material that has been presented (Sudjana, 2013). The conventional method will succeed if it gets serious attention from students, presented systematically, excitingly, providing opportunities for students (Suryosubroto, 2009).

At the end of the conventional method it is necessary to put forward conclusions, give assignments to students and the final assessment. The use of the conventional method can be more communicative in recognizing student problems. Conventional are often used to teach organized knowledge and it is necessary to hold a question and answer (Zakirman, Lufri & Khairani, 2018). This question and answer is needed to find out students' understanding of what the teacher has conveyed through the conventional method. Almost for all subjects or subject matter, the teacher must present information and ideas. The teacher must introduce the topic, summarize the main points of learning activities and stimulate further learning (Mudjiono, 2009). All of these activities require the use of conventional methods.

Students' Achievement in Senior Secondary School Chemistry

Academic achievement is the level of attainment of the predetermined learning objectives by the learner. This is mainly shown by the results of either internal examinations in the school or external examinations like Senior School Certificate Examination (SSCE). Poor academic achievement in senior secondary school Chemistry is alarming and disturbing. Reports of researchers and WAEC chief examiners show a continuous dwindling, and poor performances of candidates for over three decades in senior school secondary chemistry.

Despite the importance of chemistry and its education value which is relevant to the need of individual learner, economics and technological breakthrough of a nation and the effort of researchers to improve on its teaching and learning, the performance of students in the subjects is not still encouraging, this shows that the level of performance is still not good enough. The poor achievement of student in chemistry has continued to be a major cause of concern to all, particularly those in the mainstream of chemical education in Nigeria (Adamu, Boris & Kenni, 2013). Among the factors that have been identified to be responsible for poor performance in chemistry are poor methods of instruction, teacher attitude, laboratory inadequacy, poor science background and non-availability of effective teaching and learning resources in classrooms (Adamu, *et al.*, 2013).

Despite huge investment of the stakeholders in this sector, the performance of students continue to be generally poor. Several factors have been advanced to affect students' poor performance. Korau (2006) reported that such include the student factor, teacher factor, societal factor, the governmental infrastructural problem, language problem examination body related variables, curriculum related variables, test related variables, textbook related variables and home related variables. Saage (2009) identified specific variables such as poor primary school background in science, lack of incentives for test, lack of interest on the part of students, students not interested in hard work, incompetent teachers in the primary school, large classes, fear of the subject psychologically among others. However, students do not perform well in Senior School Certificate Examination (SSCE) in chemistry (Eze, 2010).

The implication of a student failing Chemistry at the ordinary level is that he/she will not be enrolled for science based courses at institutions of higher learning. The WASSCE Chief Examiner's Reports between 1999 and 2005 also showed that the percentage of passes in Chemistry is low across Nigeria, thereby affecting the general performance of most candidates who sat for Senior School Certificate Examination over the years. WASSCE Chief Examiner's Reports (2016) also showed that Chemistry students' poor performance in Chemistry paper 2 (theory) over the years, arises from students' having difficulties in tackling questions which required explanation, making logical deductions, calculations, plotting of graph, energy profile diagrams, distinguishing between nuclear and ordinary chemical reactions, chemical symbols and formulae. They lost marks for among other reasons: Inability to write balanced equations with the stated symbols; non-adherence to rubrics; poor knowledge of basic chemical principles; poor communication skills; wrong spellings. From the above discussion it is understood that the Chemistry examination constitutes two aspects; the theory aspect

and the practical aspect. It is also understood that students do fail in Chemistry examination, but it is not yet clearly understood in which of the two aspects of the examination they have serious problems.

Durum (2003) observed that one of the problems found in science teaching in Nigeria is that science is presented dogmatically in most schools which students find difficult to relate to real world. Most of our secondary schools' laboratories are ill-equipped and as a result students are denied that feeling of participation in the reality, which practical classes and demonstration provide. All other factors put apart, this is enough to make students perform poorly in examination.

Studies on variables of teaching found poor performances of students to be as a result of poor classroom teaching and students' attitude to school (Okebukola, 2005). Okebukola (2005) identified some topics in 'O' level Chemistry, which teachers perceived as difficult to teach and this difficulty correlated significantly with their professional qualifications and years of teaching experience. The implication of this is that they could not teach the perceived difficult topics well because of lack of confidence, experience and qualification. Many teachers do not plan in their day to day teaching and learning processes, selection of teaching methods and resources but were efficient in presentation, classroom management and students' involvement.

Gender Difference and Students' Performance in Chemistry

Many researchers have provided reports that there are no longer distinguishing differences in the cognitive, affective and psychomotor skill achievements of students in respect of gender. Nja, et al. (2019) in their findings reported that the mean score of the female students' class attendance was 83.76, which was greater than that of the males (67.2). This indicated that female students' based on the variables involved in the study performed better than male students in Chemistry. In other studies that investigated gender effect, it was discovered that females performed better than males (Natasha, 2018). Nja, et al. (2017) reported a non-joint effect of gender and class attendance on academic performance of Chemistry students. Some previous studies have suggested that females tend to attend class more than males. While the focus of this study is on the underachievement of female students in chemistry at the senior secondary school level, it is important to stress that female underrepresentation in science and science-related courses is a product of the long-coming underachievement of females in science subjects and particularly in chemistry.

Nzewi (2020) revealed that while there are other contending school factors such as gender-biased counselling, the persistent poor performance of female students in science subjects as they move up the learning ladder is the major factor for this lack of interest in science. Though, underachievement of female students in science at the secondary school level is not peculiar to chemistry, female students in secondary school in Nigeria are not doing so well in biology and physics too (Ajayi, 2020; Onowugbeda, 2020 and Onyewuchi, 2020). Oladejo (2018) reported better performance of male students in senior school chemistry than female students. This coupled with existing perceived difficulty in teaching and learning senior school chemistry. According to Ademola (2020); Oladejo (2020); and Okebukola, et al. (2020), this can be attributed to why many females are not attracted to chemistry and hence science and science-based courses and career path.

Eya & Ezeh (2020) in their study found out that gender generally has small effect on the students' achievement in chemistry. It was also found that the percentage variance in the students' academic achievement attributed to gender is 3.8% which is also small. Okorie (2016) reviewed that gender was not a significant factor in the overall mean achievement rating of students in practical skills on acid-base titration. Ssempala (2016) investigated gender differences in the performance of practical skills on quantitative analysis, an aspect of chemistry, among senior secondary school girls and boys in selected co-educational schools. The author showed that there were no statistical significant differences between girls and boys in their ability to manipulate the apparatus/equipment, take observation, report/record results correctly, and compute/interpret/analyse results during chemistry practical; girls performed slightly better than boys overall; boys performed slightly than the girls in the following skills: recording/reporting results correctly, and computing/ interpreting/ analysing results.

Component Task Analysis and Students Performance

Chow, Aro & Eccles (2012) who also established the fact that task values are usually positively correlated with the academic performances of students. The researchers did not provide a qualitative exploration explaining how the former affects the latter as it was in the case of current study. Nasiriyani et al. (2011) established that task value also exert direct effect on mastery goals and efforts. Whereas findings established a negative direct influence of performance approach goals on science achievements, mastery goals were found to be exerting positive effect on effort. Raymond & Ogbuanya (2015) investigated a study on comparative effects of cognitive task analysis and traditional task analysis-based instructional guide students' skill achievement in electronics work. The study found out that cognitive and traditional task analysis techniques are more effective than traditional (convectional) method. Lamidi, Oyelekan & Olorundare (2015) carried out a study on effects of mastery learning instructional strategy on senior school students' achievement in mole concept. The study revealed a significant difference in the achievement of low scorers, medium scorers and high scorers.

Salman, Ayinla, Adeniyi, Ogundele & Ameen (2012) conducted a study on effects of problem solving instructional strategy on senior secondary school students' attitude toward mathematics. The study found out that there exist significant differences between the three levels of scorer. The study also revealed that high scorer benefitted more followed by the medium scorers and low scorers in that order.

Taura, *et al.* (2015) investigated the relationships between self-efficacy, task value, and active procrastination; and what role does self-regulation strategy play in these relationships. A total of 426 pre-service teachers, 223 males and 203 females, studying in colleges of education in North-Western Nigeria participated in the study. The results revealed that task value beliefs were not directly significant predictors of active procrastination. However, the reviewed study targeted a total of 426 pre-service teachers 223 males and 203 females, studying in colleges of education in North-Western Nigeria participated in the study. The study by Taura, *et al.*, (2015) mainly focused on quantitative aspects of the relationship between task value and academic performances. There was no qualitative exploration of the concepts. In other words, Taura, *et al.* (2015) failed to explain in detailed how and why task value should be treated as one of the variables affecting academic performances.

In addition, Chow, Aro & Eccles (2012) performed a quantitative study, which meant that a number of qualitative components of the study were left behind; hence, the use of mixed research approach in the current study. Similarly, Gwen, Bohle, Hebert & Wim (2012) analyzed the role of emotions in a virtual world (Second Life) through students' level of enjoyment and boredom and their influence on students' achievement level. The virtual world was an educational tool used to fully immerse students in the content of the course. Pekrun's Academic Emotions Questionnaire (AEQ) was used to measure two academic emotions: boredom and enjoyment. Results from their study show that task value was unrelated to academic performance. However, the reviewed study suffered from weaknesses of using only one research approach unlike in the current study where both qualitative and quantitative studies were adopted.

Methodology

The design of this study was the quasi-experimental research design. To be specific, it is non-equivalent control group design. This design was appropriate because the researcher cannot randomly sample and assign subjects into groups under normal school situation. Thus he has to use groups already in existence such as groups already organized as intact class were used in order not to disturb the normal class and school settings. It is diagrammatically represented as follows;

Group	Pretest	Treatment	Posttest
Demonstration	0 ₁	X	0 ₂
Control	0 ₃	X	0 ₄

Key: 0₁ = Pre-test, 0₂ = Post-test, X₁ = Treatment, X₂ = control, 0₃ = Pre-test Control, 0₄ = Post-test control.

The study was conducted in public secondary schools in Ikere local government area in Ekiti State, Nigeria.

The population of the study is the entire senior secondary school two (SSS2) Chemistry students in all the public schools in Ikere local government area of Ekiti State. SSS2 students are

chosen because it is the class that is very close to preparation for external examination and that the topic introduction to organic chemistry to be taught are offered at Senior Secondary School II according to the new senior secondary school curriculum.

The sample size for the study is Forty (40) students in two (2) intact classes in the senior secondary school two (SSS2) class. The schools were randomly drawn from the ten (10) schools using simple random sampling by balloting without replacement. Amongst the schools that were selected, one was assigned to the demonstration method group and the other was assigned to conventional method group using simple random sampling by balloting without replacement.

Two instruments were used for data collection. These instruments are; the Chemistry Achievement Test Pre-Test (CATPT) and Chemistry Achievement Test Post-Test (CATPOT) on the topics introduction to organic chemistry. The package used for the study was tagged: Component task Analysis Instructional Package (CTAIP).

The instrument (CAT) was developed by the researcher. Fifty multiple choice objective items based on the topic were collated and was used for pre - test and re – shuffled for post - test during the data collection.

Face and content validity of the instrument was ensured through appropriate mechanism.

In order to ascertain the consistent level of CAT, the instrument was administered to a total of 20 students in a co-educational school within the local government but not originally sampled for data collection. The test –retest method of reliability was used such that the researchers first administered the instrument to twenty (20) students and later re-administered the instrument to the same twenty (20) students within the interval of two-weeks after which the CAT had been re-shuffled. The data collected were subjected to item analysis using Pearson Product Moment Correlation Statistics. The reliability index obtained was 0.79 at 0.05 significance level. This showed that the instrument was reliable for the study.

Classes in the schools that were used for the study were randomly assigned to both experimental and control group. The first group was taught the introduction to organic chemistry with “component task analysis instructional package” of teaching and the second group was exposed to conventional method of teaching. Chemistry teachers of the schools sampled were used for teaching students in conventional method group while the researcher handled the demonstration method class. The “component task analysis instructional package” was prepared and used by the researchers and lesson note for conventional method of teaching were used by the teachers for the study.

The researchers with the help of the subject teachers in schools administered the test to the students; the time allotted for the test was forty (40) minutes. The question papers were retrieved from the students after test. The researcher marked and scored the pre-test.

Also with help of the subject teachers, the treatment was administered using all the demonstration method with different instructional medium. Six lesson plans were prepared and were used for the treatment. Three lesson plans were used for the “component task analysis instructional package” group, while the other three were used for the Conventional Method group.

At the end of the treatment based on the two different teaching methods, the post-test was administered to the students with help of the subject teachers at the allotted time forty (40) minutes. The answer scripts were collected, marked and scored with the help of the subject teachers.

The research hypotheses were tested using the t-test and analysis of covariance (ANCOVA) at 0.05 level of significance.

Results and Discussion

Hypothesis 1: There is no significant difference in the academic achievement of students taught by component task analysis and conventional method in the pretest and posttest.

Table 1a: t-test analysis of difference in the mean performance scores of students taught Chemistry using component task analysis and conventional method in the pre-test

Method	N	Mean	SD	df	t _(cal)	t _(tab)	Decision
Component task analysis	20	9.01	3.007	38	0.274	1.98	NS
Conventional	20	10.11	3.258				

P < 0.05 level of significance

NS = Not Significant

From table 1a, the mean score of the respondents taught Chemistry using component task analysis method (9.01) is less than the mean score of the respondents taught Chemistry using conventional method (10.11) with a mean difference of (1.10). The measure of variability (Standard Deviation) has a difference of (0.251). The t-test analysis shows that the calculated value (0.274) is lesser than the table value (1.98) at 0.05 level of significance. This implies that there is no significant difference in the academic achievement of students taught by component task analysis and conventional method in the pretest. Hence, the null hypothesis is upheld. This infers that there was no significant difference in the previous knowledge of the respondents taught using component task analysis and conventional method on the areas of Chemistry where they were tested.

Table 1b: t-test analysis of difference in the academic achievement of students taught by component task analysis and conventional method in the posttest

Method	N	Mean	SD	df	t _(cal)	t _(tab)	Decision
Component task analysis	20	24.10	4.227	38	2.555	1.98	S
Conventional	20	15.87	5.109				

P < 0.05 level of significance

S = Significant

From table 1b above, the mean score performance of the respondents taught using component task analysis method (24.10) is more than the mean score of the respondents taught using conventional method (15.87) with a mean difference of (8.23). The measure of variability (Standard Deviation) has a difference of (0.882). The t-test analysis shows that the calculated value (2.555) is higher than the table value (1.98) at 0.05 level of significance. This implies that there is significant difference between the mean performance scores of Chemistry students taught using component task analysis and conventional method. Since students taught using component task analysis method had higher mean score rating than those exposed to conventional method, then students in component task analysis group performed better than their counterparts in conventional group. Hence, the null hypothesis is not upheld.

Hypothesis 2: There is no significant difference in the academic achievement of male students taught using component task analysis and conventional method.

Table 2: t-test analysis of difference in the academic achievement of male students taught using component task analysis and conventional method

Method	N	Mean	SD	df	t _(cal)	t _(tab)	Decision
Component task analysis	10	33.00	7.315	18	2.075	1.98	S
Conventional	10	31.28	9.618				

P < 0.05 level of significance

S = Significant

From table 2 above, the mean score of the respondents taught Chemistry using component task analysis method (33.00) is more than the mean score of the respondents taught Chemistry using conventional method (31.28) with a mean difference of (1.72). The measure of variability (Standard Deviation) has a difference of (2.303). The t-test analysis shows that the calculated value (2.075) is higher than the table value (1.98) at 0.05 level of significance. This implies that there is significant difference in the academic achievement of male students taught using component task analysis and conventional method. Since male students taught using component task analysis method had higher mean score rating than those exposed to conventional method, then students in component task analysis group performed better than their counterparts in conventional group. Hence, the null hypothesis is not upheld. This implies that there was a significant difference in the performance of the male respondents taught using component task analysis and conventional method on the areas of Chemistry where they were tested.

Hypothesis 3: There is no significant difference in the academic achievement of female students taught by component task analysis and those taught by conventional method.

Table 3: t-test analysis of difference in the academic achievement of female students taught by component task analysis and those taught by conventional method

Method	N	Mean	SD	df	t _(cal)	t _(tab)	Decision
Component task analysis	10	22.67	3.559	18	2.017	1.98	S
Conventional	10	16.80	5.519				

P < 0.05 level of significance

S = Significant

From table 3 above, the mean performance scores of the female respondents (22.67) is higher than the mean score of the female respondents (16.80) with a mean difference of (5.87). The measure of variability (Standard Deviation) has a difference of (1.96). The t-test analysis shows that the calculated value (2.017) is higher than the table value (1.98) at 0.05 level of significance. This implies that there is significant difference in the academic achievement of female students taught by component task analysis and those taught by conventional strategy. Since female students taught by component task analysis had higher mean performance, it implies that female students taught by component task analysis outperformed their female counterparts who were exposed to conventional method. Hence, the null hypothesis is not upheld.

Hypothesis 4: There is no significant difference in the academic achievement between male and female students taught using component task analysis and those taught using conventional strategy.

Table 4: One-way Analysis of Variance (ANOVA) of difference in the academic achievement between male and female students taught using component task analysis and those taught using conventional strategy

Source	SS	df	MS	F	P
Between Groups	3892.014	2	711.902	32.507	0.000
Within Groups	5683.227	58			
Total	9575.241	60	19.37		

Table 4 shows the one way Analysis of Variance (ANOVA) of difference in the academic achievement between male and female students taught using component task analysis and those taught using conventional strategy. The table revealed that the significant value (.00) is less than the significant level (0.05). This implies that there is a significant difference somewhere among the mean scores of dependent variables for the groups. Hence, the null hypothesis is rejected. This implies that there was a significant difference in the academic achievement between male and female students taught using component task analysis and those taught using conventional strategy in favour of male students.

Discussion of Findings

The finding revealed that students in component task analysis group performed better than their counterparts in conventional group. This was in line with the findings of Raymond & Ogbuanya (2015) that cognitive task analysis techniques are more effective than conventional method. Component task analysis technique is an extension of hierarchical/ traditional task analysis technique to yield information about knowledge, thought processes and goal structures that underline observable task performance. Cognitive task analysis refer to disintegration of a complex or compound tasks into sub tasks and more manageable steps in order to teach and learn the task. As learners become master of a sub task, the learners get increasingly independent in his or her ability to perform the next and larger subtasks. To achieve a task objective, the idea of task analysis provides

some structure for the description of task or activities, which then make it easier to describe how activities fit together, and to explore what implication of this may be for the design of products.

The finding further revealed that there was a significant difference in the performance of the male respondents taught using component task analysis and conventional method on the areas of Chemistry where they were tested. Also, it was revealed that there was a significant difference in the academic achievement between male and female students taught using component task analysis and those taught using conventional strategy in favour of male students. The finding further agreed with the finding of Opayinka *et al.* (2019) that male students performed better than their female counterpart when taught science subjects through task analysis method. This implies that that male students' performance was enhanced as a result of male students' exposure to cognitive task analysis technique. The finding was further in agreement with Liza (2014); Raymond & Ogbuanya (2015), as they found out that students taught using component task analysis technique perform significantly better their counterparts taught using other techniques. And also the techniques influence gender based performance among Chemistry students.

The finding also revealed that female students taught by component task analysis outperformed their female counterparts who were exposed to conventional method. This also concurred with the finding of Oyuga *et al.* (2019) that there was a significant weak (small) positive relationship between task value and academic performance among secondary school students. Even though it found out to be small in their study, there was still an evidence differences in the performance of students. The findings pointed out that female students performance varies based on the techniques used to teach them in Chemistry and this strongly influenced their academic performance. Task analysis should be used when a task is complex, when it is difficult to learn and when tasks are not pre-sequenced. It can therefore, be deduced that the acquisition of practical skills especially in Chemistry can be studied with the use of task analysis-based instructional guide because of the educational benefits for learning that the skills possessed.

Conclusion

Based on the findings of this study, it is evident that:

Students taught Chemistry using component task analysis performed better than those taught with conventional method. There was a significant difference in the performance of the male respondents taught using component task analysis and conventional method in Chemistry. Female students taught by component task analysis outperformed their female counterparts who were exposed to conventional method. There was a significant difference in the academic achievement between male and female students taught using component task analysis and those taught using conventional strategy in favour of male students.

Recommendations

Based on the findings, these recommendations were made:

1. Component task analysis method should be vastly introduced and use for teaching Chemistry in senior secondary schools since it stimulates students learning effectiveness and performance.
2. Chemistry teachers should consistently plan their lesson with techniques that will suit and assist secondary school Chemistry students learning ability that can be transformed into academic performance.
3. Chemistry teachers should make adequate use of teaching facilities for effective transfer of knowledge in teaching and learning of Chemistry.
4. Chemistry teachers should lay more emphasis on the use of component task analysis in the teaching and learning of Chemistry such that the learning of Chemistry can enhance mastery of the content being learnt for improving academic performance among students.
5. The use of conventional method in teaching Chemistry should be discouraged and be replaced by more effective and efficient teaching strategy like component task analysis.
6. In addition, the government, in conjunction with curriculum developers, the federal and state government; other professional bodies like the Science Teachers Association should create

resource centers that can sensitize other stakeholders in the education sector on the efficacy of components task analysis strategy.

References

- Adamu, A. S., Boris, O. O. & Kenni, A. M. (2013). Trends in Students' Achievement in Senior School Certificate Examination (SSCE) in Chemistry between 2008 And 2012, *International Journal of Science and Research (IJSR)*, 2(6), 393-395.
- Adekunle, D. (2019). *Education in the Modern Africa Settings*; New Press Nigeria, Ibadan.
- Adekunle, D. (2020). *Science Education: The power of the modern era technology*, New Print, Ibadan.
- Ademola, I. A. (2020). *Nuclear Chemistry as a Difficult Topic for Secondary School Students: Harnessing the Power of Indigenous (Cultural) Knowledge for Its Understanding*, In *Breaking Barriers to Learning of Science: The CTC Approach*, 167–181. Slough, UK: Sterling Press.
- Ajayi, O. A. (2020). *Variation and Evolution in Biology as Difficult Topics for Secondary School Students: Harnessing the Power of Indigenous (Cultural) Knowledge for Their Understanding*. In *Breaking Barriers to Learning of Science: The CTC Approach*, 193–204. Slough, UK: Sterling Press.
- Al-Harthy, I., & Aldhafri, S. (2014). The relationship among task-value, self-efficacy and academic performance in Omani students at Sultan Qaboos University. *International Review of Social Sciences and Humanities*, 7(2), 15-22.
- Armstrong, S. (2020). *The 10 most important teaching strategies*, <https://www.innovatemyschool.com/ideas/the-10-most-powerful-teaching-strategies>.
- Chourasiya, S. (2022). Concept of Teaching: Meaning, Definitions, Variables and Function, <https://www.samareducation.com/2022/06/concept-of-teaching-meaning-definitions-variables-and-function.html>.
- Chow, A., Aro, S. K. & Eccles, J. S (2012). Task Value Profiles Across Subjects and Aspirations to Physical and IT-Related Sciences in Finland. *Developmental Psychology*, 48 (6), 1612–162.
- Daniel, A. (2021). *Components of Task Analysis: Concept and Modality in Teaching Innovation*, August Printing, Ebonyi.
- Durum, A. I. (2003). *Education and Training of the Scientist Defects in our system of Training*, Unpublished B. Sc. Ed. Thesis, University of Ibadan.
- Eya, N. M., & Ezeh, D. N. (2020). Meta-analysis of influence of gender on students' academic Achievement in chemistry in Nigeria, *Journal of Chemical Society of Nigeria*, 45(4), 615 – 661.
- Eze, S. (2010). *Effect of practical knowledge of Chemistry as predictors of students' performance in theoretical aspect of Chemistry*, Unpublished PhD thesis, University of Nigeria, Nsukka.
- Furo, R. J., Abdullahi, Y., & Badgal, B. E. (2014). Effects of demonstration and conventional methods of teaching apiculture on achievement of agricultural students in Adamawa State University, Nigeria. *Scientific Papers Series-Management, Economic Engineering in Agriculture and Rural Development*, 14(2), 173-178.
- Kathy, R. (2020). *Effective Teaching Strategies*, Retrieved online from <https://study.com/teach/instructional-strategies.html> on 13/04/2020.
- Korau, Y. K. (2006). *Educational Crises Facing Nigerian Secondary Schools and Possible Solutions*, Being a paper presented at Faculty of Education, University of Ibadan.
- Lamidi, B. T., Oyelekan, O. S., & Olorundare, A. S. (2015). Effects of Mastery Learning Instructional Strategy on Senior School Students' Achievement in the Mole Concept. *The Electronic Journal of Science Education*, 19, 1-20.
- Lynch, M. (2020). *What are the 4 Components of Task Analysis?* <https://www.theedadvocate.org/what-are-the-4-components-of-task-analysis>.
- Mudjiono, D. (2009). *Belajardan Pembelajaran*, Jakarta: PT RinekaCipta.
- Nasiriyah, A., Azar, H. K., Noruzy, Ali, A. D., & Mohammad, R. (2011). A model of self-efficacy, task value, achievement goals, effort and mathematics achievement. *International journal of academic research*, 3(2), 612 – 652.
- Natasha, Q. (2018). The Mark of a Woman's Record: Gender and Academic Performance in Hiring. *American Sociological Review*, 83(2), 331 – 360.

- Nja, C. O., Idiege, K. J., & Obi, J. J. (2017). *Chemistry games with kitchen resources and academic performance in electronic configuration*. 9th International Conference on Languages, Humanities, Education and Social Sciences (LHESS-17) Dubai (UAE) Dec. 21-22, 2017.
- Nja, C., Cornelius-Ukpepi, B., & Ihejiamaizu, C. C. (2019). The influence of age and gender on class attendance plus the academic achievement of undergraduate Chemistry Education students at University of Calabar. *Educational Research and Reviews*, 14(18), 661-667.
- Noteborn, G., Carbonell, K. B., Dailey-Hebert, & Gijsselaers, W. The role of emotions and task significance in Virtual Education, *The Internet and Higher Education*, 15 (3), 176 – 183.
- Nzewi, U. M. (2020). *ACE 812-912: Recent Developments in Gender Issues in STEM Education*, LASU-ACEITSE, MP4. From Africa Center of Excellence for Innovative and Transformative STEM Education. YouTube, 58: 43.
- Okebukola, P. A. O. (2005). *The Race against Obsolescence: Enhancing the Relevance of STAN to National Development*, Memorial Lecture Series, 17, Science Teachers' Association of Nigeria.
- Okebukola, P. A., Oladejo, A. I., Onowugbeda, F., Awaah, F., Ademola, I., Odekeye, T., & Adewusi, M. (2020). *Deeper Probe of African Students' Perceived Difficult Concepts in Secondary School Chemistry*, Unpublished.
- Okorie, E. U. (2016). Influence of Gender and Location on Students' Achievement in Chemical Bonding, *Mediterranean Journal of Social Sciences*, 7(3), 309-318.
- Oladejo, A. I. (2018). Computer Simulation and Cognitive Achievement in Senior Secondary School Chemistry, Master's thesis, Lagos State University, Ojo, Nigeria.
- Oladejo, A. I. (2020). *Nuclear Chemistry as a Difficult Topic for Secondary School Students: Harnessing the Power of Indigenous (Cultural) Knowledge in Its Understanding*, In *Breaking Barriers to Learning of Science: The CTC Approach*, 230–238. Slough, UK: Sterling Press.
- Omwirhiren, E. M., & Ibrahim, A. U. (2016). An Analysis of Misconceptions in Organic Chemistry among Selected Senior Secondary School Students in Zaria Local Government Area of Kaduna State, Nigeria, *International Journal of Education and Research*, 4(7), 247-266.
- Onowugbeda, F. U. (2020). *Variation and Genetics as Difficult Topics for Secondary School Students in Biology: Exploring the Impact of Indigenous (Cultural) Knowledge for Better Understanding*. In *Breaking Barriers to Learning of Science: The CTC Approach*, 140–154. Slough, UK: Sterling Press.
- Onyewuchi, F. A. (2020). *Refractive Index as a Difficult Topic in Senior Secondary Physics: Harnessing the Power of Indigenous (Cultural) Knowledge for Its Understanding*, In *Breaking Barriers to Learning of Science: The CTC Approach*, 155–166. Slough, UK: Sterling Press.
- Opayinka, H. F., Kehinde, M. A. & Kadejo, L. (2019). Effect of Task Analysis on Academic Performance of Visually Impaired Students in Mathematics in Oyo, *Abacus (Mathematics Education Series)*, 44(1), 1 – 5.
- Paris, E. (2019). *Lecture Method: Pros, Cons, and Teaching Alternatives*. *Blog.udemy.com*. Retrieved 1 December 2019.
- Phambili, S. S. (2022). Teaching, learning, assessment, curriculum and pedagogy, <http://www.sun.ac.za/english/learning-teaching/ctl/t-l-resources/curriculum-t-l-assessment>
- Raymond, E., & Ogbuanya, T. C. (2015). Comparative Effects of Cognitive & Traditional Task Analysis-Based Instructional Guides on Students' Skills Achievement in Electronics Work, *International Journal of Scientific & Engineering Research*, 6(1), 1 – 9.
- Rizki, R. (2014). Penerapan Metode Ceramah dan Diskusi Dalam Meningkatkan Hasil Belajar PAI di SMA Negeri 44 Jakarta, Jakarta: *Jurnal Studi Alquran*, 10, 119-124.
- Saage, O. (2009). *Causes of Mass Failures in Mathematics Examination among Students a Commissioned Paper presented at Government Secondary School*, Karu Abuja Science Day 1st March.
- Salman, M. F., Ayinla, J. O., Adeniyi, C. O., Ogundele, L., & Ameen, S. . K. (2012). Effect of Problem-Solving Instructional Strategy on Senior Secondary School Students' Attitude towards Mathematics in Ondo, Nigeria. *International Journal of Asian Social Science*, 7(1), 1056–1066.
- Sarode, R. D. (2018). Teaching Strategies, Styles and Qualities of a Teacher: A Review for Valuable Higher Education, *International Journal of Current Engineering and Scientific Research (IJCESR)*, 5(5), 57-62.

- Schmidt, A. M., & DeShon, R. P. (2010). The moderating effects of performance ambiguity on the relationship between self-efficacy and performance. *Journal of Applied Psychology*, 95(3), 572.
- Ssempala, F. (2016). *Gender differences in performance of chemistry practical skills among senior six students in Kampala District*, <http://www.universalpublishers.com/book.php?method=ISBN&book=1599427001>. Accessed, on 22 March.
- Sudjana, N. (2013). *Dasar-dasar Proses Belajar Mengajar*, Bandung: Sinar Baru Algensindo.
- Suryosubroto, E. (2009). *Proses Belajar Mengajar di Sekolah*. Jakarta: PT Rineka Cipta.
- Suseno, D. (2013). Pengaruh Penggunaan Metode Meramadhan Metode Dialog Terhadap Hasil Belajar Siswa Kelas XI IPS pada Mata Pelajaran Ekonomi di SMA Negeri 1 Kaliwiro Kabupaten Wonosobo, *Jurnal Tarbiyah*, 21, 255-260.
- Szidon, K., & Franzone, E. (2009). *Task analysis: Madison, WI: Steps for implementation*. Development center on autism spectrum disorders, Waisman Center, University of Wisconsin, 1-6.
- Taural, A. A., Abdullah, M. A., Roslan, S., & Omar, Z. (2015). Relationship between self-efficacy, task value, self-regulation strategies and active procrastination among pre-service teachers in colleges of education, *International Journal of Psychology and Counselling*, 7(2), 11-17.
- WASSCE Chief Examiner's Reports, (2016). *Report on Students performance in Chemistry, WASSCE*.
- Woldeamanuel, M. M., & Selassie, G. G. (2019). Motivation and Attitude towards Learning Chemistry, *Amal Jyothi College of Engineering*, 9(2), 70-88.
- Yahaya, W.O., Akanbi, A. O., & Omosewo, E. O. (2017). Effects of Cognitive Task Analysis Technique on Senior School Students' Performance in Simple Harmonic Motion in Ilorin. *Journal of Curriculum and Instruction (Special Edition)*, 10(2), 1 – 10.
- Zakirman, E., Lufri, K., & Khairani, R. (2018). Factors Influencing the Use of Lecture Methods in Learning Activities: Teacher Perspective, *Advances in Social Science, Education and Humanities Research*, 178, 4-6.