# Effect of Task Hierarchy Analysis Model in Cooperative Learning Strategy on Chemistry Students' Performance in Imo State

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***Abstract:** Task Hierarchy Analysis Model in Cooperative Learning Strategy and Chemistry Students' Performance were investigated in Nwangele Local Government Area of ImoState. Two objectives, two research questions and two hypotheses guided the study. Quasi-experimental design involving pre-test and post-test non-equivalent group was adopted for the study. Out of the total population of four hundred and fifty (450) SS2 Chemistry students, one hundred and six (106) students in two intact classes purposively selected were used as the sample size. Chemistry Performance Test (CPT) which contained twenty (20) multiple choice questions drawn from the topic taught (Acid-Base Reactions) was used for data collection. The instrument was validated with the reliability index of 0.76 using Pearson Product Moment Correlation (PPMC) to determine students' performance. Mean, Standard deviation and Analysis of Covariance (ANCOVA) were used to analyze the data collected. The result revealed that students taught using Task Hierarchy Analysis Model in Cooperative Learning Strategy performed better than those taught using lecture method. The result further showed that a significant difference existed between the academic performance of students taught Chemistry using Task Hierarchy Analysis Model in Cooperative Learning Strategy and lecture method. However, there was no significant variance between the performance of male and female students taught Chemistry using Task Hierarchy Analysis Model in Cooperative Learning Strategy. It was recommended that Chemistry teachers should adopt Task Hierarchy Analysis Model in Cooperative Learning Strategy in this 21st century classroom to enhance students' performance.*
***Key words:** Chemistry, Task Hierarchy Analysis Model, Cooperative learning strategy and performance.*

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## I. Introduction

The world is changing very fast in terms of advancements in science and technology. The rapid change has made technology to determine human relevance and function. Most countries of the world are responding to this paradigm shift. For Nigeria to realize accelerated development in the 21st century, she needs qualitative science and technology education. Science education is the gateway to opportunities, the foundation of knowledge based and innovation driven economy. This is true because scientific literacy helps individuals to understand their environment, interpret the natural phenomenon, participate in the social responsibilities and take decisions on issues concerning scientific development. Supporting this, Idris (2015) advised that every nation must take Science education very serious in all institutions of learning. Without Science education, Information and Communication Technology (ICT) would almost be impossible. Science education is very much required for the elevation of a nation from a consumer position to a producing position and also changes a nation from her developing stage to a developed nation. Acquisition of appropriate scientific and technological skills is necessary to cope with the challenges presented by the evolving needs of modern work, placed in Nigerian industries and the ever growing non-formal sectors.

Chemistry, being a very important aspect of science plays a very crucial role in scientific and technological development. This is evidenced on the impact on Agriculture, Engineering, Medicine, Architecture and other Science disciplines. Chemistry education is therefore very important to any growing economy. Many graduates of Chemistry are self-employed and employers of labour. Many own schools where people work and earn their living. In most secondary schools that embrace entrepreneurial education, students of Chemistry acquire entrepreneurial skills that enable them to be self-reliant after leaving secondary school. Chemistry educationlays foundation for further study of Science education and other Science related discipline and produces the needed technologists and scientists as well as skilled scientifically literate citizens who are

required to turn the nations' economy around. The desired technological advancement is possible only when the teaching of science subjects like Chemistry in secondary schools is effective.

In view of the above, Chemistry teachers are expected to ensure effective and meaningful teaching of Chemistry concepts to the students. Nevertheless, the poor and inappropriate method adopted by Chemistry teachers during classroom instruction has led to the poor performance of students in external examinations. In an attempt to help students learn and better understand Acid-Base Reactions, task hierarchy analysis model which specified learning from simple to complex and from known to unknown ina cooperative learning strategy was employed in the study. Task hierarchy analysis model is connected to theory of learning hierarchy developed by Gagne (1967). The model examines all relevant topics pre-requisite to the defined objectives or terminal task.Crandall, Klein, and Hoffman, (2006) defined hierarchical task analysis (HTA) as a widely used type of task analysis where a high-level task is decomposed into a hierarchy of subtasks. This means that (HTA) is sometimes referred to as a hierarchical decomposition. Cooperative learning strategy is a strategy which organizes students in small groups so that they can work together to maximize each other's shared knowledge. Cooperative learning changes students' and teachers' roles in the classroom. Cally (2015) clearly asserted that students showed improvement in their academic interactions and learning styles as a result of cooperative learning strategy. Uloaku (2015) agreed that students' performance and retention increases when they are engaged in interactive strategies.Along with improving academic learning, cooperative learning strategy helps students to engage in thoughtful discourse and examine different perspectives in order to increaseself-esteem, motivation, and empathy.Considerable research like the studies of Johnson, Roger and Karl (1991) demonstrated that cooperative learning produces higher achievement, more positive relationships among students, and healthier psychological adjustment than do competitive or individualistic experience.This is so because in a cooperative learning strategy the students play the major role in their learning.

Gender is an important extraneous variable which sometimes affects the performance of secondary school students.This is probably because most students at the secondary level are between the ages of 13 to 19 years, which is the age range when most of them are used as service providers both in school and at home. Gender equality is the main objective a teacher achieves using cooperative learning strategy because of their characteristic features.Ikeme and Williams (2016) found out that gender has no significant influence on students' academic achievement when taught using innovative strategy like cooperative learning. Jacobs (2016) in a study also found out that being a male or female does not influence students' academic achievement when taught using the same teaching method. This finding however, contradicts the findings of Ezeugwu (2007) who found out that gender has significant influence on students' academic achievement when taught using the same innovative teaching strategy.The concept of Acid-Base Reactions is a difficult concept for students at the senior secondary two level of education. It therefore requires the application of innovative and learner centered strategies, well-designed laboratory and instructional materials in order to achieve the desired objectives. It was based on this conviction that the study investigated task hierarchy analysis model in Cooperative learning strategy on Chemistry students' performance in Imo State, Nigeria.

**Statement of the Problem**

According to Nwagbo (2013) academic performance could be getting high grades and a high grade point average (GPA) level. In the context of this study, academic performance means learning outcome which has to do with the knowledge attained from teaching process, it is also known as performance. Students' performance in Chemistry over the years has been poor (Ehirim, 2016). For example, the Senior Secondary School Certificate Examination (SSSCE) shows that less than 50% of candidates passed Chemistry at credit level and above between 2010 and 2016 in the Chief Examiner's Report. Esogwa (2015) posited a reason for this poor performance. The author noted that the teaching methods adopted by teachers do not make the learning of Chemistry easy for students. The teaching methods used by teachers in teaching Chemistry contribute to students' poor performance in the subject. The prevailing traditional teaching methods do not actively involve the learners in the learning process and seem to deprive the learners of taking charge of their learning, thus, affecting their performances in examinations. Effective instructional strategy is one which encourages students' active participation in the teaching/learning process which could help the students to obtain higher performance.

Some studies on students' performance in school subjects have established that there are variances in students' performance in terms of gender. On the other hand, some other studies found out that when exposed to the same instructional strategy, gender does not have significant varied on students' performance on the various school subjects. Indeed, the issue of the influence of gender on students' academic performance has not been settled. Therefore, this study sought to find out the effect of task hierarchy analysis model in cooperative learning strategy on Chemistry students' performance in Imo State.

## II. Aim and Objectives of the Study

The aim of the study was to determine the effect of task hierarchy analysis model in cooperative learning strategy on Chemistry students' performance in Imo State. Specifically, the objectives of the study were to:

1. Encourage academic performance of students when taught Chemistry using task hierarchy analysis model (THAM) in cooperative learning strategy (CLS).
2. Ascertain the academic performance of male and female studentswhen taught Chemistry usingtask hierarchy analysis model (THAM) in cooperative learning strategy (CLS)

**Research Questions**

Two research questions guided the study

1. What is the academic performance of students taught Chemistry using task hierarchy analysismodel (THAM) in cooperative learning strategy (CLS) and Lecture Method?
2. What is the academic performance of male and female students taught Chemistry using task hierarchy analysis model (THAM) in cooperative learning strategy (CLS)?

**Hypotheses**

Two null hypotheses were formulated to guide the study

$Ho_1$: There is no significant difference between the academic performance of students taught Chemistryusing task hierarchy analysis model (THAM) in cooperative learning strategy (CLS)and lecture method

$Ho_2$: There is no significant difference between the academic performance of male and female students taughtChemistryusingtask hierarchy analysis model (THAM) in cooperative learning strategy (CLS) and Lecture Method

## III. Methodology

The study adopted a quasi-experimental design involving pretest and posttest non-equivalent group. One control group and one experimental group in a co-educational setting were used**.** The population of the study was 450 SS2 Chemistry students (ISSEMB, 2018), which the sample was purposively selected to obtain two schools with 106 senior secondary two Chemistry students in the two intact classes. The researchers took advantage of SS2 students because they are preparing for the School Certificate Examination (SSSCE) in 2019.

Chemistry Performance Test (CPT) containing 20 objective questions covering important aspect of Acid-Base reactions was the instrument. The research instrument was validated by two experts in Department of Curriculum Studies and Educational Technology, University of Port Harcourt, Nigeria. The final draft was subjected to a reliability test using Pearson Product Moment Correlation formula; an index of 0.76 was obtained. Both groups were pretested prior to the commencement of the study with the instrument, to ascertain baseline knowledge.

The experimental group was taught using task hierarchy analysis model (THAM) in cooperative learning strategy (CLS) in the class. The control group was taught the same concept using the lecture method. On the conclusion of the exercise for three weeks, a posttest was administered to both groups of students in order to determine the effectiveness of the treatment. Data obtained were analyzed using mean scores and standard deviation to answer the research questions while Analysis of Co-variance (ANCOVA) was used to test the hypotheses at 0.05 level of significance.

## IV. Results

The results are presented in the following tables

**Research Question 1:** What is the academic performance of students taught Chemistry using task hierarchy analysis model (THAM) in cooperative learning strategy (CLS) and Lecture Method?

**Table 1: Mean and Standard deviation of pre-test and post-test performance of students in Acid-base Reactions using THAM in CLS**

| Group | N | Pretest | SD | Posttest | SD | Mean Difference |
|---|---|---|---|---|---|---|
| **THAM in CLS** | 55 | 13.96 | 3.57 | 21.10 | 7.20 | 7.14 |
| **LM** | 51 | 12.92 | 4.52 | 14.76 | 5.60 | 1.84 |

From the table 1 above, it can be observed that the pretest mean performance of experimental group taught using THAM in Cooperative learning strategy was 13.96 while their post-test mean performance score was 21.10. For the control group taught using the lecture method, students had a pretest score of 12.92 and a post-test score of 14.76. Considering the values, it can be seen that the mean difference between the pretest and posttest mean performance of experimental group and the control group were 7.14 and 1.84 respectively. This

result suggested that THAM in Cooperative learning strategy has a greater effect in the mean performance of students in acid-base reaction than lecture method.

**Research Question 1:** Whatis the academic performance of male and female students taught Chemistry using task hierarchy analysis model (THAM) in cooperative learning strategy (CLS)?

**Table 2:Mean and Standard deviation of pre-test and post-test performance of male and female students in Acid-base Reactions using THAM in CLS**

| THAM in CLS | N | pre-test | | Post-test | | |
|---|---|---|---|---|---|---|
| | | mean | SD | Mean | SDMD | |
| **Male** | 32 | 13.03 | 2.65 | 20.62 | 7.24 | 7.59 |
| **Female** | 23 | 15.26 | 4.29 | 21.78 | 7.26 | 6.52 |

MD= Mean Difference

Table two shows that the mean pre-test score and SD performance of the malestudents taught Acid-Base Reactions with task hierarchy analysis model in cooperative learning strategy were 13.03 and 2.65 respectively. The mean post-test score and SD were 20.62 and 7.24 while the mean pre-test score and SD of performance of female students taught using the same strategy are 15.26 and 4.29while the mean posttest scores and SD are 21.78 and 7.26 respectively. Considering the values, it can be seen that the mean difference between the pretest and posttest mean performance of male and the female were 7.59 and 6.52 respectively.This shows that male students performed better than the female students in this study.

**Ho₁:** There is no significant difference between the academic performances of students taught Chemistryusing task hierarchy analysis model (THAM) in cooperative learning strategy (CLS)and lecture method

**Table 3 Analysis of Covariance (ANCOVA) on Performance of SS 2 students taught acid-base reactions using THAM in CLS and LM**

| Source | Type III Sum of Squares | df | Mean Square | F | Sig. |
|---|---|---|---|---|---|
| Corrected Model | 1145.148[a] | 2 | 572.574 | 13.726 | .000 |
| Intercept | 1966.662 | 1 | 1966.662 | 47.147 | .000 |
| Prep | 80.009 | 1 | 80.009 | 1.918 | .169 |
| Group | 974.532 | 1 | 974.532 | 23.362 | .000 |
| Error | 4296.513 | 103 | 41.714 | | |
| Total | 40002.000 | 106 | | | |
| Corrected Total | 5441.660 | 105 | | | |

From data analysis using (ANCOVA) in the table 3 above, it can be seen that the F-value of 23.362 obtained at 1 and 103 degrees of freedom had a corresponding p-value of 0.000, which is lesser than the chosen alpha of 0.05 (.000<0.05) for the study. From this value, it can be stated that there was a significant effect of THAM in Cooperative learning strategy on the mean performance of students in acid-base reactions. The null hypothesis was therefore rejected.

**Ho₂:** There is no significant difference between the academic performance of male and female students taughtChemistryusing task hierarchy analysis model (THAM) in cooperative learning strategy (CLS) and Lecture Method

**Table 4 Analysis of Covariance (ANCOVA) of Performance of male and female SS 2 students taught acid-base reactions using THAM in CLS**

| Source | Type III Sum of Squares | df | Mean Square | F | Sig. |
|---|---|---|---|---|---|
| Corrected Model | 99.649[a] | 4 | 24.912 | .518 | .723 |
| Intercept | 2493.335 | 1 | 2493.335 | 51.861 | .000 |
| PretestP | 38.718 | 1 | 38.718 | .805 | .372 |
| Group | 22.323 | 1 | 22.323 | .464 | .497 |
| Gender | 4.685 | 1 | 4.685 | .097 | .756 |
| Group * Gender | 39.220 | 1 | 39.220 | .816 | .368 |
| Error | 5144.270 | 62 | 48.077 | | |
| Total | 57145.000 | 55 | | | |
| Corrected Total | 5243.920 | 54 | | | |

Table 4 showed the Summary of ANCOVA on performance of male and female students taught Chemistry using task hierarchy analysis model in cooperative learning strategy. There was no significant difference between the performance of male and female students taught Chemistryusing task hierarchy analysis model in cooperative learning strategy ( P=.368 > 0.05). The null hypothesis was accepted at 0.05 alpha level

## Discussion of Finding

Results in table 1 shows that students taught using task hierarchy analysis model in cooperative learning strategy performed better than those taught using lecture method on academic performance. This indicated that task hierarchy analysis model in cooperative learning strategywas more facilitative in terms of academic performance of the students when the variance was estimated. The result in table 3 showed a significant difference between the performances of students taught Chemistryusing task hierarchy analysis model in cooperative learning strategy and lecture method. (P=.000 < 0.05). The null hypothesis was rejected at 0.05 alpha level.

This result agreed with the earlier findings of Cally (2015) who clearly asserted that students showed improvement in their academic interactions and learning styles as a result of cooperative learning strategy. The earlier finding of Uloaku (2015) further agreed that students' performance increases when they are engaged in interactive strategies.Johnson, Roger and Karl (1991) demonstrated that cooperative learning produces higher achievement, more positive relationships among students, and healthier psychological adjustment than do competitive or individualistic experience. Cooperative learning strategy helps students to engage in thoughtful discourse and examine different perspectives in order to increaseself-esteem, motivation, and empathy.

Table two shows that the mean pre-test score and SD performance of the male students taught Acid-Base Reactions with task hierarchy analysis model in cooperative learning strategy were 13.03 and 2.65 respectively. The mean post-test score and SD were 20.62 and 7.24 while the mean pre-test score and SD of performance of female students taught using the same strategy are 15.26 and 4.29while the mean posttest scores and SD are 21.78 and 7.26 respectively. Considering the values, it can be seen that the mean difference between the pretest and posttest mean performance of male and the female were 7.59 and 6.52 respectively.This shows that male students performed better than the female students in this study. However, table 4 shows that there was no significant difference between the performance of male and female students taught Chemistryusing task hierarchy analysis model in cooperative learning strategy ( P=.368 > 0.05). The null hypothesis was accepted at 0.05 alpha level.This finding supports the earlier finding of Ikeme and Williams (2016) who found out that gender has no significant influence on students' academic achievement when taught using innovative strategy like cooperative learning. Jacobs (2016) in a study also found out that being a male or female does not influence students' academic achievement when taught using the same teaching method.However, the present finding contradicts the earlier findings of Ezeugwu (2007) who found out that gender has significant influence on students' academic achievement when taught using the same innovative teaching strategy.

## V. Conclusion

Based on the findings of the study, it was concluded that the use of task hierarchy analysis model in cooperative learning strategy in teaching has significant effect on the students' academic performance. This provided empirical evidence on the relative efficacy of interactive and learner centered strategy in enhancing the teaching and learning outcomes in Chemistry.

## Recommendations
The study recommended that:
1.	Chemistry teachers should adopt Task Hierarchy Analysis Model in Cooperative Learning	Strategy	in this 21st century classroom to enhance students' performance.
2.	Chemistryteachers should be retrained to improve on these innovative strategies. This can	bedone through seminars, conferences, workshops	organized by both government and  non-government agencies.

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