EFFECT OF GUIDED-INQUIRY APPROACH ON MECHANISTIC-REASONING AMONG COLLEGES OF EDUCATION CHEMISTRY STUDENTS IN ORGANIC REACTION CONCEPTS, NORTHWEST, NIGERIA.

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Abstract
This study investigated the Effects of Guided-Inquiry on Mechanistic-Reasoning among Colleges of Education Chemistry Students in Organic Reaction Concepts, Northwest, Nigeria. The study adopted Quasi-experimental Design of Pretest and Posttest. The population comprised 2288 NCE II Chemistry students from twelve (12) Colleges of Education Northwest, Nigeria. A sample of 100 male and female students were randomly selected from two colleges of education for the study. The study involves two groups (Experimental and Control groups). The Experimental Group was taught Organic Chemistry Reactions Concepts using Guided-Inquiry Approach while the Control Group was taught same concepts using Lecture method. One validated instruments; Test of Mechanistic-Reasoning Ability in Organic Reactions (TMRAOR) with reliability coefficients of 0.80 was calculated using Pearson Product Moment Correlation (PPMC). The instrument was validated by three experts in the subject area of minimum qualification of Masters Degree in chemistry. One from the Department of Science Education, Faculty of Education, one from the Department of Chemistry, Faculty of Physical Sciences, Ahmadu Bello University, Zaria, and one from the Department of Chemistry Kaduna State College of Education, Gidan-Waya, Kafanchan. Two research questions and two null hypotheses guided the study. The research questions were answered using Mean and Standard Deviation Statistics while the null hypotheses were tested using Independent Sample t-test Statistics at P≤0.05 level of significance. Findings revealed that students exposed to Guided-Inquiry Approach reasoned mechanistically and better than students exposed to Lecture Method in understanding Organic Reaction Concepts. Similarly, in the Experimental Group, the treatment was Gender friendly. Based on the findings, it was recommended among others that teachers should be trained and encouraged to use Guided-Inquiry Approach in teaching Organic Reaction Concepts.

Keywords: Guided-Inquiry, Mechanistic-Reasoning, Chemistry, Organic Reactions, Reaction Mechanisms.

Introduction
Today the world is changing very fast as a result of scientific and technological developments. The growth and development of any nation is a measure of its level of science education. Babajide (2015) defined science education as a field of study that exposes learners to the content of science as well as the methodology or processes of acquiring scientific knowledge for practical science applications. Bhagat (2018) defined science as a systematic knowledge based on facts, observations and experimentations. Chemistry as a branch of science has become one of the most important disciplines in schools curriculum. Ejidike and Oyelana (2015) found out that the importance of chemistry in general education has gained world-wide recognition. Aji (2022) observed that among basic science subjects, chemistry occupies a unique position because it is a pre–requisite for the study of a number of science courses, such as Medicine, Biochemistry, Pharmacy, Agricultural Science, Laboratory Technology and Geology among others. Suparman et al. (2024) defined chemistry as the science that

systematically studies composition, properties of organic and inorganic substances and various elementary forms of matter.

According to Ngozi-Olehi *et. al.,* (2018), beginners in learning Organic Chemistry usually have confusion and difficulties in the understanding of three-dimensional nature of molecules, conversions between two dimensional drawings used in text books and on classroom boards to represent molecules and their three-dimensional structures. Without this understanding, to perform well in organic chemistry, students have to memorize a large vocabulary of molecules and rules to pretend they understand which often leads to poor performance. Robertson *et. al.,* (2016) observed that researches in science education have shown how students often struggle to build mechanistic accounts of natural phenomena and that few science teachers know how to foster, scaffold, and assess students' development in this area of study. For effective content delivery and students' active involvement in this area of study, there is the need for a teacher to employ learners centered methods like Guided-Inquiry method.

Guided-Inquiry Approach was described by Maknun (2020) as a process that facilitates problem solving, critical thinking, reflective inquiry and deductive thinking. Johanne *et. al.,* (2016), saw inquiry as an instructional approach purposely to help students develop understanding of science content, nature of science and the development of scientific knowledge, as well as relevant inquiry skills of identifying problems, generating research questions, designing and conducting investigations, and drawing evidence-based conclusions. Dawson and Guare (2018) defined Guided-Inquiry as a careful planning, close supervision, ongoing assessment and targeted intervention by teacher(s) that gradually leads students towards independent learning. In Guided-Inquiry, children become involved in many of the activities and thinking processes that scientists use to present new knowledge. When Guided-Inquiry is properly utilized, it facilitates Mechanistic-Reasoning and invariably enhance the understanding of mechanisms of organic reactions by both male and female students in an academic environment.

According to Keiner and Graulich (2020) Educational research indicates that students have resources for productive mechanistic thinking but often struggle to explain phenomena using mechanistic accounts. Coffey *et. al.,* (2011) discovered that teachers frequently failed to pay attention to the substance of students' thinking and to recognize both productive and constraining forms of reasoning, thereby missing valuable opportunities to support and guide the development of meaningful understandings. As such Mechanistic-Reasoning is one of those reasoning abilities that needs attention Bhattacharyya (2013). Mechanistic-Reasoning as a cognitive process, is used by scientists in all natural sciences and is an important component of organic chemistry. Researches of Bhattacharyya (2013) and Caspari, *et. al.,* (2018) from chemical education literatures have shown that Mechanistic-Reasoning could be define tentatively in different ways. Based on philosophy of organic chemistry, Caspari et al. (2018) looked at Mechanistic-Reasoning as comparative reasoning about cause–effect relations between explicit structural differences and energetic changes occurring in a mechanistic step. Mechanistic-Reasoning encompasses students' descriptions of how a reaction occurs, typically at a level lower than observed phenomena: that is, descriptions of how reactions between molecules proceed through electron movements and changes in bonding (Bode *et. al.,* 2019). From the researcher's point of view, Mechanistic-Reasoning could be define as the ability of students to show the movement of electrons, atoms or ions using curved arrows to illustrate stepwise transformation of reactants into products based on established paradigm of chemical reactivity.

In mechanistic representations in organic chemistry, entities are usually represented by Lewis structures, as observed by Caspari, *et. al.,* (2018), while 'Activities' illustrate the dynamic part

of a mechanism as can be seen in nucleophilic addition. They are transformations of entities and of their sets of properties (for example, change in bonding, change in potential energy). In mechanistic representations, activities are mostly presented by curved arrows. Organic chemists also occasionally include other representations of activities alongside electron pushing formalism, for example a proton transfer. Caspari, *et. al.,* (2018) posited that the Electron Pushing Formalism is the most important tool that organic chemists use to represent activities in a reaction mechanism. Constructing mechanistic explanations is an essential feature of doing science, inquiry-based science instruction that gives students opportunities to develop Mechanistic-Reasoning skills which of course in science may be describe as the pursuit of coherent mechanistic account of phenomena. The theoretical framework that guided the design of this study were based on constructivism by Schwab (1978) and Mechanistic System Approaches by Machamer *et.al.*, (2000).

Schwab (1978), asserted that science did not only require a process for recognizing stable facts about the world that we live in but also science could be a changeable and multi-directional inquiry driven process of thinking and learning. When a piece of material is scrutinized by asking different types of questions, using different perspectives and different methods of inquiry, it can render diverse opportunities for cultivating critical thinking, freedom of thought, self-understanding and prudent thought and action. Schwab stressed that students at all levels of learning ought to successfully experience and develop deeper level of thinking skills through scientific inquiry. The step by step stages of scientific inquiry highlighted by Schwab shows that students need to cultivate thinking skills and strategies before being exposed to greater levels of inquiry.

The M-R theory of Machamer *et. al.,* (2000) by Peters (2015), the theory stated that, human behaviour can be explained in the exact same way that mechanical and physiological processes are explained and understood. Based on the work of Izquierdo-Acebes and Taber (2023) constructing mechanistic explanations is an essential feature of doing science, in which inquiry-based science instruction gives students opportunities to develop M-R skills. Indeed, inquiry in science may be described as "the pursuit of coherent mechanistic accounts of phenomena". M-R about a phenomenon involves several elements that Russ (2006) roughly organized into a hierarchy of increasing quality of evidence which includes: describing target phenomenon, identifying set up conditions, identifying entities, identifying actions, identifying properties of entities, identifying the organization of entities, and chaining which is the most essential element, and involves linking several of the elements together, either to make a prediction or to reason about how things must have been in the past.

The heterogeneous gender settings of Colleges of Education is a factor to be reckon with in terms of performance in chemistry as they were not gender bias. Casto *et.al.,* (2024) looked at gender as socially ascribed attribute, differentiating feminine from masculine. It has been reported as one of the factors that may interact with cognitive extent and sources of differences in the achievement of male and female students in chemistry. Some researches carried out in the process of teaching science-based subjects, show preference of males over female students while others females over males. Nwagbo and Okoro (2012); reported that male students achieved significantly higher than female students. The consensus view among science educators is that some instructional strategies are gender bias while some are gender friendly, however, the degree of gender related differences in learning vary from one method of instruction to the other as well as the concept being learnt Omwirhiren (2016). The aim of this study was to determine the Effect of Guided-Inquiry Approach on Mechanistic-Reasoning among Colleges of Education Chemistry Students in Organic Reaction Concepts, Northwest Nigeria.

Statement of the Problem

It has been observed that most students wrongly perceived organic chemistry as a difficult course to understand. Students' performance in organic chemistry in general and reaction mechanism in particular at NCE level has been quite unsatisfactory (Salihu, 2019). According to Erika (2017), there were many researches that showed that for the last 40 years, organic chemistry was reported to be a difficult field in chemistry. The concept of organic chemistry that is considered as difficult for students is mostly types of reactions, reaction mechanism and the synthesis of organic compounds. Rosly and Hamid (2021) observed that organic chemistry was viewed as a demanding, difficult and tiring course to learn as it requires continuous effort in understanding the flow of organic reactions, memorizing countless conditions and requirements for a reaction to occur, predicting the product based on the reactants and conditions given and vice versa. This observation was also noted from WAEC Examiner's report whereby, majority of chemistry students could not answer tasks involving organic chemistry (WAEC 2018).

From the findings carried out by the researcher (2023) of CHE221 [Organic Chemistry I] Exams results of 2018, 2019 and 2021 from one of the state colleges of education Northwest, Nigeria. It was discovered that the percentage of students' failure was very high having the percentages of 90.91%, 77.62% and 72. 49% respectively. According to Talanquer (2018), mechanistic explanations are highly valued in science because they can be used to describe, explain, and predict the behavior of many systems of interest. But unfortunately, research in science education has shown that students often struggle to build mechanistic accounts of natural phenomena (Uhl *et. al.,* 2024) and that few science teachers know how to foster, scaffold, and assess students' development in this area (Robertson *et. al.,* 2016). This study therefore, looked at the Effect of Guided-Inquiry Approach on M-R in organic reaction concepts with reference to electrophilic and nucleophilic addition reactions among NCE II chemistry students in order to have an improved teaching methodology that would enable development of M-R among learners and eventually enhance NCE students' Performance in chemistry.

Research Questions

The study addressed the following research questions:

vi. What is the difference between the mean scores in Mechanistic-Reasoning of NCE II students taught Organic Reaction Concepts using Guided-Inquiry Approach and those taught using Lecture Method?

vii. What is the difference between the Mechanistic-Reasoning Ability scores of male and female students taught Organic Reaction Concepts using Guided- Inquiry Approach?

Null Hypotheses

The study was guided by the following null hypotheses at $P \leq 0.05$ level of significance:

HO_1: There is no significant difference between the mean scores of Mechanistic-Reasoning ability of NCE II students taught Organic Reaction Concepts using Guided-Inquiry Approach and those taught using Lecture Method.

HO_2: There is no significant difference between the mean scores of Mechanistic-Reasoning Ability of male and female NCE II students taught Organic Reaction Concepts using Guided-Inquiry Approach.

Research Design

This research adopted quasi-experimental design employing the use of pretest and posttest. Two groups were formed, Experimental and Control Groups. Each group was randomly selected. The students in the Experimental Group (EG) were taught Organic Reaction concepts using Guided-Inquiry Approach (X_1) while those of the Control Group (CG) were taught same concepts using Lecture Method (X_0). After six weeks of treatment, both groups undergone

posttests (O_2) using the instrument; TMRAOR to evaluate the effectiveness of the treatment on their Mechanistic-Reasoning. The design of the study is graphically represented in figure1.

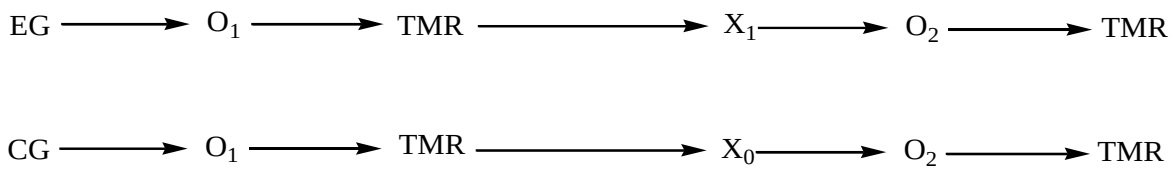

Figure 1.

KEY:

EG = Experimental Group CG = Control Group
O_1 = Pretest O_2 = Posttest
X_1 = Treatment X_0 = Lecture Method
TMR = Test of Mechanistic Reasoning

Population of the Study

The population of the study was 2288 NCE II Chemistry students of Colleges of Education in Northwest, Nigeria. The states include; Jigawa, Kaduna, Kano, Katsina, Kebbi, Sokoto and Zamfara. The choice of State Colleges of Education was because of the used of same Minimum Standard and were controlled by the same body NCCE. The number of male students was 1540 while the female students was 748. The population is presented in Table 1.

Table 1: Population of the Study

S/N	SCHOOL	State	Location	M	F	Total
1.	Kaduna State College of Education	Kaduna	Gidan-Waya	92	75	167
2.	Zamfara State College of Education	Zamfara	Maru	53	12	65
3.	Shehu Shagari College of Education	Sokoto	Sokoto	73	14	87
4.	Isa Kaita College of Education	Katsina	Dutsi-Ma	129	14	143
5.	Adamu Augie College of Education	Kebbi	Argungu	160	48	208
6.	Jigawa State College of Education	Jigawa	Gumel	161	85	246
7.	Saadatu Rimi College of Education	Kano	Kumbotso	329	142	471
8.	Federal College of Education Zaria	Kaduna	Zaria	101	83	184
9.	Federal College of Education Kano	Kano	Kano City	75	55	130
10.	Federal College of Education (Tech.)	Kano	Bichi	125	103	228
11.	Federal College of Education Katsina	Katsina	Katsina	92	22	114
12.	Federal College of Education Gusau	Zamfara	Gusau		150	95
245						
	TOTAL			**1540**	**748**	**2288**

Source: *NCCE Record of Colleges of Education in Northwest Nigeria (2023).*

Sample and Sampling Techniques

State Colleges of Education were purposively sampled as to the used of same minimum standard and colleges funded by the State Governments. Four out of seven state colleges were randomly selected and were pretested using Test of Mechanistic-Reasoning Ability in Organic Reactions (TMRAOR) to determine their equivalence in terms of Academic Performance. The results obtained from the pretest was subjected to Analysis of Variance (ANOVA), the four colleges showed no significant difference. To ascertain the colleges with significant difference, the result was subjected to Scheffe Post Hoc Tests. Two schools showed

significant differences and were used for assigning into groups. Simple Random Sampling technique by balloting was used to select the Experimental Group and the Control Group. The first college picked was labeled Experimental Group and the second picked was labeled Control Group.

The sample for the study consisted of 97 NCE II chemistry students, 50 Male participants and 47 Female participants from the two colleges selected, 25 Male and 25 Female students from one college and 25 Male, 22 Female students from the other. In selecting the students, simple random sampling by balloting was used to select 50 students for Experimental Group and 47 students for Control Group based on the sampled population of the two schools selected where male and female students' Admission Numbers were written, shuffled and picked at random separately. The sample size was in line with Sambo (2008), that central limit theorem recommended sample size minimum of 30 subjects in a variable for experimental study of this kind. The population sampled for the study is presented in Table 2.

Table 2: Sample of the study

S/N	Group	Male	Female	Total
1.	Experimental Group	25	25	50
2.	Control Group	25	22	47
	Total	**50**	**47**	**97**

Instrumentation

For the purpose of this study, Test of Mechanistic-Reasoning Ability in Organic Reactions (TMRAOR) was adapted by the researcher from Zieba (2004), Caspari, *et. al.,* (2018), and from moderated NCEII past examination questions on the course unit CHE221. The choice of CHE221was because of the difficulty experienced by NCE Chemistry Students in understanding organic reactions most especially when it comes to mechanisms of organic reactions as observed by Joseph (2018) that Organic Chemistry II, Natural products and Amines where some of the difficult courses at NCE level. The instrument, TMRAOR consisted of ten short essay questions that required students to respond by way of giving simple illustrations of breaking and formation of bonds, movement of atoms, ions, molecules and electrons by the used of curved arrows in organic reactions as means of determining M-R of students. The instrument was used as pretest and posttest.

Validation of the Instrument

The instrument was validated by three experts in the subject area of minimum qualification of Masters Degree in chemistry. One from the Department of Science Education, Faculty of Education, one from the Department of Chemistry, Faculty of Physical Sciences, Ahmadu Bello University, Zaria, and one from the Department of Chemistry Kaduna State College of Education, Gidan-Waya, Kafanchan. The experts gave both face and content validity of the instrument TMRAOR with respect to test items, clarity and appropriateness of the items in terms of level of educational attainment and ability of the items to measure basic ideas of organic reaction concepts.

Reliability of the Instruments

The result of the instrument TMRAOR administered during pilot study at the beginning of first week (test) and result of the re-administered instrument (re-test) were compared and correlated. Reliability coefficient was determined using Pearson Product Moment Correlation (PPMC). The reliability coefficient obtained indicated the level of reliability of the instrument

to be 0.80. According to Sambo (2008) and Pallant (2011) asserted that estimated reliability coefficient values above 0.70 are considered acceptable for an instrument of this kind of study.

Treatment Administration

The main treatment given in this research was teaching the Experimental Group organic reaction concepts using a planned Guided-Inquiry instructional strategy for a period of six weeks. The model of Anastopoulou *et. al.,* (2012) was used for this study which was based on questioning, investigation, evidence collection, analysis, sharing, and reflection. The researcher carefully followed all the stages to logical conclusion by first of all grouping the students, giving them charts of organic reaction concepts for them to go through, asking them questions based on the concept presented at every meeting and also giving explanation where necessary by the use of white board and a pen for illustrations. Guided-Inquiry as a strategy that uses different means to ensure that learning takes place, students were given and referred to you-tube videos to watch for deeper internalization of ideas. In addition, students were given room to ask questions and to share their ideas on any concept of discussion. The lesson flowchart is presented in Fig. 2.

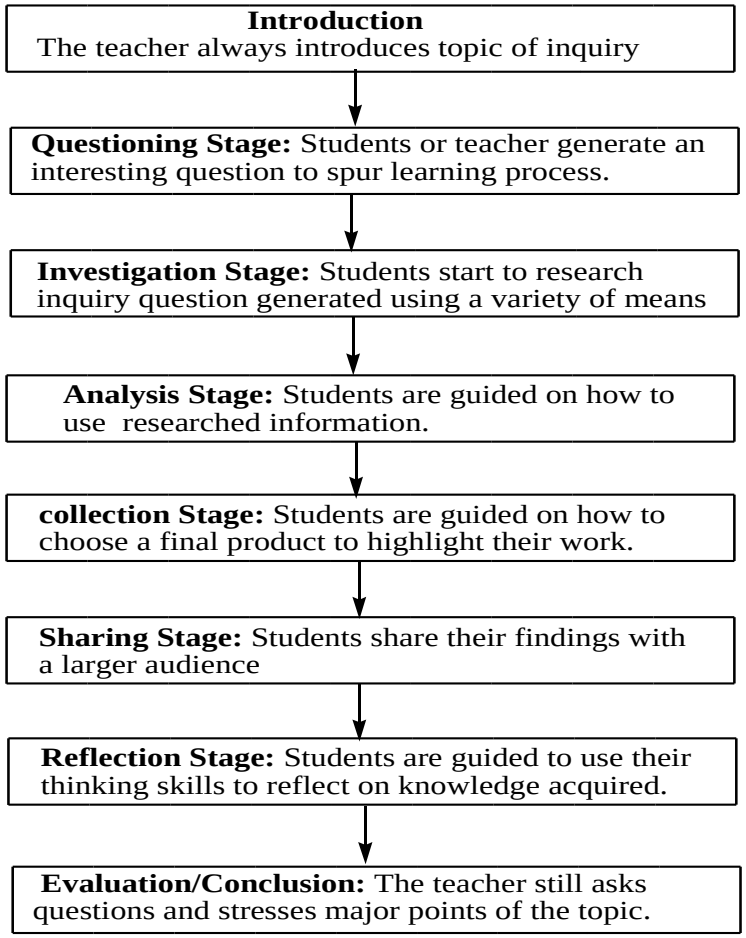

Fig 2: Flowchart illustration Guide-Inquiry Learning Model adapted from Personal Inquiry Learning Process (Anastopoulou *et al.,* (2012), Scanlon *et al.,* (2011))

Procedure for Data Collection

The researcher administered the instrument; TMRAOR for a period of one hour after treatment as posttest. The posttest obtained served as data to measure any significant difference in MRA in organic reaction concepts. Results obtained from the test instrument was collated based on research questions and hypotheses.

Analysis of Research Questions and Null Hypotheses

Data generated were analyzed to answer the research questions and null hypotheses tested as follow;

Research Question One: What is the difference between the mean scores in Mechanistic-Reasoning of NCE II students taught Organic Reaction Concepts using Guided-Inquiry Approach and those taught using Lecture Method?

To answer this research question a descriptive statistics of Means and Standard Deviations were used on the posttest scores of TMRAOR. The summary of the analysis is presented in Table 3.

Table 3: Analysis of Mechanistic-Reasoning Ability in Organic Reactions between Experimental and Control Groups.

Groups	N	Means	Std. Deviation	Means Diff
Experimental	50	16.86	6.17	
				5.23
Control	47	11.63	3.02	

Table 3 shows the mean scores of MRA in organic reaction concepts for Experimental and Control Groups. The mean scores for the Experimental Group (M=16.86, SD=6.17) was higher than that of the Control Group (M=11.63, SD=3.02). The mean difference between the two groups was 5.23 in favor of the Experimental Group.

Null hypothesis HO_1: There is no significant difference between the mean scores of Mechanistic- Reasoning ability of NCE II students taught Organic Reaction Concepts using Guided-Inquiry Approach and those taught using Lecture Method.

This null hypothesis was tested using Independent sample t-test analysis. The result of the analysis is presented in Table 4.

Table 4: Summary of t-test Analysis of Mechanistic-Reasoning Ability in Organic Reactions between Experimental and Control Groups.

Group	N	Mean	Std. Dev.	Std. Error	DF	t-value	P-value	Remark
Experimental	50	16.86	6.17	.8736				
					95	5.234	.000	significant
Control	47	11.63	3.02	.4412				

Significant at P<0.05 level of significance.

Table 4 shows the Independent t-test analysis on Mechanistic-Reasoning ability and mean scores in organic reaction concepts in Experimental and Control Groups. The means scores for the experimental group (M=16.86, SD=6.17) was higher than that of control group (M=11.63, SD=3.02). Since the obtained p-value of 0.00 is less than 0.05 level of significance, the null hypothesis which state that there is no significant difference is therefore rejected. This indicated that there was a significance difference between the Mechanistic-Reasoning ability in mean scores of students taught organic reaction concepts using Guided-Inquiry approach and those taught using Lecture Method in favor of the Experimental Group.

Research question two: What is the difference between the Mechanistic-Reasoning Ability scores of male and female students taught Organic Reaction Concepts using Guided-Inquiry Approach?

The research question was answered using descriptive statistics of means and standard deviations using the posttest scores of TMRAOR for the male and female students in Experimental Group. The summary of the analysis is presented in Table 5.

Table 5: Analysis of Mechanistic-Reasoning Ability in Organic Reactions between Male and Female Students in Experimental Group.

Gender	N	Means	Std. Deviation	Means Diff
Male	25	17.16	6.28	
				0.6
Female	25	16.56	6.17	

Table 5 shows the Mechanistic-Reasoning ability means scores in organic reaction concepts for male and female students in Experimental Group. The means scores for the male (M=17.16, SD=6.28) is almost the same to that of female (M=16.56, SD=6.17) the means difference between the male and female was 0.6 in favor of the male students which was too insignificant.

Null hypothesis HO_2: There is no significant difference between the mean scores of Mechanistic- Reasoning Ability of male and female NCE II students taught Organic Reaction Concepts using Guided-Inquiry Approach.
This null hypothesis was tested using independent sample t-test. The result of the analysis is presented in Table 6.

Table 6: Summary of t-test Analysis on Mechanistic Reasoning Ability in Organic Reaction Concepts between Male and Female Students in Experimental Group.

Gender	N	Mean	Std. Dev.	Std. Error	DF	t-value	P-value	Remark
Male	25	17.16	6.28	1.25				
					48	.340	.735	not
significant								
Female	25	16.56	6.17	1.23				

Significant at P>0.05 level of significance.

Table 6 shows the Independent Sample t-test and Mean Scores on Mechanistic-Reasoning ability in organic reactions between male and female students in Experimental Group. The mean scores for the male (M=17.16, SD=6.28) was insignificantly higher than that of female (M=16.56, SD=6.17). The obtained p-value 0.735 is greater than 0.05 level of significance. The null hypothesis that stated no significant difference was therefore accepted and retained. This indicates that there was no significant difference between the Mechanistic-Reasoning ability in mean scores of male and female students taught organic reactions using Guided-Inquiry Approach for both male and female students.

Summary of Major findings

1. There was significant difference between M-R ability mean scores of students taught organic reaction concepts using Guided-Inquiry approach and those taught the same concepts using Lecture Method in the favor of Experimental Group.

2. There was no significant difference between the MRA means scores of male and female students after exposure to Guided-Inquiry approach for both male and female students.

Discussion of Findings

Based on the findings of this study, it was revealed that Guided-Inquiry approach provides a platform for group work for students to gain first exposure prior to class presentations, provides incentive for students to prepare for class, provides a mechanism to assess students' comprehension and also provides activities that focus on higher level cognitive activities. The research hypotheses revealed that using Guided-Inquiry Approach has facilitated better MRA of students in organic reaction concepts in the Experimental Group. This has been so, because, there existed statically significant difference between the mean score of Experimental and Control Groups.

The result obtained in this study was in consonance with the findings of Bode and Flynn (2016) who found out that students who explicitly demonstrated certain well-defined M-R in association with one another were more successful in solving mechanistic problems than students who did not demonstrate a well-defined strategy. The results of Leah et al. (2024) also suggested that students who were modeled causal mechanistic reasoning in class in the context of an observable phenomenon were more readily able to translate that to phenomenon-based tasks. This could be due to the unique characteristics of Guided-Inquiry Approach of giving learners the opportunity to interact with one another, the instructor and also to share ideas freely which promotes meaningful learning.

The result of male and female MRA exposed to Guided-Inquiry classroom instructional strategy revealed that there was no significant difference in both male and female students M-R. The finding of this study agrees with the findings of Nzewi *et al.* (2014) where they discovered that there was no significant difference in the M-R pattern employed by male and female biology students in their explanation of biology phenomena. Kadarisma *et al.* (2019) also found out that there was no significant difference in MRA between male and female students after learning mathematical concepts using Problem Base Learning approach. This stems from the fact that smaller groups from diverse background can help in overcoming social barriers amongst students and allow collaborative learning amongst them, Aweke *et al.* (2017). The finding of this study showed that Guided-Inquiry instructional strategy has the potentiality of enhancing chemistry students' Mechanistic-Reasoning ability as it is gender friendly that showed significant improvement after treatment.

Conclusion

Based on the results obtained from this study, the following conclusions were made:

iii. The analysis of results showed that there was significant difference in MRA of NCE II chemistry students after treatment which implies that Guided-Inquiry model is effective in promoting high ordered thinking skills of science students. Based on this finding, Guided-Inquiry Approach can be used as an effective instructional tool as it encourages learners to construct their own knowledge out of prior knowledge.

iv. The analysis of results showed that there was no significant difference in MRA between male and female NCE II chemistry students after treatment which implies that Guided-Inquiry model is effective in promoting high ordered thinking skills of both male and female chemistry students.

Recommendations

Based on the findings from this study, the following recommendations were made:

1. The use of Guided-Inquiry model was found to enhance students' Mechanistic-Reasoning abilities. Teachers should be trained and encouraged to adopt the instructional strategy in order to improve performance of students in chemistry.
2. Because Guided-Inquiry instructional model is gender friendly, Tella and Ogundiya (2022), chemistry teachers should use it to minimize gender disparities among science students.

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