

EFFECT OF GUIDED DISCOVERY ON STUDENTS' ACADEMIC PERFORMANCE IN ORGANIC CHEMISTRY AMONG SECONDARY SCHOOL STUDENTS IN KATSINA ZONAL EDUCATION QUALITY ASSURANCE, KATSINA STATE, NIGERIA

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Abstract

This study investigated Effect of Guided Discovery on Students' Academic Performance in Organic Chemistry among Secondary School Students in Katsina Zonal Education Quality Assurance, Katsina State, Nigeria. Two research questions and two hypotheses guided the study. Quasi-experimental design involving pretest and posttest experimental – control group composed of one experimental group and one control group. The study population composed of 12,853 science students, from which 171 SS 2 students were used as the study sample selected using purposive randomization technique. The instrument for data collection was tagged as Chemistry Performance Test consisting of thirty multiple choice items with reliability coefficient of 0.89 established using PPMC. The data collected were analyzed using mean, standard deviation and t-test independent statistical tools. Research findings revealed among others that no significant difference in students' academic performance between males and females taught using guided discovery method. It was therefore concluded that, guided discovery improves students' academic performance, competency and is gender friendly. Based on the findings, it was recommended among others that, teachers should be trained on effective and skillful utilization of guided discovery in their day-to-day teaching activities.

Keywords: Guided discovery, Academic performance, Organic chemistry

Introduction

In the current trends in science curriculum design, students are supposed to be trained to acquire sound scientific knowledge, demonstrate scientific attitudes and work like scientists both within and outside the school environment for them to discover, invent and communicate their experiences with the global scientific community. Organic Chemistry is an aspect of Chemistry where students demonstrate a lot of challenges with respect to building authentic mental models is Organic chemistry (Hanson, 2017) and is perceived as difficult concept by both students and teachers in senior secondary chemistry (Nduudee & Ikiroma, 2021). Hence, that tends to lead to students' poor academic performance. Academic performance is the level of scores obtained by the students from the given test after a period of treatment at post-test.

Exam Year	No. of Students	No. Pass (A1-C6)	% Pass	No. Fail (D7-F9)	% Fail
2012	13,297	3,550	26.70%	9,747	73.30%
2013	16,898	2,674	15.82%	14,224	84.18%

Exam Year	No. of Students	No. Pass (A1-C6)	% Pass	No. Fail (D7-F9)	% Fail
2014	20,141	9,941	49.40%	10,200	50.60%
2015	21,514	13,303	61.83%	8,212	38.17%
2016	20,404	7,790	38.28%	12,614	61.80%
2017	21,717	11,612	53.47%	10,105	46.53%
2018	23,916	7,188	30.06%	16,728	69.94%
2019	27,134	11,850	43.67%	15,464	56.33%
2020	27,050	5,968	22.10%	21,082	77.90%
2021	30,122	12,167	40.39%	12,167	59.61%

Source: Katsina State Ministry of Education (2022) in Sani (2024)

Guided Discovery is a learner-centered method/strategy to teaching in which learners are actively involved in the classroom activities guided by the teacher to discover the required information, concepts and ideas by themselves. Umar (2019) disclosed that, Guided Discovery helps to increase the degree of students' academic performance both in theory and practice. However, Essam (2018) and Omiko (2017) revealed that guided discovery has significant effect than the traditional method in improving students' academic performance.

Organic chemistry is an aspect of Chemistry dealing with the study of carbon and its naturally occurring and artificially synthesized compounds for the benefit of mankind.

As many efforts are being made to address the above-mentioned problems by schools, teachers, parents and significant other stakeholders, students' academic performance persisted to be unimpressive and fluctuating in both internal and external examinations. This hinders the chances of students for securing admission into various tertiary institutions to study Chemistry and many science courses. The overall problem may be caused by the persistent and inappropriate use of traditional method of instruction or inability of the teachers to skillfully and effectively utilize the innovative instructional strategies which are learner-centered and activity based towards an improved academic performance. This may be the reason why students find it difficult and highly challenging to comprehend and perform well in Chemistry and other science subjects. As for the innovative teaching strategies, several options were being considered, among which include the use of Guided Discovery. On this note, the Effect of Guided Discovery on Students' Academic Performance and Retention in Organic Chemistry among in Katsina Zonal Education Quality Assurance was investigated by the researchers.

studies on gender in relation to academic performance, retention, interest and attitude in Chemistry and other science subjects remain conflicting, fluctuating and inconclusive. Busolo (2010), reported that boys were more interested in Chemistry, found learning Chemistry related tasks easier, showed a more pronounced interest in starting a career in Chemistry, and had a stronger affinity and interest towards Chemistry and rated Chemistry to be more beneficial than their female classmates, but Shaibu and Mari in Udo and Udofia (2014) observed females' superiority in performance. On the other hand, Mampageti (2019) revealed that, the use of guided discovery was not gender-bias and the performance of boys and girls did not differ significantly as also revealed by Ugwoke, Olulowo and Adedayo (2020) that, guided discovery was not gender-specific as it offers common opportunities to

male and female learners.

Going by the afore-mentioned statements, the problem of this study is to ascertain whether Guided Discovery is more effective in enhancing students' academic performance in Organic Chemistry in comparison to the traditional method of instruction and also to ascertain the method that proves more gender friendly in relation to academic performance.

Objectives of the Study

The specific objectives of this study are as follows.

To find out the difference in mean score of students taught Organic Chemistry using guided discovery and those taught using traditional method.

To compare gender difference in the academic performance in Organic Chemistry among students taught using guided discovery.

Research Questions

The following research questions were raised to guide the study.

RQ1: What is the difference in mean score of students taught Organic Chemistry using guided discovery and those taught using traditional method?

RQ2: What is the gender difference in the academic performance in Organic Chemistry among students taught using guided discovery?

Research Hypotheses

The following null hypotheses were formulated to guide the study.

H01: There is no significant difference in the mean score of students taught Organic Chemistry using guided discovery and those taught using traditional method.

H02: There is no significant gender difference in the academic performance in Organic Chemistry among students taught using guided discovery

Methodology

In this study, the researcher employed quasi-experimental research design involving pretest, posttest and post-posttest experimental – control groups. Guided discovery and traditional (chalk and talk) strategies were randomly assigned through balloting as the experimental group and the control group respectively.

Twelve thousand eight hundred and fifty three (12,853) science students from twenty five (25) public secondary schools in Katsina Zonal Education Quality Assurance formed the population of the study, from which two hundred and eighty five (285) science students were selected as the sample of the study using purposive-randomization sampling technique. Experimental group constituted 126 students (71 males & 55 females), 114 students (64 males & 50 females), while 45 students (18 males & 27 females) formed the control group giving a total sample size of 285 students. The selection of the sample size was based on the central limit theorem which stated a minimum of thirty (30) subjects as adequate enough to form a sample size in an experimental research as revealed by Sambo in Hashimu (2015).

The instrument used for the purpose of this study was tagged Organic Chemistry Performance Test (OCPT). The instrument contains thirty (30) multiple choice items adapted from standardised past assessment items of both WAEC and NECO based on the selected topics of Organic Chemistry.

The instrument was meant to measure students' academic performance in Organic Chemistry. Hence,

the instrument was further validated by two experts whom are senior lecturers in the Department of Science and Vocational Education, Faculty of Education and two others in the Department of Pure and Industrial Chemistry, Faculty of Natural and Applied Sciences all of Umaru Musa Yar'adua University, Katsina. Comments and modifications made by these experts were incorporated before the final copy was produced and administered.

Pilot testing (trial testing) of the instrument was conducted on thirty (30) students whom were outside the sample size used, but within the population of the study from which the result obtained was then computed and yielded the reliability coefficient, $r = 0.89$ (89%) determined using Pearson Product Moment Coefficient (PPMC).

After all possible preparations were made, the researcher, with the aid of research assistants (Chemistry teachers in the sample schools) administered pretest to both the experimental and the control groups in order the performance of the students in the two groups before treatment. Treatment for both experimental and control groups lasted for a period of six weeks in each group where the experimental group was taught using Guided Discovery instructional strategy, while the control group was taught using the traditional instruction (chalk and talk). At the end of the treatment, posttest was administered separately to both the experimental group and control groups, scored and recorded. Two weeks after the posttest was then administered separately to each of the two groups using the reshuffled version of the instrument. The data collected from the pretest and posttest of the two groups were used in answering the research questions raised and testing the formulated null hypotheses.

The data obtained were analyzed statistically using mean and standard deviation descriptive statistical tools for answering the research questions, at inferential level, the formulated hypotheses were tested using t-test independent samples statistical tool at significance level of $P < 0.05$ in retaining or rejecting the formulated null hypotheses.

Results

The following results were obtained and discussed based on the research questions answered using mean and standard deviation as well as the null hypotheses tested using t-test independent at $p < 0.05$ level of significance

Answering Research Questions

RQ1: What is the difference in mean score of students taught Chemistry using guided discovery (experimental group) and those taught using traditional method (control group)?

Table 1: Posttest Mean and Standard Deviation Results of Students' Academic Performance for Experimental and Control Groups

Groups	N	Mean	Std. Deviation	Std. Error Mean
Experimental Group	126	23.7778	3.78606	.33729
Control Group	45	22.4444	4.84090	.72164
Total	171			

Table 1 shows that, on average the students' mean scores at posttest for experimental group (guided discovery) and the control group (traditional method) are 23.7778 and 22.4444 with standard deviation 3.78606 and 4.84090 respectively which are almost the same. That means, guided discovery and the traditional chalk and talk methods of instruction show no much difference in enhancing students' academic performance taught Chemistry concepts.

RQ2: What is the gender mean difference in the academic performance in Organic Chemistry among

students taught using guided discovery?

Table 2: Posttest Mean and Standard Deviation Results of Students' Academic Performance for Experimental and Control Groups

Group	Gender	N	Mean	Std. Deviation	Std. Error Mean
Experimental Group	Male	71	23.8451	3.87168	.45948
	Female	55	23.6909	3.70621	.49975
Total		126			

The table 2 above suggests that, there is no much difference between male and female students' academic performance taught Chemistry using guided discovery since the mean scores of 23.8451 for male and 23.6909 for female students are almost the same with their corresponding standard deviation 3.87168 and 3.70621.

Testing Hypotheses

H01: There is no significant difference in mean score of students taught Organic Chemistry using guided discovery and those taught using traditional method.

Table 3: Posttest Independent t-test Results of Students' Academic Performance for Experimental and Control Groups

Group	N	Mean	Mean Difference	t	df	P-value	Decision
Experimental Group	126	23.7778	1.3333	1.674	169	0.062	Ho1 retained
Control Group	45	22.4444					
Total	171						

Level of significant difference: $P < 0.05$

Since the calculated t-value is 1.674 and p-value (sig value) for testing the hypothesis one is 0.062 and is greater than 5% (0.05) level of significance, the hypothesis is then retained and concluded that there is no significant difference in students' academic performance taught Chemistry using guided discovery and that of students taught using traditional method.

H02: There is no significant gender difference in the academic performance in Organic Chemistry among students taught using guided discovery.

Table 4: Posttest Independent t-test Results of Students' Academic Performance for Male and Female Students in Experimental Group (Guided Discovery)

Group	Gender	N	Mean	Mean Difference	t	df	P-value	Decision
Experimental Group	Male	71	23.8451	0.15416	0.226	124	0.822	H02 retained
	Female	55	23.6909					
Total		126						

Level of significant difference: $P < 0.05$

Since the calculated t-value is 0.226 and p-value (sig value) for testing the hypothesis one is 0.822 and is greater than 5% (0.05) level of significance, the hypothesis is then retained and conclude that there is no significant difference in male and female students' academic performance taught

Chemistry using guided discovery and that of students taught using traditional method.

Discussion of Findings

The first finding of this study revealed no significant difference in students' academic performance taught Chemistry using guided discovery and that of students taught using the traditional (chalk and talk) method. That means, both guided discovery and the traditional strategies can equally be used in enhancing students' performance in Chemistry. Constructivist in Andrew (2015) totally agrees with the finding of this study that, guided discovery is not significantly better than the meaningful exposition (traditional method) in improving students' academic performance. On the contrary, the common finding of Essam (2018) and Omiko (2017) revealed that, guided discovery has significant effect than the traditional method in improving students' academic performance.

The finding is said to have agreed with that of Mampageti (2019) which disclosed that, the use of guided discovery was not gender-bias and the performance of boys and girls did not differ significantly. This also connotes with that of Ugwoke, Olulowo & Adedayo (2020) whose result also revealed that, guided discovery was not gender-specific as it offers common opportunities to male and female learners.

The finding is said to be against of what was reported by Busolo (2010) that, boys were more interested in Chemistry, found learning Chemistry related tasks easier, showed a more pronounced interest in starting a career in Chemistry, and had a stronger affinity and interest towards Chemistry and rated Chemistry to be more beneficial than their female classmates. This also contradicts Shaibu and Mari in Udo and Udofia (2014) that female students show superiority in academic performance than the male counterparts.

Conclusion

The following conclusions were drawn from findings of the study.

Both guided discovery and traditional (chalk and talk) teaching strategies have positive effect and were not significantly different in enhancing students' academic performance.

Guided discovery was gender friendly in enhancing academic performance of both male and female students.

Recommendations

Based on the above conclusions, the following recommendations were offered.

Chemistry and other science teachers should be encouraged on effective utilization of guided discovery strategy by organizing seminars and workshops in order to enhance students' academic performance particularly in Chemistry and other science subjects.

In order to curtail the problem of gender disparity in science, it is recommended that, Chemistry and other science teachers should be trained and encouraged on skillful utilization of guided discovery in improving academic performance since the method is gender friendly to both male and female students

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