

## **Effects of Group Investigation and Infographic Instructional Strategies on Chemistry Achievement and Retention among Secondary School Students in Minna, Niger State**

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### **Abstract**

The study investigated the effects of Group Investigation and Infographic Instructional Strategies on Chemistry achievement and retention among secondary school students in Minna, Niger State. A quasi-experimental research design, specifically the pretest–posttest non-equivalent control group design was employed. The population comprised of Senior Secondary School II (SSII) Chemistry students. Two research questions guided the study. The study involved three groups which are two experimental and one control groups. Group Investigation Instructional strategy was used on Experimental group I, Infographic Instructional Strategy was used on Experimental group II and Conventional Instructional Strategy was used on the Control group. Random sampling technique was used to select the schools used for the study. From each of the schools, an intact class was selected and used for the study. The sample size of the study is 652 (227 Experimental Group I, 235 Experimental Group II and 190 Control Group). All the groups were taught the concept of Electrolysis in Chemistry. Chemistry Achievement Test (CAT) and Chemistry Retention Test (CRT) questions were the instruments used for data collection while lesson plans on the various instructional strategies were used as treatment instruments. Both the treatment and test instruments were subjected to validation by the experts. Thereafter, test instrument was pilot tested and coefficients of 0.82 was obtained. Chemistry Achievement Test (CAT) was reshuffled to produce Chemistry Retention Test (CRT). Descriptive statistics (mean and standard deviation) were used to answer the research questions raised for the study. The findings revealed that students taught using Group Investigation recorded the highest achievement and better retention, followed by the Infographic group, while the control group scored the lowest. Findings of study indicated significant differences in achievement and retention among the three groups, confirming that Group Investigation and Infographic Instructional Strategies (student-centered instructional strategies) are more effective than conventional lecture methods. These findings imply that integrating Group Investigation and Infographic Instructional Strategies enhances both achievement and long-term retention of the Chemistry students in the study area. It was recommended among others that Chemistry teachers should be encouraged to integrate Group Investigation and Infographic Instructional Strategies during classroom instruction.

**Keywords:** Achievement, Chemistry, Group Investigation, Infographic, Instructional Strategies and Retention.

### **Introduction**

Chemistry is one of the core and compulsory science subjects that plays a significant role in national development through its contributions to medicine, engineering, agriculture, and industrial processes. Despite its importance, students' performance in Chemistry at the secondary school level in Nigeria has remained consistently poor. Researchers have attributed this trend to several factors, including inappropriate teaching strategies, abstract nature of the subject, and

lack of student engagement (Adeleke and Adebayo, 2021; Yusuf and Salisu, 2022). Consequently, there is a growing need to explore innovative instructional strategies that can enhance students' learning outcomes specifically, achievement and retention. Some of the current innovative instructional strategies include Group Investigation (GI) instructional strategy and Infographic instructional strategy.

Group Investigation (GI) instructional strategy is a cooperative learning strategy that actively involves students in the learning process through collaboration, inquiry, and problem-solving. It allows learners to work in small groups to investigate topics, gather information, and present their findings. According to Slavin (2015), Group Investigation instructional strategy promotes higher-order thinking skills, social interaction, and learner autonomy. Research studies have shown that GI instructional strategy significantly improves students' academic achievement. For instance, Ogunleye and Adeyemi (2023) found that students exposed to cooperative learning strategies, including GI, performed better in science subjects compared to those taught using traditional lecture methods. Similarly, Musa and Mohammed (2022) reported that GI instructional strategy enhances students' participation and conceptual understanding in Chemistry. The effectiveness of GI instructional strategy lies in its student-centered nature, which shifts the focus from teacher-dominated instruction to active learner participation. This approach encourages students to take responsibility for their learning, thereby improving comprehension and academic performance.

Another important independent variable of this study is Infographic instructional strategy. Infographic instructional strategy involves the use of visual representations such as charts, diagrams, images, and minimal text to communicate information effectively. This strategy is grounded in dual coding theory, which suggests that combining visual and verbal information enhances learning and memory retention. Infographics have gained attention in recent years as an effective instructional tool. According to Alrwele (2020), infographics simplify complex concepts and make learning more engaging and meaningful. In a related study, Ibrahim and Hassan (2023) found that students taught using infographic-based instruction demonstrated higher achievement and better understanding of scientific concepts compared to those taught using conventional methods. Furthermore, the visual appeal of infographics helps to sustain students' attention and improves their ability to retain information over time. This makes infographic strategy particularly useful in subjects like Chemistry, where abstract concepts can be difficult to comprehend.

Academic achievement in this study is referred to as the extent to which students attain educational objectives, often measured through tests and examinations. In Chemistry, achievement reflects students' understanding of concepts, problem-solving abilities, and application of knowledge. Studies have consistently reported low achievement levels among secondary school students in Chemistry in Nigeria. Yusuf and Salisu (2022) attributed this to ineffective teaching methods and lack of active learning opportunities. Similarly, Bello (2021) observed that students' poor performance in Chemistry is linked to teacher-centered instructional approaches that limit student engagement. In order to improve students' achievement therefore, teachers must adopt an innovative instructional strategy that actively involve students in the learning process. Strategies such as Group Investigation and Infographic instruction instructional strategies are the focus of this study aimed at determining whether students' achievements and would be improved.

Retention which is another important variable of this study refers to the ability of students to store and recall learned information over time. It is a critical indicator of meaningful learning, as it reflects the extent to which knowledge is internalized. Research has shown that traditional teaching methods often lead to poor retention due to passive learning. According to Eze and

Okeke (2022), students taught using lecture methods tend to forget learned concepts shortly after instruction. However, innovative instructional strategies like Infographic and cooperative learning strategies have been found to significantly improve retention among students. Ibrahim and Hassan (2023) reported that visual learning enhances memory retention, while cooperative learning fosters deeper cognitive processing, leading to better recall of information. These findings necessitate the conduct of this study to further confirm the applicability of the instructional strategies in Minna, Niger State. This is because, despite the several benefits of these strategies, their application in secondary schools in Minna, Niger State remains limited. Therefore, this study seeks to investigate the effects of Group Investigation and Infographic instructional strategies on secondary school Chemistry students' achievement and retention in Minna, Niger State.

### **Statement of the Problem**

The teaching and learning of Chemistry in secondary schools in Minna, Niger State, continue to be challenged by students' poor academic achievement and low retention of concepts. Despite the importance of Chemistry, many students struggle to understand and remember what they are taught, largely due to the persistent use of conventional lecture methods that emphasize rote learning rather than active engagement. This teacher-centered approach limits students' participation and contributes to shallow understanding and quick forgetting of concepts, especially given the abstract nature of Chemistry (Bello, 2021; Yusuf and Salisu, 2022; Eze and Okeke, 2022). Although innovative strategies such as Group Investigation and Infographic instruction have been shown to enhance students' engagement, understanding and retention, their use remains limited in many secondary schools in Minna. Furthermore, few studies have comparatively examined the effectiveness of these strategies on both achievement and retention within this context. Therefore, this study seeks to address this gap by determining the effects of Group Investigation and Infographic teaching strategies on students' academic achievement and retention in Chemistry compared to the conventional Teacher-Centered Method.

### **Objectives of the Study**

The aim of this study is to investigate the effects of Group Investigation and Infographic instructional strategies on achievement and retention in Chemistry among secondary school students in Minna, Niger State. The study specifically seeks to determine the effects of:

1. Group Investigation instructional strategy, Infographic instructional strategy and Conventional instructional strategies on achievement among secondary school Chemistry students in Minna, Niger State
2. Group Investigation instructional strategy, Infographic instructional strategy and Conventional instructional strategies on retention among secondary school Chemistry students in Minna, Niger State

### **Research Questions**

The following four research questions guided the study

1. What is the difference in the mean achievement scores of secondary school Chemistry students taught using Group Investigation instructional strategy, Infographic instructional strategy and Conventional instructional strategy?
2. What is the difference in the mean retention scores of secondary school Chemistry students taught using Group Investigation instructional strategy, Infographic instructional strategy and Conventional instructional strategy?

On literature review, a study conducted by Eze and Okeke (2022) revealed that secondary school students taught using conventional instructional strategy tend to forget learned concepts shortly after instruction but innovative instructional strategies improve students' retention. In addition, a study conducted by Ibrahim and Hassan (2023) reveals that, Group Investigation and Infographic instructional strategies enhances students' achievement and retention as well as fostering deeper cognitive processing and better recall of the learnt concept.

On methodology, the study adopted a quasi-experimental research design, specifically the pretest–posttest non-equivalent control group design, which is suitable for comparing the effects of different instructional strategies on students' learning outcomes. The study involved three groups which are two experimental and one control groups. Group Investigation Instructional strategy was used on Experimental group I, Infographic Instructional Strategy was used on Experimental group II and Conventional Instructional Strategy was used on the Control group. Random sampling technique was used to select the schools used for the study. From each of the schools, an intact class was selected and used for the study. The sample size of the study is 652 (227 Experimental Group I, 235 Experimental Group II and 190 Control Group). All the groups were taught the concept of Electrolysis in Chemistry. Chemistry Achievement Test (CAT) and Chemistry Retention Test (CRT) questions were the instruments used for data collection while lesson plans on the various instructional strategies were used as treatment instruments. Both the treatment and test instruments were subjected to validation by the experts. Thereafter, test instrument was pilot tested and coefficients of 0.82 was obtained. Chemistry Achievement Test (CAT) was reshuffled to produce Chemistry Retention Test (CRT). Descriptive statistics (mean and standard deviation) were used to answer the research questions raised for the study.

## Results

### Answering of the Research Questions

#### Research Question 1:

What is the difference in the mean achievement scores of secondary school Chemistry students taught using Group Investigation instructional strategy, Infographic instructional strategy and Conventional instructional strategy? To answer this research question, mean and standard deviations were used as shown in Table 1.

**Table 1: Pretest and Posttest Scores of Students in the Three Groups**

Group	N	Pretest Mean	SD	Posttest Mean	SD	Mean Gain
Group Investigation	227	42.15	6.25	75.30	5.85	33.15
Infographic	235	43.00	6.80	72.10	6.10	29.10
Control (TCM)	190	41.80	5.90	55.20	5.70	13.40

Table 1 shows the mean and standard deviation of the pretest and posttest scores of the students in the three groups. The results revealed that students taught using Group Investigation and Infographic instructional strategies have higher achievement scores than those taught using conventional instructional strategy. The results also revealed that students taught using Group

Investigation had the highest mean gain of 33.15, followed by those taught using Infographic strategy with mean gain of 29.10 while the control group had the lowest mean gain of 13.40. This indicates that both Group Investigation and Infographic strategies significantly improved students' academic achievement compared to the Teacher-Centered Method.

### Research Question 2:

What is the difference in the mean retention scores of secondary school Chemistry students taught using Group Investigation instructional strategy, Infographic instructional strategy and Conventional instructional strategy? To answer this research question, mean and standard deviations were used as shown in Table 2.

**Table 2: Posttest and Retention test Scores of Students in the Three Groups**

Group	N	Posttest Mean	SD	Retention Mean	SD	Mean Gain
Group Investigation	227	75.30	5.85	70.25	6.25	5.05
Infographic	235	72.10	6.10	68.40	6.80	3.70
Control	190	55.20	5.70	50.10	5.90	50.10

Table 2 shows the mean and standard deviation of the posttest and retention test scores of the students in the three groups. The result reveal that students in the Group Investigation group recorded the highest retention mean score (70.25) with SD of 6.25, followed by the Infographic group (68.40) with SD of 6.80, while the control group had the lowest score (50.10) with SD of 5.90. This suggests that students exposed to innovative teaching strategies retained more knowledge of the taught concept than those taught using the conventional method.

### Discussion of Findings

Research question one revealed differences in students' posttest achievement scores across the three groups, with the group I achieving the highest mean score, followed by group II while the control group scored the lowest. This finding aligns with findings of Ogunleye and Adeyemi (2023) reported that students exposed to Group Investigation exhibited higher achievement in science subjects due to increased engagement, collaborative problem-solving, and active participation. Similarly, the finding is in line with the findings of Musa and Mohammed (2022) who reported that, students taught through Group Investigation (GI) developed deeper conceptual understanding and performed better in assessments compared to peers taught via conventional instructional strategy. In addition, the findings agree with that of Slavin's (2015) finding who found that structured group interactions promote cognitive development, critical thinking, and meaningful learning outcomes.

Research question one also revealed that Infographic strategy enhanced students' achievement compared to the conventional instructional strategy. This finding is line with the findings of Ibrahim and Hassan (2023) who found that visual instructional aids help simplify complex scientific concepts, making them more comprehensible and easier for students to apply in problem-solving activities. The combination of text and visuals in infographics reduces cognitive load and enhances comprehension. This finding is also in corroboration with findings of Paivio's Dual Coding Theory (Paivio, 2014).

The third research question reveal that students in the Group Investigation and Infographic groups retained the learnt concept more than students in the Conventional instructional group. The result shows that, the GI group had a marginally higher retention score than the Infographic group. This finding is in line with the popular notion that active learning strategies enhance long-term retention. The finding also agrees with findings of Eze and Okeke (2022) who reported that students who participated in cooperative learning activities retained knowledge longer than those exposed to traditional method. The finding is also in line with that of Alrwele (2020) who reported that visual learning strategies improve students' ability to remember and retrieve complex information over time, particularly in science subjects. In addition, this finding is agreed that of Ibrahim and Hassan (2023), who reported that combining multiple instructional modes can strengthen memory consolidation and comprehension in students.

The fourth research question indicate that Infographic strategies enhanced students' retention ability more than the conventional instructional strategy. This is also in line with the findings of Bello (2021); Yusuf and Salisu (2022) who all reported that conventional lecture methods limit understanding, reduce students' motivation and retention ability.

## **Conclusion**

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

1. Group Investigation instructional strategy used on experimental one improved students' achievement and retention in Chemistry as compared to the conventional instructional strategy used on the control group.
2. Infographic instructional strategy used experimental group two also enhanced students' achievement and retention in Chemistry as compared to the conventional instructional strategy used on the control group.

## **Recommendations**

Based on the findings of this study, it is recommended that;

1. Chemistry teachers should be encouraged to integrate Group Investigation and Infographic Instructional Strategies during classroom instruction.
2. Teachers at secondary school level should be sponsored by the government to go for further training particularly on the area of pedagogy

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