REVIEW OF THE EFFECT OF INQUIRY-BASED LEARNING ON THE ACADEMIC ACHIEVEMENT OF SECONDARY SCHOOL STUDENTS IN CHEMISTRY

Gebrehiwot Hagos Weldemichael[1*], Gebrekidan Mebrahtu Tesfamariam[2], Goitom Gebreyohannes Berhe[3], Tesfamariam Teklu Gebretsadik[4]
[1]Department of Chemistry, Mekelle University, Mekelle, [2]Department of Chemistry, Mekelle University, Mekelle, [3]Department of Chemistry, Mekelle University, Mekelle, [4]Department of Chemistry, Mekelle University, Mekelle, Ethiopia
*Corresponding author: gere2130@gmail.com

ABSTRACT

The study examined the effects of inquiry-based learning on the academic achievement of secondary school students in chemistry in different areas of the world based on different published works. The most recent and majorly the last 9 years that were published in reputable journals have been reviewed and used as a direct source. The findings revealed that the inquiry-based method was a student-centered approach that encouraged learners to explore, ask questions, and engage in critical thinking to construct new knowledge and understanding, and was more effective in improving the academic achievement of chemistry students than the conventional lecture method. The findings also revealed that gender has no significant effect on the academic achievement of students exposed to chemistry through inquiry-based learning. It is recommended that chemistry and science teachers should adopt the use of inquiry-based methods, and the government should provide funding and facilities for workshops and seminars to teachers for the successful implementation of inquiry-based learning in chemistry and other sciences. *[African Journal of Chemical Education—AJCE 16(1), January 2026]*

INTRODUCTION

Any country's development is based on its educational system, which is also essential to every facet of its economy. The entire process of human learning is what shapes knowledge, develops capacities, and produces skills. According to [1-2], education may be defined as the process of gaining and disseminating general information as well as a tool for affecting human learning, transformation, and capacity development. As a result, it serves as a tool for people to study, become high achievers, and shape themselves to fit into society [3-4].

Science is the field of knowledge or study that deals with a collection of truths or facts that have been carefully arranged to demonstrate how universal law operates. According to [5], the science of today will both be the problem and the answer to the future. Science has played a key role in both starting and accelerating human progress and development throughout human history. Science has a significant impact on the environment, energy, health, education, and economic growth of all countries [6-7].

Today's fast-changing world needs trained people in science and technology since they are a key indicator of a nation's social and economic progress. Since science and technology are undoubtedly becoming increasingly integrated into our daily lives, any culture that ignores them runs the risk of being completely cut off from the rest of the world [8]. Because of this, science courses ought to receive extra attention from high-quality and productive education. In addition to helping nations around the world achieve their aim of a knowledge-based economy, high-quality science education will be essential in addressing the difficulties posed by the twenty-first century [9].

Chemistry is one of the science disciplines that is taught in secondary schools and is taught extensively because of its applications in daily life and the function it plays in helping students improve their intellectual capacities. Encouraging students to apply their newly learned information and abilities to address difficulties in their daily lives is one of the goals of teaching chemistry. Since it links all other science subjects, including biology, physics, and agriculture, it is a fundamental science subject [4, 10].

Every aspect of life, even non-living things, involves chemistry, since all things, living or non-living, have reactions. Chemical components that undergo physical or chemical changes make up every item's body. These changes cause the object to alter chemically or physically. Furthermore, chemistry is used in almost every industry or profession, including engineering, medicine, textiles, agriculture, and others. Having a solid understanding of chemistry can help you pursue a wide range of employment opportunities [9-10].

Chemistry should also be taught and learned in a way that equips students to deal with concurrent scientific and technological development in order to improve man's lot in his society, since chemistry is crucial to any country's scientific (industrial) and technological development. To ensure that, instruction must be effective, and this is guarantee to students to be well-prepared at the end of the school year. In doing so, the student will acquire the skills and attitudes needed to live and contribute to his community as expected, together with a comprehensive approach to learning that will lead to an understanding of even the most complicated scientific issues [10].

Despite its reputation as a challenging subject for high school and college students, [11] contend that chemistry is one of the most significant scientific subjects that studies the nature and reactions of substances. Thus, a way is needed for students to develop a sound understanding of the concepts in learning chemistry and thus enhance their overall attainment [3].

Research findings stated that there is a huge gap between the intended chemistry curriculum and what actually happens when students study chemistry in secondary schools, and it is not as expected. There have been reports of students' poor comprehension of the subject's most fundamental ideas [12-13]. The final grades that students receive for a course of study are getting worse. Students' performance in chemistry has been extremely low over the previous few decades in both internal and external exams [12, 14].

The deficiencies in scientific concepts exhibited by the pupils are called misconceptions or alternative conceptions regarding fundamental terminology in chemistry [15]. These misunderstandings impede the acquisition of knowledge in other areas. As to [16], perspective, misconception can also be called preconceived notions, predetermined conceptions, non-scientific ideas, naive theories, or conceptual misunderstanding. As a result, students are unsuccessful in chemistry despite working hard [3]. Several misconceptions have been found regarding a number of chemistry topics, including periodicity [17], acid-base [15], particulate nature of matter and chemical bonding [18], and redox reaction [19].

The following are some of the factors that have been linked to students' misconceptions and poor academic performance: a lack of deep conceptual knowledge; an inability to integrate ideas into a coherent conceptual framework; a lack of understanding of basic concepts in qualitative (identification of elements or ions by simple tests) and quantitative (like volumetric) analysis; a lack of basic mathematical knowledge; the qualifications of teachers; the background of parents; a lack of laboratory equipment; ineffective teaching methods [19, 20-22], over-loaded chemistry syllabus, abstract and difficult character of many chemical ideas, lack of enthusiasm on the part of students, high class size, fear of the subject psychologically, and attitude of students towards science [14, 23-26].

The primary issue with learning in formal education (schools) nowadays, according to [3, 27], is the low absorption of learners. This is unmistakably related to instructors' incapacity to choose, recognize, and apply appropriate teaching and learning strategies. The low academic achievement of students in chemistry has been linked to issues with teachers [3, 10]. Students' comprehension and level of interest in science are significantly influenced by the ways in which science is taught by teachers. According to [28], the way that each subject is taught is crucial to increase the practitioners' effectiveness. Pedagogy and methodology are both involved in teaching, and it is the teacher's responsibility to choose a method that will effectively involve the students in the process of learning [7].

It's important to recognize and address students' misconceptions about chemical concepts using the right teaching techniques [10, 14]. Common teaching methods, including lectures, lab exercises, and textbook reading, are ineffective in dispelling students' misconceptions about certain chemistry concepts [29]. Those strategies that receive much attention are focused on factual information, memorization, driven by textbook use and tests, lack of small group activity, negotiation of low-level cognitive demand, and the concentration of conceptual activity in a minority of target students [30]. This has contributed to the negative attitude that pupils have about science [4, 7]. Furthermore, disheartening is the fact that, despite chemistry's relative importance, students' academic achievement in the subject has remained relatively poor on both internal and external examinations [31-32].

The lecture style of instruction, in which the teacher assumes a central role and speaks to obedient students, does not promote independent thought, student participation, or 21st century skills, rather, the teacher performs all the talking and dictates the notes, regardless of the accuracy of the concepts, and it is the student's responsibility to record the rubbish that the teacher says. The student is not allowed to challenge other students and to challenge the disequilibrium in their thinking that they brought to the classroom. The teacher, on the other hand, serves as the mentor and is the owner of all the knowledge that he/she imparts to the student and uses to conclude. The lack of an effective interactive approach in this lecture style has been blamed for the low academic accomplishment in chemistry. As a result, most of the teachers' approach of teaching chemistry, which has been in use for more than a decade, has not significantly improved students' comprehension of the material or their academic performance [5, 10, 33-36].

According to modern science, learning strategies should be student-centered, include the learner continuously, and ensure that the learner never becomes invisible or outdated in the learning process [10]. To promote student-centered learning, students will be required to be able to interact, argue, debate, and collaborate, transforming the role of the teacher from being a teacher to a facilitator of students' learning in the classroom [37]. Since chemistry is an activity-oriented scientific subject, it should be taught using an efficient, student-centered, activity-based teaching approach that fosters the discovery of knowledge. Therefore, finding a method for teaching chemistry that would enhance students' learning outcomes is relevant at this crucial moment when a high value is placed on science education in general and chemistry education, in particular, as the cornerstone of national growth [4].

Several teaching strategies have proven effective in promoting conceptual change and facilitating students' acquisition of scientifically accurate concepts. According to [38], inquiry-based teaching strategies are instructional approaches that emphasize students' active participation in reconstructing their prior experiences. These approaches place learners at the center of the teaching–learning process, encouraging them to interact with teaching and learning materials (TLMs), ask questions, and explore concepts either independently or with the guidance of a teacher. Such strategies are particularly advantageous for achieving meaningful learning in chemistry [39–40].

Science educators [41–42] have long advocated replacing traditional teacher-centered methods often dominated by lectures, textbooks, and rote memorization with inquiry-oriented approaches that (i) stimulate students' curiosity about science, (ii) provide opportunities to apply proper laboratory techniques, (iii) engage learners in problem-solving through logic and evidence, (iv) motivate them to conduct further investigations for deeper explanations, and (v) emphasize the construction of scientific explanations based on empirical evidence.

According to [39–40], inquiry may take different forms, such as guided inquiry, where the teacher provides partial support, or open inquiry, where students take full responsibility for designing and conducting investigations. Similarly, [3–4] describe inquiry-based learning as an instructional approach that encourages students to ask questions, generate ideas, and seek solutions to problems through systematic investigation, sometimes with minimal teacher intervention.

Inquiry-based learning (IBL) is considered an active learning strategy wherein students engage in scientific processes to explore and construct understanding [43]. This engagement fosters critical thinking, hands-on exploration, and deeper conceptual comprehension of chemistry content. As noted by [44–45], inquiry-based learning models employ scientific inquiry processes as a framework for teaching and learning, emphasizing student questioning, application of knowledge, real-world relevance, and discovery-based investigation. These characteristics mirror the authentic practices of scientists in laboratories, fieldwork, and scholarly discussions.

According to [46], inquiry-based learning does not involve the simple transmission of predetermined facts; rather, it begins with questions, problems, or scenarios that prompt exploration. It aligns with the authentic processes of scientific inquiry—formulating hypotheses, conducting research, analyzing evidence, and drawing reasoned conclusions about the natural world [47]. As a result, students' motivation to learn and their understanding of the nature of science are enhanced, while their inquiry skills are strengthened to support lifelong learning [9–10].

The central aim of inquiry-based learning, as explained by [48], is to create a learner-centered environment that supports students in identifying scientific concepts and principles through curiosity-driven exploration. Its overarching objective is to develop intellectual and process skills, including question formulation, evidence-based reasoning, and knowledge construction. Through inquiry, learners engage in problem-solving, drawing conclusions, and generating predictions, activities that promote scientific attitudes such as objectivity, honesty, creativity, and inquisitiveness [3, 10, 49].

Empirical evidence [50–51] indicates that inquiry-based learning enhances students' conceptual understanding and enables them to apply scientific principles to real-world contexts. In contrast, research by [52–55] shows that many chemistry students rely heavily on algorithmic or rote methods to solve quantitative problems without fully grasping the underlying conceptual frameworks. Therefore, implementing inquiry-based strategies can help students move beyond procedural learning toward conceptual understanding.

Overall, inquiry-based learning fosters skill development, long-term retention, and a positive perception of science and scientists. It encourages students to analyze real-life phenomena, interpret evidence, and solve problems through open-ended investigations [56]. As [57] asserts, inquiry-based learning helps students integrate prior knowledge with new information, strengthen research skills, and seek solutions to societal challenges through systematic investigation. Thus, inquiry-based instruction not only focuses on outcomes but also aims to develop learners' abilities, attitudes, and scientific reasoning [10, 58–59]. Recognizing its importance, numerous educational reforms and curriculum revisions across nations have incorporated inquiry-based and active teaching methodologies to align science instruction with the authentic nature of scientific inquiry [60].

GENDER

Certain learner traits, like gender, may also have an impact on academic progress in chemistry. Gender is a significant variable in educational research, and academics and educators continue to be concerned about it [4, 6, 9-10, 12, 58]. According to [61], gender is the degree of disparity between the enrolment of men and women in science and technology courses and their access to and participation in these courses. It is possible to think of gender as a sexual classification into male and female. In the context of education, gender issues are defined as the disparities in opportunities and accomplishments between boys and girls, both actual and perceived [62].

Gender is as an analytical construct that characterizes the expectations placed on men and women in a certain society or cultural context, as well as their sociological roles and cultural obligations [63]. In addition, gender refers to the characteristics of the two sexes that society assigns differently, such as roles, expectations, attitudes, behaviors, values, and relative power and influence [64]. In light of this, gender is a psychological word as well as a cultural construct that society has created to distinguish between the roles, behaviors, and mental and emotional characteristics of men and women. In this study, gender is described as a biased role that culture and society assign depending on a person's gender. Our society and culture are still rife with gender role stereotyping, which, in a sense, dictates how far along and how successful students studying chemistry will advance [65].

Educationists and psychologists continue to debate and discuss the impact of gender on learning and performance [4, 12]. However, gender equality and women's empowerment are Millennium Development Goals at all levels of education [4]. According to a study by [66-68], and others, gender significantly influences students' chemistry achievement. It also demonstrates that male students outperformed female students in this subject. However, research by [69-70], found that women outperformed men in chemistry in terms of academic achievement.

According to [71], certain courses, including mathematics, physics, and chemistry, are associated with men, while topics like home economics and secretarial studies are associated with women. Gender and gender stereotypes are a problem that affects all human endeavors. Gender stereotypes have negative effects on social, economic, political, and educational advancement, particularly in the fields of science and technology [72].

The results of [73-75], showed a substantial difference in chemistry achievement between males and females subjected to an activity-based teaching strategy. Nevertheless, studies by [76-79], found no discernible differences in the performance of male and female students when teaching basic science or chemistry through hands-on activities.

Based on the aforementioned studies, it seems that gender has an influencing factor in learning and achievement in aspects of chemistry remains important but controversial. The need to conduct a study to ascertain the impact of inquiry-based learning on secondary school male and female students' academic achievement in chemistry has arisen from the contradictory evidence regarding academic achievement and the lack of a clear trend regarding gender influence in the study of chemistry.

Therefore, the purpose of this review is to investigate how inquiry-based learning affects secondary school students' academic achievement in chemistry. Reviewing and examining the effect of inquiry-based learning on secondary school students' academic achievement in chemistry at different secondary schools is of great interest to the researcher. Further information on its broader impact from different findings across the globe will be gathered, arranged, and presented. This article essentially aims to address the following questions: what is the effect of inquiry-based learning on students’ academic achievement in chemistry at secondary schools; will male and female students' academic achievement differ as a result of this teaching approach?

THEORETICAL FRAMEWORK

Constructivism serves as the fundamental learning theory underpinning the inquiry-based teaching approach. Dissatisfaction with behaviorism’s emphasis on rote memorization and teacher-centered instruction gave rise to constructivist theories of learning [80]. Unlike didactic environments where learners passively receive information, constructivist classrooms emphasize learners’ active engagement in constructing and reconstructing their understanding of the world through inquiry, questioning, exploration, discussion, and reflection [7, 9]. Learning, therefore, becomes a dynamic process in which students make meaningful connections between prior knowledge and new experiences, leading to deeper conceptual understanding [7, 9].

According to Piaget, one of the founders of constructivism, learning involves a process of active discovery: “to understand is to discover or reconstruct by rediscovery” [81]. He emphasized that education should aim to cultivate creative and productive individuals rather than mere reproducers of existing knowledge. Constructivism, therefore, encourages learners to engage in problem-solving and experimentation as they acquire new knowledge. Through interaction and reflection, students connect prior conceptions with new experiences to achieve cognitive restructuring.

Moreover, constructivism does not eliminate the teacher’s role but redefines it. Teachers become facilitators and architects of learning rather than transmitters of information [9, 82]. They design learning environments that stimulate curiosity, scaffold inquiry, and guide students toward self-directed knowledge construction. Although students play an active role, the teacher’s presence remains essential in structuring and guiding cognitive processes, ensuring that inquiry remains focused and productive [9, 83].

The constructivist approach aligns closely with the principles of inquiry-based learning (IBL). Cognitive science, particularly cognitive psychology, provides the theoretical foundation for IBL by focusing on mental models, problem solving, and metacognitive development [83]. In inquiry-based classrooms, students engage in meaningful investigations, formulate hypotheses, test ideas, and draw conclusions based on evidence—mirroring the processes of scientific discovery. This approach is particularly effective in chemistry education, where conceptual understanding often requires linking abstract models with observable phenomena.

Constructivism's goal is meaningful learning through active construction rather than passive reception. This process involves engaging students in group discussions, experiments, projects, and presentations that connect classroom concepts to real-life situations. Collaborative inquiry and shared problem-solving help learners develop intrinsic motivation and ownership of their learning [83]. The teacher's responsibility, therefore, is to design challenging but achievable learning tasks that provoke curiosity, encourage interaction, and promote knowledge reconstruction.

In a constructivist classroom, learning occurs through social interaction and reflective thinking. Students investigate problems, share their ideas, and refine their understanding collaboratively. The teacher supports this process through guided inquiry, scaffolding, and feedback. One of the key strengths of the constructivist framework is its transformation of the learner from a passive consumer of information into an active constructor of knowledge [84]. The teacher's role extends beyond knowledge delivery to include interpreting, adapting, and translating content into forms that align with learners' existing cognitive levels, thereby facilitating meaningful and sustainable understanding [84].

METHODOLOGY

This review was restricted to journal articles published between 2017 and 2025 and to articles written in English to investigate research that is available to the wider research community. The library databases ERIC, Web of Science, Google Scholar and related Websites as the indexed database was used to source articles describing the effect of inquiry-based learning on the academic achievement of secondary school students in chemistry. The search also included the effect of inquiry-based learning on the academic achievement of secondary school students in science to obtain more studies that could increase the data as a search term. One hundred-thirty (130) studies were obtained; some of them were not related to our investigation, and those that did not answer the research question were excluded; we remained with 11 studies. The search terms enquiry, enquiry-based learning, secondary school, effect of inquiry, and chemistry learning were used to ensure that relevant studies for the concept were targeted.

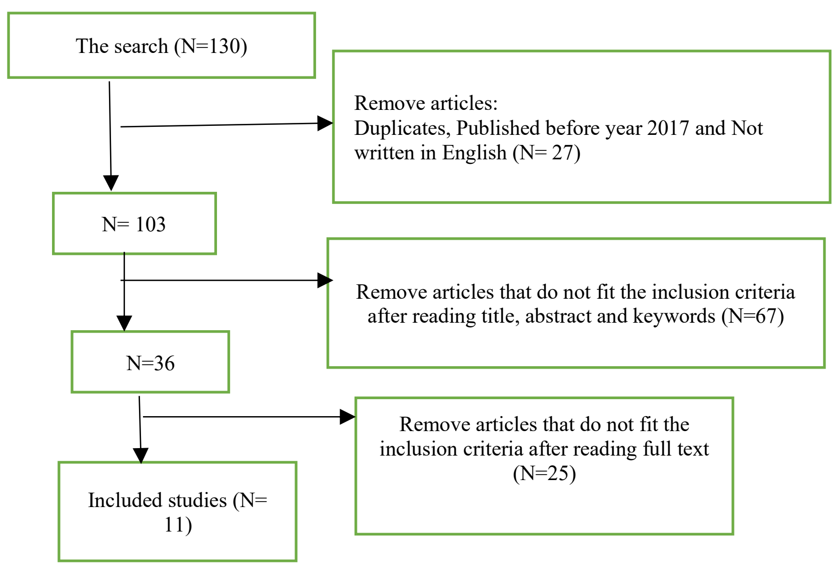

Figure 1. The selection processes

The selection of studies was guided by the inclusion and exclusion criteria listed in Table 1 below.

Table 1. Inclusion and Exclusion Criteria Developed Based on the Research Questions

No	Inclusion	Exclusion
1	Studies focusing on inquiry-based learning	Studies with inquiry-based learning as a context, not focus
2	Studies focusing on chemistry topics and science.	Studies in biology, physics or other subjects without an emphasis on chemistry
3	Studies focusing on secondary schools	Studies focusing on preschool, primary schools, or higher education, including teacher education
4	Studies focusing on students' achievement	Studies presenting teaching tools or materials without student's achievement
5	Studies related to formal learning	Studies presenting document analysis (e.g. textbooks or curricula) or informal settings such as apprenticeship programs

Generally, the selection of studies was based on the year of publication, location of the study, type of method, target group (students or teachers) and school level. Cited and citing references of these articles were consulted to identify additional relevant material.

Overview of Articles

Table 2. Overview of Articles

Characteristics		**Number (N=11)**
Research design	Quasi-experimental or pretest-posttest non-equivalent control group design	All
Area of study	Secondary school	All
Instrument	Test	All
Sampling	Purposive	N= 1
	Random	N= 10
Method of data analysis	Descriptive/inferential statistics	N= 11
Subject	Chemistry	N= 10
	Integrated science	N= 1
Objective of the article	To examine the effect of inquiry-based learning on student achievement.	N= 11
	To examine the effect of inquiry-based learning on male and female achievement.	N= 6

RESULTS AND DISCUSSION

Question 1: What is the effect of inquiry-based learning on students' academic achievement in chemistry at secondary schools as compared with the conventional method?

Table 3. Pretest and Posttest Means Achievement and Standard Deviation Scores of the Experimental and Control Groups

Article	Groups	N	Pretest		Posttest		Mean Gain
			$\bar{X}$	SD	$\bar{X}$	SD	
[3]	Experimental	27	24.64	4.39	86.07	6.49	61.43
	Control	28	24.89	6.78	81.82	4.86	56.93
	Mean difference		-0.25		4.25		
[4]	Experimental	35	31.26	14.29	78.34	6.27	47.08
	Control	52	25.77	13.69	47.38	9.87	21.61
	Mean difference		5.49		30.96		
[7]	Experimental	146	10.79	1.42	24.18	13.3	13.39
	Control	146	10.72	1.39	16.35	2.27	5.63
	Mean difference		0.07		7.83		
[9]	Experimental	43	13.93	7.76	20.79	4.28	6.86
	Control	35	15.06	3.40	17.14	4.11	2.08
	Mean difference		-1.13		3.65		
[10]	Experimental	70	6.74	3.087	11.34	2.543	4.60
	Control	60	8.33	2.820	11.93	2.049	3.60
	Mean difference		-1.59		-0.59		
[12]	Experimental	75	18.60		36.65		18.05
	Control	69	17.90		27.76		9.86
	Mean difference		0.7		8.89		
[59]	Experimental	21	3.55	4.96	52.48	19.07	48.93
	Control	24	2.22	2.87	40.77	16.78	38.5
	Mean difference		1.33		11.71		
[85]	Experimental	60	36.60		51.87		15.27
	Control	60	31.33		46.43		15.10
	Mean difference		5.27		5.44		
[86]	Experimental	41	32.42	12.07	60.24	12.75	27.82
	Control	40	31.50	11.99	50.63	8.93	19.13
	Mean difference		0.92		9.61		
[87]	Experimental	30	11.17	3.5	16.60	2.044	5.43
	Control	30	12.17	3.3	12.27	3.930	0.1
	Mean difference		-1		4.33		
[88]	Experimental	50	32.24	9.22	67.36	8.25	35.12
	Control	50	23.20	11.67	62.40	8.04	39.20
	Mean difference		9.04		4.96		

Data presented in Table 3 show that the control group had a pretest and posttest mean achievement scores 24.89, 81.82 [3], 25.77, 47.38 [4], 10.72, 16.35 [7], 15.06, 17.14 [9], 8.33, 11.93 [10], 27.76, 17.90 [12], 2.22, 40.77 [59], 31.33, 46.43 [85], 31.50, 50.63 [86], 12.17, 12.27 [87], and 23.20, 62.40 [88], while those of the experimental group were

24.64, 86.07 [3], 31.26, 78.34 [4], 10.79, 24.18 [7], 13.93, 20.79 [9], 6.74, 11.34 [10], 18.60, 36.65 [12], 3.55, 52.48 [59], 36.60, 51.87 [85], 32.42, 60.24 [86], 11.17, 16.60 [87], and 32.24, 67.36 [88], respectively. This implies that the posttest result of both experimental and control groups was better than the result of the pretest of the experimental and control groups, respectively.

The pretest standard deviation for control groups 13.69 [4], 11.99 [86], and 11.67 [88], and experimental groups 14.29 [4], and 12.07 [86], indicates that the individual scores are widely spread apart from mean and from each other. While the pretest standard deviation for control groups 6.78 [3], 1.39 [7], 3.40 [9], 2.820 [10], 2.87 [59], 3.3 [87], and experimental groups 4.39 [3], 1.42 [7], 7.76 [9], 3.087 [10], 4.96 [59], 3.5 [87], and 9.22 [88], indicates that the individual scores are not too far from the mean and from each other. The posttest standard deviation for control group 16.78 [59], and experimental groups 13.3 [7], 19.07 [59], and 12.75 [86], indicates that their scores are too far from the mean and from each other. On the other hand, their posttest standard deviation control groups 4.86 [3], 9.87 [4], 2.27 [7], 4.11 [9], 2.049 [10], 8.93 [86], 3.930 [87], 8.04 [88], and experimental groups 6.49 [3], 6.27 [4], 4.28 [9], 2.543 [10], 2.044 [87], and 8.25 [88], indicates that their scores are not too far from the mean and from each other.

The table also reveals that the mean gain achievement score of the experimental group was 61.43 [3], 47.08 [4], 13.39 [7], 6.86 [9], 4.60 [10], 18.05 [12], 48.93 [59], 15.27 [85], 27.82 [86], 5.43 [87], and is remarkably higher than that of the control group which was 56.93 [3], 21.61 [4], 5.63 [7], 2.08 [9], 3.60 [10], 9.86 [12], 38.5 [59], 15.10 [85], 19.13 [86], and 0.1 [87], respectively. This means that the experimental group taught with an inquiry-based method achieved more than the control group taught with a conventional method.

Table 4. ANCOVA Analysis Result of Students Taught with Inquiry-Based and Those Taught with the Conventional Method

Article	F	Df	T	Sig.
[3]	4.838	1 and 52		.012
[4]	127.043	1and 84		.000
[9]		76	-3.82	.0002
[12]		142	4.22	.001
[59]		43	-2.19	0.03
[85]	3.347	1 and 117		.070
[86]	41.374	1 and 122		.000
[87]	17.057	2 and 89		.000

The result of the 2-ways analysis of covariance from Table 4 shows that the Df-value was 1 and 52, 1 and 84, 76, 142, 43, 1 and 122, 2 and 89, and the P-value was 0.12, 0.000, 0.0002, 0.001, 0.03, 0.000, 0.000, respectively. This indicates a significant difference in the means score of students taught using the inquiry-based method and those taught using the conventional method. It can be concluded that the inquiry-based method of learning was more effective than the conventional method in terms of developing students' academic achievement with a significance $p < 0.05$. However, from the result of the study [85], in Table 4 indicates that the method was significant at 0.070, which is greater than 0.05. This implies that there was no significant statistical difference in the mean score of students taught the inquiry teaching strategy and the conventional method.

Question 2: What is the effect of inquiry-based learning on male and female students' academic achievement in chemistry at secondary schools?

Table 5. Pretest and Posttest Means Achievement and Standard Deviation Scores of the Male and Female Students

Article	Groups	N	Pretest		Posttest		Mean Gain
			$\bar{X}$	SD	$\bar{X}$	SD	
[4]	Male	14	30.71	16.85	76.14	8.65	45.43
	Female	21	31.63	12.74	80.29	7.78	48.66
	Mean difference		-0.92		-4.15		
[7]	Male	77	10.60	1.11	24.47	1.77	13.87
	Female	69	10.25	1.69	23.88	1.61	13.63
	Mean difference		0.35		0.59		
[86]	Male	26	39.00	9.90	61.20	11.39	22.20
	Female	25	28.44	12.61	58.75	14.89	30.31
	Mean difference		10.56		2.45		

Table 5 reveals that, the male and female students in the experiment group had a pretest mean achievement scores 30.71, 31.63 [4], 10.60, 10.25 [7], and 39.00, 28.44 [86], respectively while their posttest mean achievement scores were 76.41, 80.29 [4], 24.47, 23.88 [7], and 61.20, 58.75 [86], respectively. The pretest standard deviation for male 16.85 [4], and female 12.74 [4], 12.61 [86], indicates that their responses were far from the mean and from each other whereas the pretest standard deviation for male 1.11 [7], 9.90 [86] and female 1.69 [7], indicates their responses were not too far from the mean and from each other. The posttest standard deviation male 8.65 [4], 1.77 [7], and female 7.78 [4], 1.61[7], indicates that their responses were not too far from the mean and from each other. On the hand, their posttest standard deviation male 11.39 and female 14.89 [86], indicates their responses were far from the mean and from each other. The mean gain achievement score of female students 48.66 [4], and 30.31 [86], was slightly higher than the mean gain achievement score of the male students 45.43 [4], and 22.20 [86], respectively. This indicate that inquiry-based learning crucial for promoting gender equity in education and ensuring that female student reaches their full potential. On the other hand, the mean gain achievement of female 13.63

[7], was slightly lower than the mean gain achievement of the male students 13.87 [7]. This shows that both male and female students maintain unequal intellectual level even when they were exposed to the same learning environment and structure.

Table 6. Mean and Summary of t-Test Analysis Mean Achievement Scores of Male and Female Students Taught Using Inquiry-Based and Conventional Method One Study.

Article	Experimental Group						
	Group	N	Mean	SD	Df	T	Sig. (2-tailed)
[12]	Male	42	32.96	2.59	73	1.24	0.185
	Female	33	32.02	2.27			
	Mean difference		0.94				
	Control Group						
	Male	37	31.56	2.60	67	1.38	0.211
	Female	32	30.68	2.42			

Table 6 revealed that the male and female students had mean scores of 32.96 and 32.02, respectively, for the inquiry-based method and mean scores of 31.56 and 30.68 for the conventional method. The t-value for the analysis inquiry-based method and conventional method 1.24 and 1.38 was obtained, and the p-value for those methods observed was 0.185 and 0.211, respectively. The p-value of both groups (inquiry-based and conventional method) was 0.185 and 0.211, which is greater than the alpha value of; 0.05 level of significance. This indicated that there is no significant difference between male and female students taught chemistry using inquiry-based and conventional methods. On the other hand, the mean score of male 32.96 and female 32.02 in the experimental group better than the mean score of male 31.56 and female 30.68 in the control group. This indicates that students who engaged in inquiry-based learning achieved more than students who were taught by conventional methods.

Table 7. ANCOVA on the Mean Achievement Scores of Male and Female Chemistry Students Taught with an Inquiry-Based Method

Article	F	Df	Sig.
[4]	1.889	1 and 32	.179
[9]	.169	1 and 40	.683
[10]	0.313	1 and 125	0.577
[12]	32.46	1 and 137	0.113
[86]	.071	1 and 40	.791

The result of the 2-ways analysis of covariance from Table 7 indicates that the F-value was 1.889, 0.169, 0.313, 32.46, 0.071, and the P-value was 0.179, 0.683, 0.577, 0.113, and 0.791, respectively. Since the P-value was greater than 0.05 level of significance at df of 1 and 32, 1 and 40, 1 and 125 1 and 137, 1 and 40, it shows that there is no significant difference between the mean achievement scores of male and female chemistry students who were taught with inquiry-based method.

Generally, the results of most studies show that students taught with an inquiry-based method achieved better than their counterparts taught using a conventional method. The effectiveness of this inquiry-based method as a means of enhancing students' academic achievement in chemistry may be attributed by the nature of the instruction. It is more practically oriented as well as student-centered, and thus it provides a lot of activities for the students to control their own actions in the learning process. Inquiry-based learning has a positive impact on secondary school student achievement in chemistry by promoting active learning, deep understanding, problem-solving skills, knowledge retention, increased interest, motivation, and improved academic performance. On the other hand, conventional teaching methods typically involve more teacher-centered instruction, where information is presented to students in a structured manner. This conventional method allows only the teacher to handle the learning material completely, making the learner passive in the learning and so does not allow him the privilege to be fully involved in the learning and this can also limit his knowledge gain of the content presented. Therefore, inquiry-based learning is most effective in enhancing the learning of science subjects in general chemistry in particular than the conventional method.

Based on the results of studies, inquiry-based learning can have a positive effect on both male and female students' academic achievement in chemistry at secondary schools. By promoting active engagement, critical thinking, and collaboration, this approach can enhance students' understanding of chemical concepts and improve their overall performance in the subject. The equivalent performance of both male and female students reported in those studies might have been induced by the fact that the participant of experimental group was able to discuss freely with one another within the group and even the whole class. This indicated that inquiry-based learning has inclusive learning environments that cater to the diverse learning needs of male and female students in chemistry education.

CONCLUSION

The overall results of findings of the studies indicate that students taught using an inquiry-based approach performed much better academically than students taught using a conventional teaching approach. As a result, inquiry-based learning improves students' academic performance and fosters knowledge of chemistry subjects. Gender has no discernible impact on students' performance when the inquiry method of teaching is used, since there was no statistically significant difference in the performance of male and female students in chemistry. For both male and female students, the inquiry-based learning approach improves academic achievement in chemistry. In contrast, there was a notable disparity in the academic performance of male and female students in chemistry while using the conventional.

RECOMMENDATIONS

Considering the findings and the conclusions drawn from this review, some recommendations were made for inquiry-based learning. These are:

- It is recommended that chemistry and other science teachers support their students' use of inquiry-based learning and discourage the use of traditional methods that do not incorporate activity-oriented learning exclusively. This is because the use of inquiry-based learning improves students' academic achievements.
- Chemistry and other science teachers should adopt inquiry-based teaching methods to promote gender equality and prevent gender stereotypes in science education in general, and chemistry in particular.
- The government ought to provide funding for teachers to participate in workshops and seminars focused on applying inquiry-based teaching techniques appropriately and effectively to improve science students' performance.
- The government should provide all the needed instructional and infrastructural facilities for the successful implementation of inquiry-based teaching methods in chemistry classes in secondary schools.

REFERENCES

1. Chukwuma, E. T. C. and M. G. Aniekwe, "Adult Education as an Agent for Enhancing the Learning and Capacity Development of Out of School Street Children in Nigeria," *The Educational Psychologist,* 5(1), 102 –109, 2011.
2. Ugwu, O., "How Students of Different Backgrounds Use Strategies to Strengthen College Enrolment Applications," *Science Daily Journal,* 16(7), 22-67, 2019.

3. Annisa, D. and E. Rohaeti, "The effect of inquiry-based learning on students' understanding of the chemical equilibrium concept," *AIP Conf. Proc. 2021,* https://doi.org/10.1063/1.5062823, 2018.
4. Odukwe, O. C. and S. C. Nwafor, "Effect of Guided-Inquiry Method on Senior Secondary School Chemistry Students' Academic Achievement in Anambra State, Nigeria," *Unizik Journal of Educational Research and Policy Studies,* 11(1), 2022.
5. Ada, N., "Curriculum and instruction: An Introduction to general methods and principle of teaching," *Makurdi Aboki publisher*, 2014.
6. Alachi, S., et al., "Effect of Inquiry Based Learning on Secondary Schools Students' Misconception of Science Concepts and Academic Achievement in Science," *International Journal of Research in Education and Sustainable Development* 1(7), 2021.
7. Issaka, M., "Effect of inquiry-based teaching method on students' achievement and retention of concepts in integrated science in senior high school," *Texila International Journal of Academic Research,* **7**(2), 78-88, 2020.
8. Tsvyk V., A. and V. Tsvyk I., "Scientific and technological development of modern society: the ethical aspect," *RUDN Journal of Philosophy,* 22, 281-290, 2018.
9. Dushimimana, F. and D. L. Mugabo, "Effects of Inquiry-Based Teaching Method on Students' Academic Performance and Attitudes towards Chemistry in Two Selected Secondary Schools of Bugesera District, Rwanda," *Journal of Research Innovation and Implication in Education,* 6(2), 44-56, 2022.
10. Abbey-Kalio, I., "The Effect of Guided-inquiry Approach on Senior Secondary School Students' Academic Achievement in Practical Chemistry in Okrika Local Government Area, Rivers State, Nigeria," *Direct Research Journal of Social Science and Educational Studies***,** 6 (9), 138-142, 2019.
11. Çalik, M. and A. Ayas, "An analogy activity for incorporating students' conceptions of types of solutions," *Asia-Pacific Forum on Science Learning and Teaching*, 6(2), 1-13, 2005.
12. Uzezi, J. G. and S. Zainab, "Effectiveness of Guided-Inquiry Laboratory Experiments on Senior Secondary Schools Students Academic Achievement in Volumetric Analysis," *American Journal of Educational Research***,** 5(7), 717-724, 2017.
13. Ali, T., "A case study of the common difficulties experienced by high school students in chemistry classroom in Gilgit Baltisian (Paskistan), SAGE Open," 1-3, 2012.
14. Adeoye, I. F. and D. Ajeyalemi, "Effects of Inquiry-Based Learning Strategies on Chemistry Students' Conceptions in Chemical Kinetics and Equilibrium," *American Journal of Humanities and Social Sciences Research (AJHSSR)*, 02(07), 07-14, 2018.
15. Harizal, Z. M., "Analysing misconceptions on acid-base chemistry at senior high schools in Medan," *Journal of Education and Practice,* 3(15), 65-74, 2012.
16. Ogbole, M., "Understanding physics and the rule of science education in Nigeria," *Makurdi Aboki publishers,* 2015.
17. Satilmis, Y., "Misconceptions about periodicity in secondary chemistry education: The case of Kazakhstan," *International online Journal of Primary Education***,** 3(2), 53-58, 2014.
18. Othman, J., Treagust, D. F. and A. L. Chandrasegaran, "An investigation into the relationship between students' conception of the particulate nature of matter and their understanding of chemical bonding," *International Journal of Science Education*, 30(11), 1531-1550, 2008.
19. Shehu, G., "Two ideas of redox reaction: Misconceptions and their challenges in chemistry education," *IOSR Journal of Research & Method in Education,* 5(1), 15-20, 2015.

20. Kolomuc, A. and M. Calik., "A comparison of chemistry teachers and grade 11 students' alternative conceptions of rate of reaction," *Journal of Balitic Science Education*, 11(4), 333-346, 2012.
21. Akor, S., "Effect of physics practical on students achievement in physics," *Journal of Occupation and Training* 5(3), 63-68, 2013.
22. Sokrat, H., Tamani, S. and M. Radid., "Difficulties of students from the faculty of science with regard to the understanding the concepts of thermodynamics," *Precedia-Social and Behavioral Science,* 116, 368-372, 2014.
23. Jack, G. U., "Analysis of Senior Secondary School Students' experienced difficulty in science process skills acquisition in chemistry," *DELSU, Abraka. PhD*, 2013.
24. Jack, G. U., A comparative study of teachers' and students' perceptions of difficulty levels of topics in secondary school chemistry, *Delta State University, Abraka. M.Ed*., 2005.
25. Ibrahim, A., "Effect of science process teaching approach on primary school pupils' achievement in basic science and technology in Katsina State, Nigeria," *Unpublished master's thesis, Ahmadu Bello University, Zaria*, 2012.
26. Njoku, Z. C. and U. S. Ezenwa, "Comparative effects of peer teaching and lecture method on students' achievement and interest in some difficult concepts in chemistry," *Journal of Science Teachers Association of Nigeria*, 49(1), 60-73, 2014.
27. Giginna, L. I. and B. N. Nweze, ''Creativity in Chemistry Teaching: Effect of E-learning on Students' Achievement in Acids, Bases and Salts,'' *55th Annual Conference Proceedings of Science Teachers Association of Nigeria (STAN)*, 2014.
28. Sree, K. J., Methods of Teaching Science India, Discovery Publishing House, 2010.
29. Burgoon, J. N., et al., "Re-examining the similarities between teacher and student conceptions about physical science," *Journal of Science Teacher Education* 7, 859-872, 2010.
30. Tytler, R., "A Window for a Purpose: Developing a framework for describing effective science teaching and learning," *Research in Science Education* 33, 273-298, 2003.
31. Erinosho, S. Y., "How do students perceive the difficulty of physics in secondary school? An exploratory study in Nigeria," *International Journal of cross-disciplinary Subjects in Education (IJCOSE)*, 3(3), 1510-1515, 2013.
32. Nja, C. O., et al., "Effect of the use of ICT on chemistry performance," *Education for today* 13(1), 148-153, 2017.
33. Usoh, C., "Technological design and laboratory activities in teaching and learning physics," *Alvan Journal of Science,* 9(1), 46-52, 2015.
34. Adams, G. A., "Effects of inquiry-based teaching strategy on students' science process skill acquisition in some selected biology concepts in secondary school in Borno state," *International Journal of scientific Research*, 1(2), 96-106, 2016.
35. Njoku, Z. C., "Comparison of students' achievement in the three categories of questions in SSCE practical chemistry examination," *Alvan Journal of Science,* 8(1), 67-72, 2013.
36. Achimugu, L., Teaching basic science for creativity: the use of cooperative group assignment, *The 55th Annual Conference Proceedings of Science Teacher Association of Nigeria*, 2014.
37. Eggen, P. D. and D. P. Kauchak, "Strategi dan model pembelajaran: mengajarkan konten dan keterampilan berpikir (Ed 6) (Indeks, Jakarta),"39, 2016.
38. Maxwell, D. O., et al., "Effects of using inquiry-based learning on science achievement for fifth-grade students," *Asia- Pacific Forum on Science Learning and Teaching*, 16(1), 1-31, 2015.
39. Adeoye, I. F., Effects of inquiry-based learning strategies on senior secondary school students' learning outcomes in chemistry. Lagos State, Nigeria, University of Lagos, PhD, 2016.

40. Ajeyalemi, D., Practical work in school science. Are the aims and objectives being achieved? *52nd Annual Proceedings of Memorial Lecture Science Teachers Association Nigeria*, 2011.
41. Aminu, F., Issue in science education, *Global City Publisher*, 2010.
42. Nnadi, N., Effect of cooperative group learning strategy on secondary schools students achievement in physics in Imo State, *Imo State University Owerri*, M.Sc., 2011.
43. Yagger, R. E. and H. Akcay, "The advantages of an inquiry approach for science instruction in middle grade," *School Science and Mathematics,* 110(3), 5-12, 2010.
44. Ketpichainarong, W., et al., "Enhanced learning of biotechnology students by an inquiry-based cellulase laboratory," *International Journal of Environmental & Science Education (IJESE),* 5(2), 169-187, 2010.
45. Evrim, U., "The Effect of Guided-Inquiry Laboratory Experiments on Science Education Students' Chemistry Laboratory Attitudes, Anxiety and Achievement," *Journal of Education and Training Studies,* 4(4), 217-218, 2016.
46. Marcus, G., "All about inquiry based learning: Prodigy January 19, 2017 online retrieval" June 20, 2017.
47. National Research Council, " Inquiry and the National Science Education Standards: A Guide for Teaching and Learning. Washington, DC: The National Academies Press. https://doi.org/10.17226/9596," 2000.
48. Trowbridge, L. W. and R. W. Bybee, Becoming a scondary school science teacher, *Merrill Publishing Company, Columbus*, 1990.
49. Jogendra Singh and V. Kaushik, "A Study on the effectiveness of the Inquiry- based learning method in chemistry teaching learning process," *Suresh Gyan Vihar University Journal of Engineering & Technology (An International Bi-Annual Journal),* 7(1), 25-31, 2021.
50. Aydeniz, M., et al., "Using inquiry-based instruction for teaching science to students with learning disabilities," *International Journal of Special Education*, 27(2), 189-206, 2012.
51. Chairan, S., et al., " Exploring secondary students of chemical kinetics through inquiry-based learning activities," *Eurasia Journal of Mathematics, Science and Technology Education*, 11(5), 937-956, 2015.
52. Surif, J., et al., " Problem solving: Algorithms and conceptual and open-ended problems in chemistry," *Procedia-Social and Behavioural Sciences*,116, 4955-4963, 2014.
53. Holme, T. A., et al., "Defining conceptual understanding in general chemistry," *Journal of Chemical Education,* 92(9), 1477-1483, 2015.
54. Adeoye, I. F., "Secondary school students' conceptual and computational knowledge in electrochemistry," *Oyo State Journal of Mathematical Association of Nigeria*, 3(2), 96-106, 2012.
55. Gultepe, N., et al., "Exploring effects of high school students mathematical processing skills and conceptual understanding of chemical concepts on algorithmic problem solving," *Australian Journal of Teacher Education,* 36(10), 106-122, 2013.
56. Chen, J., et al., "Using a three-dimensional thinking graph to support inquiry learning," *Journal of Research in Science Teaching*, 55(9), 1239-1263, 2018.
57. Bevins, S. and G. Price, "Re-conceptualizing inquiry in science education,"*International Journal of Science Education,* 38(1), 17-29, 2016.
58. Adeoye, I. F., "Effects of Inquiry-Based Learning Strategies on Senior Secondary School Students' Conceptual and Computational Knowledge in Chemistry," *International Journal of Social Science and Humanities Research* 7(1), 367-376, 2019.

59. Nursen Azizoğlu*, et al., "An Inquiry-Based Instruction on the Main Subatomic Particles: Enhancing High-School Students' Achievement and Motivation," *Science Education International*, 33(1), 75-85, 2022.
60. Oplatka, I., " Reforming Education in Developing Countries: From Neoliberalism to Communitarianism," (2018).
61. UNESCO, "United Nations Educational, Scientific and Cultural Organization (UNESCO), Defintion of Gender UNESCO (2014) retrieved from www.unesco.ng/education/wet/countryreports/report-2-12-html," 2014.
62. Mankumari, P. and T. Ajay, "Gender differences in the academic achievement of students." *Journal of development and social engineering*, 3(1), 39-47, 2017.
63. Kanno, T. N., Gender neutral nature of modern careers, *Paper presented at a workshop organised by Federal Ministry of Education for women and girls, at Owerri from 26th -28th* August, 2008.
64. Ezeh, D. N., "Science without women: a paradox. 75th Inaugural Lecture of the University of Nigeria, Nsukka delivered on 30th May, 2013, Nsukka: University of Nigeria Senate Ceremonials Committee," 2013.
65. Okorie, E. U. and D. N. Ezeh, "Influence of Gender and Location on Students' Achievement in Chemical Bonding," *Mediterranean Journal of Social Sciences MCSER Publishing, Rome-Italy,* **7**(3), 309-317, 2016.
66. Ifeakor, A. C., ''Effects of commercially produced computer assisted instruction package on students' achievement and interest in secondary school chemistry, University of Nigeria, Nsukka,'' *Unpublished Ph.D Thesis*, 2005.
67. Hashim, A., et al., "Effects of inquiry-based teaching on junior secondary school students academic achievements: A case study in Hadejia Zonal Education Area of Jigawa State, Nigeria," *SUST Journal of Humanities,* 16(1), 156-170, 2015.
68. Sever, D. and M. Guven " Effect of inquiry-based learning approach on student resistance in a science and technology courses," *Educational Science: Theory and Practice,*14(4), 1601-1605, 2015.
69. Anyafulude, J. C. " Effects of problem-based and discovery-based instruction strategies on chemistry achievement," *Journal of Educational and Social Research*, 3(6), 105-111, 2013.
70. Uwaleke, C. C., "Analytical skill as a correlation of chemistry achievement among senior secondary school students in Anambra state," *A master's thesis, Nnamdi Azikiwe University, Awka,* 2013.
71. Fatokum, K. V. F. and I. A. Odagboyi, "Gender disparity and parental influence on secondary schools achievement in Nasarawa State," *Journal of Research in National Development*, 2010.
72. Nnorom, N. R., Alachi, S and T. P. Anozie, "Effect of generative learning model approach and expository method in teaching basic science for creativity in secondary schools," *ANSU Journal of Education Research*, 2(1), 193-200, 2014.
73. Abunugu, H. E. O., et al., " Effect of science process skills teaching strategy on boys and girls achievement in chemistry in Nyando district, Kenya,"*Journal of Education and Practice,* 5(15), 42-48, 2014.
74. Oribhabor, C. B., " The influence of gender on mathematics achievement of secondary school students in Bayelsa state," *African Journal of Studies in Education*, 14(2), 196-206, 2019.
75. Kisigot, C. K., et al., "Effect of gender on students' academic achievement in public secondary schools in marakwet East Sub of Country, Kenja," *International Journal of Humanities, Social Sciences and education,* 8(3), 1-10, 2021.

76. Adeyemi, T. O., "Teachers teaching experience and students learning outcomes in secondary schools in Ondo State Nigeria," *Asian Journal of Information Technology*, 7(5), 201-209, 2008.
77. Ajayi, O. V. and J. Ogbeba, "Effect of Gender on senior secondary chemistry students' Achievement in Stoichiometry Using Hands-on Activities," *American Journal of Educational Research*, 5(8), 839-842, 2017.
78. Godpower-Echie, G. and S. Ihenko, "Influence of gender on interest and academic achievement of students in integrated science in Obio Akpor local Government Area of Rivers State," *European Scientific Journal*, 13(10), 272-279, 2017.
79. Ajaja, O. P. and Eravwoke, "Effects of cooperative learning strategy on junior secondary schools students achievement in integrated science," *Electron.J.Sci.Educ. Sci3,* (1), 49-57, 2010.
80. Lister, C. A. P., "A framework for implementing inquiry-based learning in the elementary classroom. Master's thesis https://dspace.library.uvic.ca/bitstream/handle/1828/6950/Lister_Christopher_MEd_201 5.pdf? Sequence=1 andisAllowed=y," 2015.
81. Piaget, J., To understand is to invent. New York, NY: The Viking Press, 1973.
82. Mcleod, B. S., "Constructivism as a theory for teaching and learning: What are the principles of constructivism? (1978)," 1–7, 2019.
83. Dostal, J., " Theory of problem solving. Procedia-Social and Behavioral Sciences, This is an open access article under the CC BY-NC-ND license," *Published by Elsevier Ltd.*, 174, 2798-2805, 2015.
84. Khalid, A. and M. Azeem, " Constructivist vs. traditional: Effective instructional approach in teacher education,"*International Journal of Humanities and Social Science*, 2(5), 170–177, 2012.
85. Sylvanus, T. and S. Eke, "Effect of Inquiry Teaching Strategy on Academic Achievement of Senior Secondary School Chemistry Students in Okrika Local Government Area," *International Journal of Education and Evaluation,* 3(12), 2017.
86. OKOLI, C. S. and E. C. OKIGBO, "Effects Of Cooperative Learning Strategy And Inquiry Based Learning On Secondary School Students' Academic Achievement In Chemistry In Nnewi Education Zone," *International Journal of Innovative Research and Advanced Studies (IJIRAS),* 8(5), 2021.
87. Derejaw, Y., "Secondary School Students' Achievement and Attitude Towards Chemistry Within Computer Simulation Assisted Inquiry-Based Chemistry Teaching: Case of Finote Selam Town,"*AJCE,* 12(1), 2022.
88. Anari, M. I., Agim, F. B., & Obi, J. J., Impact of Inquiry Based Learning on Student Engagement and Conceptual Understanding in Chemistry in Calabar South Local Government Area, Nigeria, *Prestige Journal of Counselling Psychology*, 8(1), 2025.