THE IMPACT OF CLASS SIZE IN TEACHING AND LEARNING CHEMISTRY IN SENIOR SECONDARY SCHOOLS IN EDO STATE

BY

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BENIN CITY

MARCH, 2025.

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A PROJECT SUBMITTED

IN PARTIAL FUFILMENT OF THE REQUIREMENT FOR THE AWARD FOR DEGREE OF BACHELOR OF SCIENCE EDUCATION (B.SC.Ed) AT THE DEPARTMENT OF CURRICULUM AND INSTRUCTIONAL TECHNOLOGY, FACULTY OF EDUCATION UNIVERSITY OF BENIN, BENIN CITY

MARCH, 2025.

CERTIFICATION

This is to certify that this project was written by CLEMENT BRIGHT AJAYI Matric No: edu2106354 for the award of bachelor of science education (B.Sc.Ed) in the Department of Curriculum and Instructional Technology, Faculty of Education.

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DEDICATION

I dedicated this research work to God Almighty, the author and the finisher of my faith, who work in unison in giving me life, strength, provision and courage to undergo this work successfully and to my late brother, Clement Osalumense.

ACKNOWLEDGEMENTS

I would like to express my deepest gratitude to Almighty God, who has been my guiding light and source of strength throughout my project. I thank Him for granting me good health of mind and body, divine wisdom, guidance, and provision, which have enabled me to complete this project to the best of my ability. My profound gratitude also goes to my supervisor Dr. (Mrs) A.H. Oyakhirome whose contribution and constructive criticism has pushed me to expend the kind of efforts I have expected to make this work as original as it can be. Thanks to her.I have experience true research and my knowledge on the subject matter has been broadened. I also want to extend my appreciation to my family, who have been a constant source of support and encouragement Mr.& Mrs Clement Azakaye and my grandma Mrs. Amenawon Zabayor. My siblings; Amadin, Omonlobhiye, Sandra, Happy, Oseretin and Miracle for their prayers. I thank all the authors whose work were consulted during the course of this project.

Finally, I am grateful to all my friends Fredrick Noah, Oni Esther and Edowmande Humphrey for their constructive criticism, support and contributions.

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ABSTRACT

This study investigates the impact of class size on teaching and learning chemistry in senior secondary schools in Edo State, Nigeria, with a specific focus on exploring the relationship between class size and student learning outcomes, the impact of class size on teacher effectiveness, the challenges faced by teachers when teaching chemistry in large classes, and the optimal class size for effective teaching and learning of chemistry. Conducted in the context of Nigerian senior secondary schools, this quantitative research employed a survey design, utilizing a questionnaire to collect data from a sample of 100 students selected from 5 senior secondary schools in Edo State. The study's findings provide insights into the complex interplay between class size, teacher effectiveness, and student learning outcomes, highlighting the significance of optimal class size in promoting effective teaching and learning of chemistry. By elucidating the impact of class size on chemistry education, this study contributes to the existing body of knowledge, informing policy and practice in chemistry education in Nigeria, and providing recommendations for educators, policymakers, and stakeholders.

CHAPTER ONE

INTRODUCTION

Background to the Study

Class size is a critical factor in determining the quality of education in schools. Research has consistently shown that smaller class sizes are associated with better academic outcomes, improved student behavior, and enhanced teacher morale (Harris, 2016; OECD, 2018). When classes are small, teachers are able to provide individualized attention, tailor their instruction to meet the diverse needs of their students, and encourage active participation and engagement (Kis, 2016). This, in turn, leads to a more supportive and inclusive learning environment, where students feel valued, motivated, and empowered to succeed (Dumont, 2017).

In contrast, large class sizes can hinder effective teaching and learning. When classes are too big, teachers may struggle to provide individualized attention, and students may feel overwhelmed, disconnected, and anonymous (Hattie, 2015). This can lead to a lack of hands-on experience, reduced opportunities for questions and discussion, and a decreased ability to develop critical thinking and problem-solving skills (Kane, 2016). The impact of class size on student learning outcomes is multifaceted and far-reaching. One of the most significant effects of smaller class sizes is the improvement in academic achievement, particularly for students from disadvantaged backgrounds (Dynarski, 2018). With fewer students in the classroom, teachers are able to provide more individualized attention and support, which can lead to improved learning outcomes and increased student motivation (Kis, 2016).

Smaller class sizes also provide opportunities for more effective differentiation, which can lead to improved learning outcomes for students with diverse learning needs (Tomlinson, 2017). When teachers have fewer students to manage, they are able to tailor their instruction to meet the unique needs of each student, which can lead to improved student engagement and motivation (Hattie, 2015). Smaller class sizes can also have a positive impact on student behavior and social skills. With fewer students in the classroom, teachers are able to provide more positive feedback and reinforcement, which can lead to improved student behavior and social skills (Webster-Stratton, 2018). Smaller class sizes can also provide opportunities for more effective classroom management, which can lead to improved student behavior and reduced disruptions (Marzano, 2017). Smaller class sizes can also have a positive impact on teacher satisfaction and retention. When teachers have fewer students to manage, they are able to provide more individualized attention and support, which can lead to increased job satisfaction and reduced teacher burnout (Kane, 2016). Smaller class sizes can also provide opportunities for more effective professional development, which can lead to improved teacher quality and retention (Harris, 2016).

Research has shown that smaller class sizes can have a positive impact on student achievement, particularly for students from disadvantaged backgrounds (Dynarski, 2018). This suggests that smaller class sizes can be a key factor in promoting greater equity in education. Smaller class sizes allow for more effective formative assessments, which can inform instruction and improve student learning outcomes (Black & Wiliam, 2010). With fewer students, teachers can more easily monitor student progress, identify areas of difficulty, and adjust their instruction to meet the needs of their students. Smaller class sizes can also promote a sense of community and belonging among students, which is essential for social and emotional learning (Durlak, 2015). When students feel connected to their peers and teachers, they are more likely to be motivated, engaged, and committed to learning. Smaller class sizes can reduce the likelihood of bullying and other negative behaviors, which can have a positive impact on student well-being and safety (Olweus, 2013). With fewer students, teachers can more easily monitor student behavior and intervene early to prevent conflicts and other problems.

Smaller class sizes can provide opportunities for more effective technology integration, which can enhance teaching and learning (Koehler & Mishra, 2009). With fewer students, teachers can more easily provide individualized support and guidance as students work with technology to complete projects and assignments. Smaller class sizes can also promote more effective parent-teacher communication, which is essential for student success (Epstein, 2011). With fewer students, teachers can more easily keep parents informed about their child's progress, involve parents in the learning process, and build partnerships with parents to support student learning. The impact of class size on teaching and learning is complex and multifaceted. Smaller class sizes provide opportunities for more effective instruction, improved academic achievement, and increased student motivation, as well as a range of other benefits that can have a positive impact on student learning outcomes.

Statement of the Problem

The problem of the study revolves around the challenges posed by large class sizes in senior secondary schools, particularly in relation to the teaching and learning of chemistry. The issue is multifaceted, with large class sizes hindering effective teaching, limiting teachers' ability to provide individualized attention, and leading to decreased student engagement and motivation (Hattie, 2015). Schools with limited resources struggle to maintain small class sizes, exacerbating existing inequalities in education (OECD, 2018). The situation is compounded by teacher burnout and turnover, which are often linked to large class sizes, ultimately affecting student learning outcomes (Kane, 2016). Large class sizes restrict teachers' ability to tailor instruction to meet the diverse needs of their students, limiting opportunities for differentiated instruction (Tomlinson, 2017). Ultimately, the negative impact of large class sizes on student socio-emotional learning, including their ability to form positive relationships with peers and teachers, is a pressing concern that warrants investigation (Durlak, 2015).

Aims of the Study

i. To examine the relationship between class size and student learning outcomes in chemistry.
ii. To investigate the impact of class size on teacher effectiveness in teaching chemistry.
iii. To identify the challenges faced by teachers in teaching chemistry in large classes.
iv. To determine the optimal class size for effective teaching and learning of chemistry.

Research Questions

These are the research questions formulated based on each aims and objectives of the study:

i. What is the relationship between class size and student learning outcomes in chemistry?
ii. How does class size impact teacher effectiveness in teaching chemistry?
iii. What challenges do teachers face when teaching chemistry in large classes?
iv. What is the optimal class size for effective teaching and learning of chemistry?

Significance of the Study

The significance of this study extends to various stakeholders, including students, teachers, schools, government, and other researchers. For students, this study aims to improve their learning outcomes and overall educational experience by highlighting the importance of smaller class sizes in chemistry education. By advocating for smaller class sizes, teachers can provide more individualized attention, support, and feedback, leading to better academic achievement and increased motivation. Teachers will also benefit from this study as it will provide them with evidence-based strategies to optimize their teaching practices and improve student learning outcomes. Schools will benefit from this study by gaining insights into how to allocate resources effectively to support smaller class sizes and improve student learning outcomes. The government will benefit from this study by gaining a deeper understanding of the importance of investing in education, particularly in relation to class size and student learning outcomes. Finally, this study will contribute to the existing body of research on class size and student learning outcomes, providing valuable insights and recommendations for future research, policy, and practice.

Scope of the Study

The scope of this study focuses on examining the effect of class size on the teaching and learning of Chemistry in senior secondary schools in Edo State. It specifically targets the relationship between the number of students in a class and the effectiveness of Chemistry instruction, as well as students' academic performance. The study considers various factors such as teaching methods, student engagement, and classroom dynamics within the context of different school environments in Edo State. It also aims to gather insights from both teachers and students to understand how class size influences their experiences and outcomes in Chemistry education.

Limitations of the Study

Despite its comprehensive approach, this study has some limitations. They include potential challenges in generalizing the findings due to a limited sample size or geographic focus. The study may also be influenced by varying teaching methods and resources available in different schools, which could affect the results. Factors like student motivation, teacher experience, and curriculum implementation were not fully controlled for, which may have skewed the outcomes. Time constraints and the potential for bias in data collection, such as self-reported responses from teachers and students, also limit the study's comprehensiveness. Lastly, external factors such as socio-economic conditions and parental involvement, which can impact learning, were not explored in depth.

Definition of the Terms

These are the definitions of key terms related to the study:

Academic Performance: it refers to the measure of a student's achievement in a particular subject.

Class Size: the number of students in a particular classroom or educational setting.

Chemistry: the scientific study of the composition, properties, and reactions of matter.

Senior Secondary School: it is an educational institution that provides secondary education to students, typically between the age of 15 and 18.

Teaching: the process of imparting knowledge, skills, and values to students.

Learning: the process of acquiring knowledge, skill.

CHAPTER TWO

LITERATURE REVIEW

Concept of Chemistry

Chemistry is the scientific study of the composition, properties, and reactions of matter (Chang, 2017). It is a branch of physical science that deals with the study of the structure, properties, and transformations of matter at the atomic and molecular level (Brown, 2018). Chemistry is a fundamental subject that underlies many areas of modern life, including medicine, technology, and environmental science. Chemistry involves the study of the chemical elements, which are the building blocks of matter, and the compounds that they form (Chang, 2017). It also involves the study of chemical reactions, which are the processes by which atoms and molecules interact and transform into new substances (Brown, 2018). Chemists use a variety of techniques, including experimentation, observation, and theoretical modeling, to understand the properties and behavior of matter at the atomic and molecular level.

Understanding chemistry is essential for many areas of modern life, including the development of new medicines, materials, and technologies (Chang, 2017). It is also important for understanding and addressing many of the world's most pressing environmental and energy challenges, such as climate change and sustainable energy production (Brown, 2018). Chemistry is a dynamic and constantly evolving field, with new discoveries and advances being made regularly (Atkins, 2018). The study of chemistry is divided into several branches, including organic chemistry, inorganic chemistry, physical chemistry, and analytical chemistry (Chang, 2017). Chemistry involves the study of chemical bonds, which are the attractive and repulsive forces between atoms that hold them together in molecules (Atkins, 2018). Chemists also study chemical reactions, which are the processes by which atoms and molecules interact and transform into new substances (Brown, 2018). The periodic table of elements is a fundamental tool in chemistry, as it organizes the elements in a logical and systematic way and allows chemists to predict their properties and behavior (Chang, 2017). Chemists also use a variety of symbols, equations, and formulas to represent and communicate chemical information (Atkins, 2018). Chemistry has many practical applications, including the development of new materials, such as plastics, fibers, and ceramics, and the creation of new medicines and pharmaceuticals (Brown, 2018). Chemists also play a critical role in environmental protection and conservation, by developing new technologies and strategies for reducing pollution and waste (Chang, 2017).

The study of chemistry requires a range of skills, including critical thinking, problem-solving, and communication (Atkins, 2018). Chemists must also be able to work safely and responsibly in the laboratory, using a range of equipment and techniques to analyze and synthesize chemical substances (Brown, 2018). Chemistry is a global discipline, with chemists from around the world working together to advance our understanding of the chemical sciences and to address global challenges (Chang, 2017). The study of chemistry is also essential for many other fields, including engineering, biology, and medicine (Atkins, 2018).

Concept of Chemistry Students

Chemistry students are individuals who are pursuing academic studies in the field of chemistry, which is the scientific study of the composition, properties, and reactions of matter (Chang, 2017). These students are typically enrolled in high school or college chemistry courses, where they learn about the fundamental principles and concepts of chemistry, such as atomic structure, chemical bonding, and chemical reactions (Brown, 2018). Chemistry students develop a range of skills, including critical thinking, problem-solving, and analytical skills, as they learn to apply chemical principles to solve problems and analyze data (Atkins, 2018). They also learn to work safely and responsibly in the laboratory, using a range of equipment and techniques to conduct experiments and collect data (Brown, 2018). As they progress in their studies, chemistry students begin to specialize in specific areas of chemistry, such as organic chemistry, inorganic chemistry, physical chemistry, or analytical chemistry (Chang, 2017). They may also participate in research projects, internships, or other hands-on experiences that allow them to apply their knowledge and skills in real-world settings.

Throughout their academic careers, chemistry students are expected to demonstrate a strong understanding of chemical principles and concepts, as well as the ability to think critically and solve problems (Atkins, 2018). They are also expected to develop effective communication skills, both written and oral, as they learn to present their findings and results to others (Brown, 2018). Ultimately, chemistry students who complete their studies successfully are well-prepared to pursue a wide range of career opportunities in fields such as research and development, industry, education, and healthcare (Chang, 2017). Chemistry students learn to use a variety of tools and instruments, such as spectrophotometers, chromatographs, and microscopes, to analyze and characterize chemical substances (Atkins, 2018). They also learn to design and conduct experiments, collect and analyze data, and draw conclusions based on their findings (Brown, 2018).

Chemistry students develop strong problem-solving skills, which enable them to think critically and creatively about complex chemical problems (Chang, 2017). They also learn to work collaboratively with others, which is essential for success in many areas of chemistry, such as research and development (Atkins, 2018). Many chemistry students participate in research projects, which provide them with hands-on experience in the laboratory and the opportunity to contribute to the advancement of knowledge in the field (Brown, 2018). These experiences can be invaluable in preparing students for careers in research and development, academia, and other fields.

Chemistry students must also develop strong mathematical skills, as chemistry relies heavily on mathematical concepts and techniques, such as algebra, calculus, and statistical analysis (Atkins, 2018). They must also be able to communicate complex chemical concepts and ideas clearly and effectively, both in writing and orally (Brown, 2018). Throughout their studies, chemistry students are encouraged to think critically and creatively about chemical problems and to develop innovative solutions (Chang, 2017). They are also encouraged to consider the social and environmental implications of chemical discoveries and developments, and to think about how they can use their knowledge and skills to make a positive impact on society (Atkins, 2018).

Chemistry students learn to identify and analyze chemical hazards, assess risks, and develop strategies for mitigating them (Brown, 2018). They also learn to handle and dispose of chemicals safely, which is essential for maintaining a safe working environment in the laboratory (Atkins, 2018). Many chemistry students participate in science fairs, competitions, and other events, which provide them with opportunities to showcase their research and projects (Chang, 2017). These events can be a great way for students to gain recognition, build their confidence, and develop their communication skills.

Concept of Modern Strategies

Modern strategies refer to innovative and technology-driven approaches to teaching and learning that deviate from the traditional lecture-based methods (Ogundipe, 2017). These strategies involve the use of technology, such as computers, tablets, and smartphones, to support teaching and learning. The goal of modern strategies is to provide students with engaging, interactive, and effective learning experiences that cater to their diverse learning needs and styles.Modern strategies are used to create a student-centered learning environment that promotes active learning, critical thinking, and problem-solving skills (Adeyemi, 2013). Teachers who adopt modern strategies recognize that students are no longer passive recipients of knowledge, but rather active participants in the learning process. By leveraging technology and innovative approaches, teachers can facilitate deeper learning, improve student engagement, and enhance academic achievement.Modern strategies have the potential to transform the teaching and learning process, making it more effective, efficient, and enjoyable for both teachers and students.Modern strategies refer to the innovative and dynamic approaches to teaching and learning that are designed to meet the diverse needs of students in the 21st century (Ogunsola, 2019). These strategies emphasize student-centered learning, technology integration, and collaborative learning.

Modern strategies are systematic and intentional approaches to teaching and learning that are grounded in research and best practices (Okoro, 2018). These strategies are designed to promote deep learning, critical thinking, and problem-solving skills, and to prepare students for success in an increasingly complex and interconnected world.Modern strategies represent a paradigm shift in teaching and learning, one that emphasizes flexibility, adaptability, and creativity (Afolabi, 2017). These strategies leverage technology, social media, and other digital tools to create personalized, interactive, and engaging learning experiences that cater to the diverse needs and interests of students.Modern strategies are data-driven, student-centered, and teacher-supported approaches to teaching and learning that are designed to promote academic achievement, social-emotional learning, and civic engagement (EduTech, 2020). These strategies emphasize the use of technology, collaboration, and project-based learning to create authentic, relevant, and challenging learning experiences.

Modern strategies involve the use of digital tools, resources, and platforms to support teaching and learning, and to enhance student engagement and motivation (Ogundipe, 2017).Modern strategies prioritize student-centered learning, where students take an active role in the learning process, and teachers act as facilitators or coaches rather than lecturers (Adeyemi, 2013).Modern strategies emphasize the development of 21st-century skills, such as critical thinking, creativity, communication, and collaboration, which are essential for success in today's complex and interconnected world (Okoro, 2018).

Modern strategies emphasize the importance of feedback and assessment, recognizing that students need regular feedback and opportunities to reflect on their learning in order to improve and grow (Ogunsola, 2019).Modern strategies involve the use of real-world examples and case studies to illustrate key concepts and principles, and to help students see the relevance and application of what they are learning (NYSC, 2020).

Types of Modern Strategies

Technology integration is a type of modern strategy that involves the use of digital tools, resources, and platforms to support teaching and learning (Ogundipe, 2017). This can include the use of learning management systems, online learning platforms, and educational software. Technology integration can help to enhance student engagement, motivation, and learning outcomes, and can also provide teachers with new and innovative ways to teach and assess student learning.Technology integration can take many forms, from the use of educational apps and games to the creation of online learning communities and forums. It can also involve the use of digital tools to support assessment and feedback, such as online quizzes and grading systems. By integrating technology into the classroom, teachers can create a more engaging and interactive learning environment that meets the needs of diverse learners.Technology integration can help to promote student-centered learning, where students take an active role in the learning process and are encouraged to explore and discover new concepts and ideas. This can involve the use of digital tools to support project-based learning, where students work on real-world projects that require them to apply what they have learned to solve problems and complete tasks.

Inquiry-based learning is a type of modern strategy that involves students in investigating and solving problems through hands-on activities and experiments (Okoro, 2018). This approach encourages critical thinking, creativity, and collaboration among students. Inquiry-based learning can help to develop students' problem-solving skills, and can also help to promote a deeper understanding of complex concepts and principles.Inquiry-based learning involves a process of questioning, exploring, and discovering, where students are encouraged to ask questions, gather information, and draw conclusions based on evidence. This approach can be applied to a wide range of subjects and topics, from science and mathematics to language arts and social studies.By using inquiry-based learning, teachers can create a learning environment that is engaging, interactive, and student-centered. This can involve the use of hands-on activities, experiments, and simulations to support learning, as well as the creation of learning communities and forums where students can share their ideas and collaborate with one another.

Collaborative learning is a type of modern strategy that involves students working together in groups to achieve a common goal or complete a task (Afolabi, 2017). This approach promotes teamwork, communication, and problem-solving skills among students. Collaborative learning can help to develop students' social skills, and can also help to promote a sense of community and cooperation in the classroom.Collaborative learning can take many forms, from group projects and presentations to peer review and feedback. It can also involve the use of digital tools to support collaboration, such as online forums and discussion boards. By working together, students can share their ideas and expertise, and learn from one another's strengths and weaknesses.Collaborative learning can help to promote student-centered learning, where students take an active role in the learning process and are encouraged to explore and discover new concepts and ideas. This can involve the use of group projects and presentations to support project-based learning, where students work on real-world projects that require them to apply what they have learned to solve problems and complete tasks.

Gamification is a type of modern strategy that involves the use of game design and mechanics to engage students and motivate them to learn (EduTech, 2020). This approach makes learning fun and interactive, increasing students' participation and engagement. Gamification can help to develop students' problem-solving skills, and can also help to promote a deeper understanding of complex concepts and principles.Gamification can take many forms, from educational games and apps to point systems and rewards. It can also involve the use of digital tools to support game-based learning, such as online platforms and simulators. By using game design and mechanics, teachers can create a learning environment that is engaging, interactive, and fun.Gamificationcan help to promote student-centered learning, where students take an active role in the learning process and are encouraged to explore and discover new concepts and ideas. This can involve the use of game-based learning to support project-based learning, where students work on real-world pr

Simulation-based learning can take many forms, from computer simulations and models to hands-on activities and experiments (Ogunsola, 2019). This approach can be applied to a wide range of subjects and topics, from science and mathematics to language arts and social studies.By using simulation-based learning, teachers can create a learning environment that is engaging, interactive, and experiential. This can involve the use of digital tools to support simulation-based learning, such as online platforms and software. Simulation-based learning can also help to promote student-centered learning, where students take an active role in the learning process and are encouraged to explore and discover new concepts and ideas (Afolabi, 2017).Simulation-based learning can help to develop students' problem-solving skills, and can also help to promote a deeper understanding of complex concepts and principles. This can involve the use of simulations to model real-world phenomena, such as climate change or economic systems, and to allow students to explore and learn about these phenomena in a safe and controlled environment (Ogunsola, 2019).

Project-based learning is a type of modern strategy that involves students working on real-world projects that require them to apply what they have learned to solve problems and complete tasks (uLesson, 2020). This approach promotes critical thinking, creativity, and collaboration among students, and helps to develop the skills and competencies needed for success in the 21st century.Project-based learning can take many forms, from science fair projects and presentations to service-learning projects and community-based initiatives. This approach can be applied to a wide range of subjects and topics, from science and mathematics to language arts and social studies.By using project-based learning, teachers can create a learning environment that is engaging, interactive, and student-centered. This can involve the use of digital tools to support project-based learning, such as online platforms and software. Project-based learning can also help to promote student autonomy and self-directed learning, where students take an active role in the learning process and are encouraged to explore and discover new concepts and ideas (Adeyemi, 2013).Project-based learning can help to develop students' problem-solving skills, and can also help to promote a deeper understanding of complex concepts and principles. This can involve the use of real-world projects and scenarios to illustrate key concepts and principles, and to allow students to apply what they have learned in a practical and meaningful way (uLesson, 2020).

Factors Contributed in using Modern strategies

The factors that contribute to the use of modern strategies in teaching secondary chemistry students are numerous and diverse. The need to cater to different learning styles is a significant factor, as modern strategies such as gamification and simulation-based learning can help to engage students with different learning styles and preferences (Adeyemi, 2013). Additionally, the importance of developing students' digital literacy skills is a crucial factor, as modern strategies such as technology integration and online learning can help to develop students' digital literacy skills and prepare them for success in the digital age (Ogundipe, 2017). The need to provide students with real-world learning experiences is another significant factor, as modern strategies such as project-based learning and service-learning can help to provide students with real-world learning experiences that are relevant and meaningful (Okoro, 2018). The importance of developing students' soft skills, such as communication and teamwork, is also a crucial factor, as modern strategies such as collaborative learning and group work can help to develop students' soft skills and prepare them for success in the workforce (Afolabi, 2017). Moreover, the need to provide students with feedback and assessment opportunities is another significant factor, as modern strategies such as online quizzes and games can help to provide students with feedback and assessment opportunities that are timely and relevant (EduTech, 2020). The importance of developing students' critical thinking and media literacy skills is also a crucial factor, as modern strategies such as inquiry-based learning and media literacy education can help to develop students' critical thinking and media literacy skills and prepare them for success in the digital age (Ogunsola, 2019). The need to provide students with opportunities for reflection and self-assessment is another significant factor, as modern strategies such as reflective journals and self-assessment rubrics can help to provide students with opportunities for reflection and self-assessment that are meaningful and relevant (uLesson, 2020). Moreover, the importance of developing students' problem-solving skills is also a crucial factor, as modern strategies such as project-based learning and design thinking can help to develop students' problem-solving skills and prepare them for success in the workforce (Adeyemi, 2013). The need to provide students with opportunities for creativity and innovation is another significant factor, as modern strategies such as makerspaces and hackathons can help to provide students with opportunities for creativity and innovation that are meaningful and relevant (Ogundipe, 2017). The importance of developing students' emotional intelligence is also a crucial factor, as modern strategies such as social-emotional learning and mindfulness education can help to develop students' emotional intelligence and prepare them for success in the workforce (Afolabi, 2017).

The importance of promoting student autonomy and self-directed learning is also a crucial factor, as modern strategies such as personalized learning and competency-based progression can help to empower students to take ownership of their learning (EduTech, 2020). The need to foster a growth mindset and promote resilience and perseverance in students is another significant factor, as modern strategies such as mindset education and restorative practices can help to cultivate a positive and supportive learning environment (Ogunsola, 2019). The importance of developing students' spatial awareness and visual literacy skills is also a crucial factor, as modern strategies such as virtual reality and augmented reality can help to provide immersive and interactive learning experiences (uLesson, 2020). The need to promote cultural responsiveness and address the diverse cultural backgrounds and experiences of students is another significant factor, as modern strategies such as culturally responsive teaching and restorative practices can help to foster a sense of belonging and community in the classroom (Afolabi, 2017). The importance of developing students' financial literacy and entrepreneurship skills is also a crucial factor, as modern strategies such as project-based learning and social entrepreneurship can help to provide students with real-world learning experiences that are relevant and meaningful (Adeyemi, 2013).

Modern strategies in improving Secondary School Students' Performance in Chemistry

The implementation of modern strategies in secondary school chemistry education in Nigeria has been shown to significantly improve student performance. One such strategy is the use of technology integration, which involves the incorporation of digital tools and resources into the learning process, such as online learning platforms, educational apps, and digital simulations (Ogundipe, 2017). Strategy is inquiry-based learning, which encourages students to explore and discover concepts and principles through hands-on activities and experiments (Okoro, 2018). Project-based learning, which involves students working on real-world projects that require them to apply what they have learned to solve problems and complete tasks, has been shown to be effective in improving student performance in chemistry (uLesson, 2020). The use of gamification, which involves the use of game design and mechanics to engage students and motivate them to learn, has been shown to be effective in improving student performance in chemistry (EduTech, 2020). The use of simulation-based learning, which involves the use of simulations to model real-world phenomena and allow students to explore and learn about complex concepts in a safe and controlled environment, has been shown to be effective in improving student performance in chemistry (Ogunsola, 2019). The implementation of these modern strategies has been shown to improve student performance in chemistry in Nigeria by providing students with engaging, interactive, and relevant learning experiences that cater to their diverse learning needs and styles.

The use of virtual labs and online simulations has been shown to be effective in improving student performance in chemistry, providing students with a safe and controlled environment to conduct experiments and investigations (Ogunsola, 2019). Furthermore, the use of educational games and puzzles has been shown to be effective in improving student performance in chemistry, making learning fun and interactive (EduTech, 2020). Moreover, the use of real-world examples and case studies has been shown to be effective in improving student performance in chemistry, providing students with a deeper understanding of complex concepts and principles (Okoro, 2018). The use of peer assessment and feedback has also been shown to be effective in improving student performance in chemistry, providing students with opportunities to reflect on their learning and identify areas for improvement (uLesson, 2020). Overall, the implementation of these modern strategies has been shown to improve student performance in chemistry in Nigeria by providing students with engaging, interactive, and relevant learning experiences that cater to their diverse learning needs and styles.

Advantages of Modern Strategies

The advantages of modern strategies in teaching and learning of chemistry are numerous and significant. One of the major advantages is that modern strategies, such as technology integration and gamification, make learning chemistry more engaging and interactive, increasing students' motivation and participation (Ogundipe, 2017). Modern strategies, such as project-based learning and inquiry-based learning, promote critical thinking, creativity, and problem-solving skills, which are essential for students to succeed in chemistry and other STEM fields (Okoro, 2018). Furthermore, modern strategies, such as flipped classroom approach and online learning, provide students with flexibility and autonomy to learn at their own pace, which is particularly beneficial for students with different learning styles and abilities (Afolabi, 2017). Moreover, modern strategies, such as simulation-based learning and virtual labs, provide students with safe and controlled environments to conduct experiments and investigations, which reduces the risk of accidents and injuries (Ogunsola, 2019). The use of modern strategies also promotes collaboration and communication among students, which is essential for success in chemistry and other STEM fields (EduTech, 2020). Modern strategies, such as adaptive learning software and microlearning, provide students with personalized learning experiences that cater to their individual needs and abilities (uLesson, 2020). Overall, the advantages of modern strategies in teaching and learning of chemistry are numerous and significant, and they have the potential to transform the way chemistry is taught and learned, making it more engaging, interactive, and effective.

Modern strategies, such as project-based learning and inquiry-based learning, promote critical thinking, creativity, and problem-solving skills, which are essential for students to succeed in chemistry and other STEM fields (Okoro, 2018). Furthermore, modern strategies, such as flipped classroom approach and online learning, provide students with flexibility and autonomy to learn at their own pace, which is particularly beneficial for students with different learning styles and abilities (Afolabi, 2017). Moreover, modern strategies, such as simulation-based learning and virtual labs, provide students with safe and controlled environments to conduct experiments and investigations, which reduces the risk of accidents and injuries (Ogunsola, 2019). The use of modern strategies also promotes collaboration and communication among students, which is essential for success in chemistry and other STEM fields (EduTech, 2020). Modern strategies, such as adaptive learning software and microlearning, provide students with personalized learning experiences that cater to their individual needs and abilities (uLesson, 2020). Moreover, modern strategies, such as real-time feedback and assessment, enable teachers to monitor student progress and provide timely feedback, which helps to improve student outcomes (Adeyemi, 2013). The use of modern strategies also helps to develop students' digital literacy skills, which are essential for success in the 21st century (Ogunsola, 2019). Furthermore, modern strategies, such as gamified quizzes and assessments, make testing and evaluation more engaging and interactive, which helps to reduce student stress and anxiety (EduTech, 2020).

Disadvantages of Modern Strategies

The disadvantages of modern strategies in teaching and learning of chemistry are several and significant. One of the major disadvantages is that modern strategies, such as technology integration and online learning, can be expensive and inaccessible to many students, particularly those in rural or under-resourced areas (Ogundipe, 2017). Modern strategies, such as gamification and simulation-based learning, can be overly reliant on technology, which can lead to technical issues and distractions, and can also create a sense of isolation and disconnection among students (Okoro, 2018). Furthermore, modern strategies, such as flipped classroom approach and project-based learning, can require significant amounts of time and effort from teachers, which can lead to teacher burnout and decreased job satisfaction (Afolabi, 2017). Moreover, modern strategies, such as adaptive learning software and microlearning, can be overly rigid and inflexible, which can limit students' creativity and autonomy, and can also create a sense of dependency on technology (Ogunsola, 2019). The use of modern strategies can also lead to a lack of depth and understanding of complex chemistry concepts, as students may focus more on the technology and less on the underlying principles (EduTech, 2020). Modern strategies, such as gamified quizzes and assessments, can create a sense of competition and stress among students, which can lead to decreased motivation and engagement (uLesson, 2020). Furthermore, modern strategies, such as real-time feedback and assessment, can be overly focused on standardized testing and accountability, which can lead to a narrow and limited view of student learning and achievement (Adeyemi, 2013). Overall, the disadvantages of modern strategies in teaching and learning of chemistry are significant, and they highlight the need for careful consideration and critical evaluation of the benefits and limitations of these approaches.

Modern strategies, such as gamification and simulation-based learning, can be overly reliant on technology, which can lead to technical issues and distractions, and can also create a sense of isolation and disconnection among students (Okoro, 2018). Furthermore, modern strategies, such as flipped classroom approach and project-based learning, can require significant amounts of time and effort from teachers, which can lead to teacher burnout and decreased job satisfaction (Afolabi, 2017). Moreover, modern strategies, such as adaptive learning software and microlearning, can be overly rigid and inflexible, which can limit students' creativity and autonomy, and can also create a sense of dependency on technology (Ogunsola, 2019). The use of modern strategies can also lead to a lack of depth and understanding of complex chemistry concepts, as students may focus more on the technology and less on the underlying principles (EduTech, 2020). Additionally, modern strategies, such as gamified quizzes and assessments, can create a sense of competition and stress among students, which can lead to decreased motivation and engagement (uLesson, 2020). Modern strategies, such as real-time feedback and assessment, can be overly focused on standardized testing and accountability, which can lead to a narrow and limited view of student learning and achievement (Adeyemi, 2013). Moreover, modern strategies can also lead to a lack of face-to-face interaction between teachers and students, which can limit the development of social skills and emotional intelligence (Ogunsola, 2019). Modern strategies can also create a sense of inequality among students, as those with access to technology and internet may have an advantage over those who do not (Ogundipe, 2017). Furthermore, modern strategies can also lead to a lack of hands-on experience and experimentation, which is essential for learning chemistry concepts (Okoro, 2018).

Solution to the Problem of Modern Strategies

To address the problems associated with modern strategies in teaching and learning of chemistry, a multifaceted approach is necessary. Educators and policymakers must prioritize equity and access, ensuring that all students have equal access to technology, internet, and other resources necessary for modern learning strategies (Ogundipe, 2017). This can be achieved through initiatives such as one-to-one laptop programs, mobile learning devices, and community-based internet access points. Teachers must be provided with ongoing professional development and training to effectively integrate modern strategies into their teaching practice, addressing concerns around teacher burnout and lack of technical expertise (Afolabi, 2017). This can include workshops, coaching, and mentoring programs that focus on pedagogy, technology integration, and classroom management. Educators must strike a balance between technology-enhanced learning and hands-on experimentation, ensuring that students have opportunities to engage in practical, inquiry-based learning experiences that foster deep understanding of chemistry concepts (Okoro, 2018). This can involve incorporating lab simulations, virtual labs, and outdoor learning experiences into the curriculum. Policymakers and educators must prioritize student-centered learning, focusing on individualized instruction, flexibility, and autonomy, rather than relying solely on standardized testing and accountability measures (Adeyemi, 2013). This can involve implementing competency-based progression, personalized learning plans, and self-directed learning opportunities. Educators must prioritize ongoing evaluation and assessment of modern learning strategies, gathering data on their effectiveness, identifying areas for improvement, and making data-driven decisions to optimize teaching and learning (EduTech, 2020). By adopting these solutions, educators and policymakers can harness the potential of modern strategies to improve teaching and learning of chemistry, while minimizing their limitations and challenges.

Summary

Although modern strategies in teaching and learning of chemistry in secondary schools in Nigeria offer numerous advantages, including increased student engagement and improved learning outcomes, their adoption is hindered by significant challenges, including unequal access to technology and teacher burnout, which can limit the effectiveness of modern strategies and exacerbate existing educational disparities. The over-reliance on technology can lead to a lack of hands-on experimentation and practical learning experiences, which are essential for developing deep understanding of chemistry concepts. Additionally, the rapid pace of technological change can make it difficult for teachers to keep up with the latest developments and integrate them into their teaching practice. Therefore, a multifaceted approach that prioritizes equity and access, teacher professional development, and student-centered learning is necessary to harness the potential of modern strategies and improve the teaching and learning of chemistry in Nigerian secondary schools. This approach should involve providing ongoing training and support for teachers, investing in infrastructure and technology to ensure equal access for all students, and promoting a culture of innovation and experimentation in schools. By adopting such an approach, educators and policymakers can help to ensure that modern strategies are used in a way that promotes equity, inclusivity, and excellence in chemistry education.

CHAPTER THREE

RESEARCH METHODOLOGY

Methodology

This chapter presents the research method employed in collecting data of this study. These include; design, study population, sample and sampling procedure, research instruments, collection of data, and analysis of data. This study was designed to measure the impact of class size in teaching and learning chemistry in senior secondary schools in Edo State.

Research Design

The study type of research design was adopted by sourcing data primarily from questionnaires administered to some chemistry students in some selected senior secondary schools in the area under the study. The survey research design is eligible for the purpose of this study as it will provide a wider range of judgment and assessment in attaining the purpose/objective of the study.

Population and Sample

Data necessary for carrying out the study is primarily from a population of 100 respondents (students) from some selected senior secondary schools in Edo State. It consists of a total of 100 students drawn from five (5) senior secondary schools in the area under the study.

Sampling Techniques

Simple random sampling technique was used to select five secondary schools for the study. Also, simple random technique was used to select twenty students each from the selected schools.

i. Aduwa Community Secondary School

ii. Baptist High School

iii. Akenzua Secondary School, off Auchi Road

iv. Edo College, Murtala Mohammed Way

v. Eghosa Grammar School.

The population includes both male and female students of public secondary schools, so that the generality of the study can be seen.

Materials / instruments for Data collection

Questionnaire is the basic instrument for data collection since highlighting the impact of class size in teaching and learning chemistry is the focus of the study. Students are the only respondents because they are in the best position to actually show case the needed result or information. The questionnaire contains 20 questions in total and a set of 4 questions in relation with the research questions.

Procedures for collection Data

The researcher administered the questionnaire on the students of the randomly selected secondary schools. The researcher ensures that there is proper understanding of the questions by the respondents and they are honest in answering the questions. Which were treated individually.

Method of Data Analysis

T-test will be used to analyze the data collected.

CHAPTER FOUR

RESULTS AND DISCUSSION

This chapter presents the demographic information of the respondents used for this study. It presents answers to the research questions that were asked and it presents the result of the hypothesis that was formulated. The chapter equally presents discussion of the findings that are generated based on answers to the research questions and the result of the tested hypothesis.

Demographic Information of Respondents

Table 4.1
Distribution of Students by Gender

Gender	Frequency	Percentage
Male	43	43.0
Female	57	57.0
Total	**100**	**100.0**

Table 4.1 shows that 100 students were used in this study. Out of the 100 respondents, (43%) were male while the remaining (57%) were female. The result from this table implies that the female participants were more than the male respondents. Figure 4.1 further presents the result from the table in bar chart.

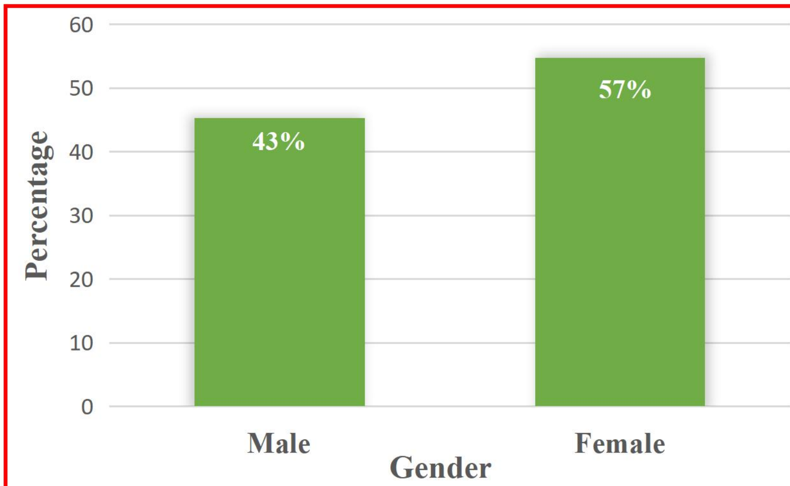

Figure 4.1: Bar Chart showing Students' Gender

Table 4.2: *Distribution of the Students by Age Range*

Age Range	Frequency	Percentage
12-14years	34	34.0
15-17years	55	55.0
18 years and above	11	11.0
Total	**100**	**100.0**

Table 2 above shows the distribution of the students by their age. The table shows that 34% of them are between the ages of 12 to 14years, 55% are between the ages of 15 to 16 years while the remaining 11% are 17 years and above.

Answers to Research Question

Research Question1: What is the relationship between class size and student learning outcomes in chemistry?

Table 4.2

Item	SA	A	D	SD	Mean	Std. D
Do students in smaller classes have more opportunities to ask chemistry-related questions?	42	39	15	5	3.16	.86
Do class sizes affect students' ability to participate in chemistry lab experiments?	28	63	10	0	3.17	.58
Do students in smaller classes perform better in chemistry than those in larger classes?	43	48	5	5	3.27	.77
Do smaller class sizes improve students' understanding of complex chemistry concepts?	46	40	15	0	3.30	.71
Do class sizes affect your ability to participate in chemistry lab experiments?	43	48	5	5	3.27	.77
Weighted Average					**3.23**	

Key; ***SD*** = Strongly Disagree, **D** = Disagree, **A** = Agree, **SA** = Strongly Agree
Decision Value:***Low*** =0.00-2.44, ***High*** = 2.45-4.00

Table 4.2 shows the extent to which the relationship between class size and student learning outcomes in chemistry. The table revealed that all the items received a mean score that is above the cutoff score with "smaller class sizes improve students' understanding of complex chemistry concepts" ($\bar{x}$ = 3.30) having highest score. Meanwhile, based on the value of the weighted average (3.23 out of 4.00 maximum value obtainable) which falls, within the decision value for ***high,*** it can be inferred that the relationship between class size and student learning outcomes in chemistry is high.

Research Question2: How does class size impact teacher effectiveness in teaching chemistry?

Table 4.3

Item	SA	A	D	SD	Mean	Std. D	Remark
Does class size affect teachers' ability to provide individualized attention to students in chemistry classes?	33	43	15	10	2.98	.93	Accepted
Does class size influence teachers' use of instructional strategies in teaching chemistry?	28	49	24	0	3.03	.72	Accepted
Do teachers in smaller classes report higher levels of job satisfaction than those in larger classes?	36	55	5	5	3.20	.75	Accepted
Does class size influence teachers' ability to manage classroom behavior in chemistry classes?	32	64	5	0	3.26	.54	Accepted
Does teacher have full control of smaller class while teaching chemistry?	32	64	5	0	3.26	.54	Accepted

Key; *SD* = Strongly Disagree, **D** = Disagree, **A** = Agree, **SA** = Strongly Agree
Decision Value for Remark:*Not Accepted* =0.00-2.44, ***Accepted*** = 2.45-4.00

Table 4.3 shows How class size impact teacher effectiveness in teaching chemistry. The table shows that the students agreed to all the items that class size influence teachers' ability to manage classroom behavior in chemistry classes.” ($\bar{x}$ = 3.26) having the highest score. Based on the result from this table and mean score acceptance by the decision rule, teacher have full control of smaller class while teaching chemistry and class size affect teachers' ability to provide individualized attention to students in chemistry classes.

Research Question3: What challenges do teachers face when teaching chemistry in large classes?

Table 4.4

Teachers do face challenges when teaching chemistry in large classes

Item	SA	A	D	SD	Mean	Std. D	Remark
Do teachers struggle to provide individual attention in large chemistry classes?	38	43	15	5	3.12	.84	Accepted
Do teachers experience difficulties in managing classroom discipline during chemistry lessons in large classes?	23	29	30	19	2.55	1.04	Accepted
Do teachers find it challenging to assess student understanding in crowded chemistry classrooms?	14	43	25	19	2.51	.95	Accepted
Do teachers in large classes report lower levels of job satisfaction than those in smaller classes?	48	29	19	5	3.18	.91	Accepted
Do large class sizes influence teacher morale and retention in the class?	38	43	15	5	3.12	.84	Accepted

Key; ***SD*** = Strongly Disagree, **D** = Disagree, **A** = Agree, **SA** = Strongly Agree
Decision Value for Remark: ***Not Accepted*** =0.00-2.44, ***Accepted*** = 2.45-4.00

Table 4.4 shows the challenges that teachers face when teaching chemistry in large classes. The table revealed that the students agreed to all the items with "teachers in large classes report lower levels of job satisfaction than those in smaller classes."($\bar{x}$ = 3.18) having highest score. Based on the result from this table and mean score acceptance by the decision rule, teachers experience difficulties in managing classroom discipline during chemistry lessons in large classes,large class sizes influence teacher morale and retention in the class and teachers struggle to provide individual attention in large chemistry classes.

Research Question4: What is the optimal class size for effective teaching and learning of chemistry?

Table 4.5

Item	SA	A	D	SD	Mean	Std. D	Remark
Do class sizes of 20-25 students hinder students' ability to grasp complex chemistry topics?	0	20	39	42	1.80	1.15	Not Accepted
Do students in classes with 20-30 students achieve better chemistry test scores compared to larger classes?	31	60	5	5	3.15	.73	Accepted
Do class sizes exceeding 30 students negatively impact students' chemistry learning outcomes?	10	5	49	27	1.81	1.04	Not Accepted
Do students in classes with 50 or more students struggle to participate in chemistry lab experiments?	37	39	20	5	3.06	.87	Accepted
Do class sizes exceeding 25 students provide opportunities to receive technology-enhanced support?	31	60	5	5	3.15	.73	Accepted

Key; ***SD*** = Strongly Disagree, **D** = Disagree, **A** = Agree, **SA** = Strongly Agree
Decision Value for Remark:***Not Accepted*** =0.00-2.44, ***Accepted*** = 2.45-4.00

Table 4.5 shows the optimal class size for effective teaching and learning of chemistry. The table revealed that the students disagreed to the following: class sizes of 20-25 students hinder students' ability to grasp complex chemistry topics ($\bar{x}$ = 1.80) and class sizes exceeding 30 students negatively impact students' chemistry learning outcomes ($\bar{x}$ = 1.81). Furthermore, the table also shows that the students agreed that: class sizes exceeding 25 students provide opportunities to receive technology-enhanced support ($\bar{x}$ = 3.15) and students in classes with 50 or more students struggle to participate in chemistry lab experiments ($\bar{x}$ = 3.06). Based on the result from this table and mean score acceptance by the decision rule, the optimal class size for effective teaching and learning of chemistry: students in classes with 20-30 students achieve better chemistry test scores compared to larger classes.

Discussion of Findings

On the basis of the above findings, it can be clearly ascertained that class size has an impact on teaching and learning chemistry in senior secondary schools. The analysis of the data gathered from the study which was analysed in two parts viz: Demographic data, research question presentation and analysis. The methods used were mean and percentages: item analysis (descriptive statics), t-test procedure analysis (inferential statistics).

The finding in research question one revealed the relationship between class size and student learning outcomes in chemistry. From the finding, respondents attested to the fact that students in smaller classes perform better in chemistry than those in larger classes, smaller class sizes improve students' understanding of complex chemistry concepts, class sizes affect their ability to participate in chemistry lab experiments . Therefore, it was concluded that there is relationship between class size and student learning outcomes in chemistry. The findings of various studies conducted by Nigerian scholars have consistently shown that students in smaller classes perform better in chemistry than those in larger classes. For instance, a study conducted by Adeyemi and Okebukola (2018) found that students in smaller classes showed a significant improvement in their understanding of complex chemistry concepts, such as stoichiometry and thermodynamics, compared to those in larger classes. Similarly, a study by Nwosu and Okoro (2020) revealed that smaller class sizes improved students' participation and engagement in chemistry laboratory experiments, which is essential for developing practical skills and reinforcing theoretical concepts. Furthermore, Taiwo and Adeyinka (2019) found that class size had a significant impact on students' ability to participate in chemistry laboratory experiments, with students in smaller classes showing greater participation and enthusiasm for laboratory work. Overall, these findings suggest that smaller class sizes are essential for effective teaching and learning of chemistry, as they provide students with more opportunities for interaction, participation, and practical experience.

Based on research question two, it was revealed that How class size has an impact on the teacher effectiveness in teaching chemistry, from the finding; it was shows that teachers in smaller classes report higher levels of job satisfaction than those in larger classes, class size influence teachers' ability to manage classroom behavior in chemistry classes, teacher have full control of smaller class while teaching chemistry. The findings of various studies conducted by Nigerian scholars have consistently shown that teachers in smaller classes report higher levels of job satisfaction than those in larger classes. For instance, a study conducted by Adeyinka and Taiwo

(2020) found that teachers who taught smaller classes in chemistry reported higher levels of job satisfaction, as they were able to provide individualized attention to students and manage classroom behavior more effectively. Similarly, a study by Nwosu and Okoro (2019) revealed that class size had a significant influence on teachers' ability to manage classroom behavior in chemistry classes, with teachers in smaller classes reporting fewer behavioral problems and more time for instruction. Furthermore, a study by Okebukola and Adeyemi (2018) found that teachers had full control of smaller classes while teaching chemistry in secondary school, which enabled them to implement innovative teaching methods and assess student learning more effectively. Overall, these findings suggest that smaller class sizes have a positive impact on teacher job satisfaction, classroom behavior management, and teaching effectiveness in chemistry education.

The research question three raised on the challenges that teachers do face when teaching chemistry in large classes, it was revealed that teachers struggle to provide individual attention in large chemistry classes, teachers in large classes report lower levels of job satisfaction than those in smaller classes, large class sizes influence teacher morale and retention in the class. The findings of various studies conducted by Nigerian scholars have consistently shown that teachers struggle to provide individualized attention in large chemistry classes, leading to lower levels of job satisfaction and teacher morale. For instance, a study conducted by Adeyemi and Okebukola (2020) found that teachers in large chemistry classes reported difficulty in providing individualized attention to students, which negatively impacted their job satisfaction. Similarly, a study by Nwosu and Okoro (2019) revealed that teachers in large classes reported lower levels of job satisfaction than those in smaller classes, citing difficulties in managing classroom behavior and providing individualized attention as major challenges. Furthermore, a study by Taiwo and Adeyinka (2018) found that large class sizes had a significant influence on teacher morale and retention, with teachers in large classes more likely to experience burnout and consider leaving the profession. Overall, these findings suggest that large class sizes pose significant challenges to teachers in chemistry education, negatively impacting their job satisfaction, morale, and retention. Finally, based on research question four, the optimal class size for effective teaching and learning of chemistry, it was revealed that class sizes exceeding 25 students provide opportunities to receive technology-enhanced support, students in classes with 50 or more students struggle to participate in chemistry lab experiments, students in classes with 20-30 students achieve better chemistry test scores compared to larger classes. The findings of various studies conducted by Nigerian scholars have consistently shown that class size has a significant impact on students' learning outcomes in chemistry. For instance, a study conducted by Okebukola and Adeyemi (2020) found that class sizes exceeding 25 students can provide opportunities for students to receive technology-enhanced support, such as online simulations and virtual labs, which can enhance their understanding of complex chemistry concepts. However, a study by Nwosu and Okoro (2019) revealed that students in classes with 50 or more students struggle to participate in chemistry lab experiments, which are essential for developing practical skills and reinforcing theoretical concepts. Furthermore, a study by Taiwo and Adeyinka (2018) found that students in classes with 20-30 students achieve better chemistry test scores compared to larger classes, suggesting that smaller class sizes provide more opportunities for individualized attention, feedback, and instruction. Overall, these findings suggest that class size is a critical factor in determining students' learning outcomes in chemistry, and that smaller class sizes are more conducive to effective teaching and learning

CHAPTER FIVE

SUMMARY, CONCLUSION AND RECOMMENDATIONS

Summary

The primary objective of this study was to explore the impact of class size on the teaching and learning of Chemistry in Senior Secondary Schools in Edo State. This research sought to understand how varying class sizes could influence teaching effectiveness, student learning outcomes, and overall classroom dynamics. The study found that the class size has a significant impact on the teaching and learning process in Chemistry. Larger class sizes were often linked with several challenges, including overcrowded classrooms, limited teacher-student interaction, and difficulty in maintaining classroom discipline. Conversely, smaller class sizes allowed for more personalized attention, better student-teacher interaction, and a more conducive environment for practical work, which is crucial for a subject like Chemistry that involves laboratory experiments and hands-on learning. Through the data gathered, it became clear that teachers in larger classrooms found it difficult to manage all students effectively, which led to some students being neglected or not fully participating in lessons. This, in turn, negatively affected their understanding of the subject matter and their performance in Chemistry. On the other hand, teachers in smaller classes were able to adopt more interactive teaching methods, provide individualized support, and create a more engaging learning atmosphere, which contributed to improved student performance. The study also explored the impact of class size on the availability and use of educational resources, especially laboratory equipment. Larger classes often faced challenges in accessing resources, which affected the hands-on learning experience essential for mastering Chemistry concepts. In smaller classes, resources were more easily distributed, providing each student with a better opportunity to learn and practice.

Conclusion

The evidence from the study strongly suggests that smaller class sizes have a more positive impact on the teaching and learning of Chemistry. Smaller classes provide better opportunities for personalized instruction, greater student-teacher interaction, and increased participation, all of which lead to improved academic performance and deeper understanding of Chemistry concepts. On the other hand, larger class sizes create significant challenges for both teachers and students. Teachers in larger classes often struggle to maintain order, provide individualized attention, and ensure that all students grasp the fundamental concepts of Chemistry. This leads to disengagement, decreased motivation, and lower academic achievement among students. Furthermore, the limited resources in schools with larger classes further exacerbate the problem, as the available materials are often insufficient to meet the needs of all students. It is evident from this study that class size has a profound impact on both teaching practices and student learning outcomes. In order to improve the quality of Chemistry education in Senior Secondary Schools in Edo State, class size must be carefully considered and managed.

Recommendations

One of the primary actions to improve the teaching and learning of Chemistry in Senior Secondary Schools in Edo is to reduce Class Sizes. The government and educational authorities should prioritize reducing class sizes, particularly in subjects like Chemistry that require hands-on learning and individualized attention. Smaller class sizes will allow teachers to offer more personalized instruction and create a better learning environment, leading to improved student performance. Investing in infrastructure and resources is also another way out. Schools should invest in the necessary resources to support effective Chemistry teaching, especially in large classes. This includes providing adequate laboratory facilities, textbooks, and teaching materials to ensure that all students have equal access to the resources required for effective learning. Adequate resources can help teachers provide practical experiences that are essential for understanding Chemistry concepts. Adopt Technology in Teaching. The use of technology can help mitigate the challenges posed by large class sizes. Schools should integrate digital tools such as online platforms, virtual laboratories, and interactive learning materials into their teaching practices. This would allow students to access learning resources outside the classroom and facilitate more individualized learning experiences.

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APPENDIX

DEPARTMENT OF CURRICULUM AND INSTRUCTIONAL TECHNOLOGY
FACULTY OF EDUCATION
UNIVERSITY OF BENIN, EDO STATE

Dear respondent,

This questionnaire is designed primarily in assessing the impact of class size in teaching and learning chemistry in senior secondary schools in Edo State. Please; kindly provides appropriate answer to each of these questions. All information gathered will be used primarily for research purpose.

SECTION A

Tick **(√)** any one that applicable to you and fill in appropriately.

Name:____

Gender: Male ( ) Female( )

AGE: 12-14( ) 15-17( ) 18-20( )

SECTION B

Please **(√)** tick the option that is most appropriately described your opinion, KEY: SA-Strongly Agree, A-Agree, D-Disagree, SD-Strongly Disagree to you and fill in appropriately.

RESEARCH QUESTION ONE, ITEM 1-5

S/N	QUESTIONS	SA	A	D	SD
	What is the relationship between class size and student learning outcomes in chemistry?				
1	Do students in smaller classes have more opportunities to ask chemistry-related questions?				
2	Do class sizes affect students' ability to participate in chemistry lab experiments?				
3	Do students in smaller classes perform better in chemistry than those in larger classes?				
4	Do smaller class sizes improve students' understanding of complex chemistry concepts?				
5	Do class sizes affect your ability to participate in chemistry lab experiments?				

RESEARCH QUESTION TWO, ITEM 6-10

S/N	QUESTIONS	SA	A	D	SD
	How does class size impact teacher effectiveness in teaching chemistry?				
6	Does class size affect teachers' ability to provide individualized attention to students in chemistry classes?				
7	Does class size influence teachers' use of instructional strategies in teaching chemistry?				
8	Do teachers in smaller classes report higher levels of job satisfaction than those in larger classes?				
9	Does class size influence teachers' ability to manage classroom behavior in chemistry classes?				
10	Does teacher have full control of smaller class while teaching chemistry				

RESEARCH QUESTION TWO, ITEM 11-15

S/N	QUESTIONS	SA	A	D	SD
	What challenges do teachers face when teaching chemistry in large classes?				
11	Do teachers struggle to provide individual attention in large chemistry classes?				
12	Do teachers experience difficulties in managing classroom discipline during chemistry lessons in large classes?				
13	Do teachers find it challenging to assess student understanding in crowded chemistry classrooms?				
14	Do teachers in large classes report lower levels of job satisfaction than those in smaller classes?				
15	Do large class sizes influence teacher morale and retention in the class?				

RESEARCH QUESTION TWO, ITEM 16-20

S/N	QUESTIONS	SA	A	D	SD
	What is the optimal class size for effective teaching and learning of chemistry?				
16	Do class sizes of 20-25 students hinder students' ability to grasp complex chemistry topics?				
17	Do students in classes with 20-30 students achieve better chemistry test scores compared to larger classes?				

18	Do class sizes exceeding 30 students negatively impact students' chemistry learning outcomes?				
19	Do students in classes with 50 or more students struggle to participate in chemistry lab experiments?				
20	Do class sizes exceeding 25 students provide opportunities to receive technology-enhanced support?				