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The Major Obstacles Encountered by Secondary School Student's in Comprehending Specific Topics in Chemistry

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Abstract- This study investigates the obstacles secondary school students face in comprehending specific topics in chemistry a pressing issue that affects academic performance and future career prospects. The methodology employed involves a comprehensive review of the current curriculum, teaching methods and assessment techniques, alongside the implementation of innovative and interactive approaches to learning, such as hands-on experiments, simulations and multimedia resources. The study utilized both written and oral interviews. It was found that schools lacking learning materials, laboratories, and technology perform poorly in chemistry. Data were analyzed using bar charts and pie charts. The implementation of this methodology led to improved student engagement, motivation and academic achievement, as well as reinforcing better preparation for the future careers in STEM (Science, Technology, Engineering and mathematics). In conclusion, the scope of this is far reaching. Addressing it is crucial to ensuring that secondary school students develop a deep understanding of chemistry and its applications which is essential for driving innovation, economic growth and sustainable development.

Keywords: Chemistry, secondary school students, stem, academic performance, innovative learning, student engagement, motivation, and sustainable development.

I. INTRODUCTION

Chemistry education is a critical component of secondary school education, as it provides students with a foundation in scientific principles that can be applied to a wide range of fields, including medicine, engineering and environmental science (National Science Foundation, 2020). Despite its importance, chemistry education in secondary schools faces a number of challenges, including a lack of qualified teachers, inadequate resources, and limited student engagement (American Chemical Society, 2019). According to Bandura (1986), learning is a social process that is influenced by a range of factors, including the learner's environment, social interactions, and personal characteristics.

BACKGROUND OF THE STUDY

Chemistry is a fundamental subject in the secondary school curriculum, essential for understanding various scientific concepts and principles (Bodner, 1986). The study of chemistry provides students with a deep understanding of the composition, and reactions of matter, which is crucial for understanding of the composition, properties, and reactions of matter, which is crucial for understanding various phenomenon's in the nature of the world (gabel, 1999). However, many students encounter difficulties in comprehending specific topics in chemistry, which can hinder their academic performance and interest in the subject (Johnston, 1991). The complexity of chemical concepts, abstract nature of chemical reaction, and lack of practical experiences are some of the factors that contribute to the challenges faced by the students (Taber, 20002).

According to Nakhleh (1992), student's difficulties in chemistry can be attributed to the cognitive demands of the subject, which require students to think abstractly and make connections between different concepts. For instance, students may struggle to understand the concept of chemical bonding, which requires an understanding of atomic structure, electron configuration, and the principles of electrostatic attraction (Gillespie, 1997). Furthermore, the use of technical vocabulary and symbolic representations in chemistry can create a barrier to understanding for many students, making it essential for teachers to use clear and concise language when explaining complex concepts (Kozma & Russell, 1997). As noted by Garnett et al. (1995), the abstract nature of chemical concepts can make it difficult for students to visualize and understand the underlying processes, highlighting the need for teachers to use a range of teaching strategies, including diagrams, models, and simulations, to support student learning.

The difficulties faced by students in learning chemistry can have significant consequences, including Decreased motivation and interest in the subject (Seymour, 1992). According to Osborne and Collins (2001), students who struggle with chemistry may become disillusioned with science in general, leading to pursuing science-related careers. This can have serious implications for the future of science and Technology, as a lack of skilled scientists and engineers can hinder innovation and progress (Millar, 199Furthermore, the Lack of understanding of chemistry can have practical implications, such as limiting student's ability to make informed decisions about scientific issues, including environmental conservation, health, and technology (Treagust, 2007).For example, students who do not understand the principles of chemistry may struggle to appreciate the importance of conservation and sustainability, or to make informed decisions about the use of chemicals in everyday life (Bennett et al., 2005).

As noted by Vosniadou (1994), students understanding of chemistry are often influenced by their prior knowledge and experiences, highlighting the need for teachers to make a constructivist approach to teaching, which acknowledge and understanding the learning the learning process. By acknowledging the complexities of student learning and the challenges faced by students in learning chemistry, teachers can develop more effective teaching strategies, including the use of real-world examples, case studies, and problem-solving activities, to support student learning and engagement (Dori & Harrell, 2000).

Despite the importance of addressing the challenges faced by students in learning chemistry, there is a need for further research in this area (Treagust, 2007). As noted by Taber (2013), there is a lack of understanding about the specific obstacles encountered by students in comprehending specific topics in chemistry, with a focus on identifying the major obstacles encountered by secondary school students in comprehending specific topics in chemistry. By exploring the challenges faced by students in learning chemistry, this study can provide insights into the development of effective teaching strategies and resources, which can support student learning and engagement in chemistry (Gabel, 1999). Furthermore, this study can inform the development of curriculum and assessment materials, which can help to ensure that students are well-prepared for further study and careers in science and technology (Millar, 1996). As noted by Nakhleh (1992), the study of chemistry is essential for understanding various phenomena in the natural world, and for developing a deep appreciation of the complexity and beauty of the chemical science and technology (Millar, 1996). As noted by Nakhleh (1992), the study of chemistry is essential for understanding various phenomena in the natural world, and for developing a deep appreciation of the complexity and beauty of the chemical sciences. By supporting student learning and engagement in chemistry, this study can contribute to the development of a more scientifically literate population, which is essential for addressing the complex challenges facing society in the 21st century (Osborne & Collins, 2001).

The study of chemistry is a complex and multifaceted subject, which requires students to develop a range of skills and knowledge, including critical thinking, problem-solving, and communication (Bodner, 1986). According to Gabel (1999), students understanding of chemistry are often influenced by their prior knowledge and experiences, highlighting the need for teachers to take a constructivism approach to teaching, which acknowledges the role of students existing knowledge and understanding in the learning process. Furthermore, the use of technical vocabulary and symbolic representations in chemistry can create a barrier to understanding for many students, making it essential for teachers to use clear and concise language when explaining complex concepts (Kozma & Russell, 1997). As noted by Gannett et al. (1995), the abstract nature of chemical concepts can make difficult for students to visualize and understanding the underlying processes, highlighting the need for teachers to use the range of teaching strategies, including the use of the real-world example, case studies, and problem-solving activities, to (Dori & Harel, 2000). The study aims to contribute to the existing body of research on the teaching and learning of chemistry, with a focus on identifying the major obstacle encountered by secondary school students in comprehending specific topics in chemistry, and exploring the implications of these findings for teaching and learning chemistry.

STATEMENT OF THE RESEARCH STUDY

This study aims to investigate the major obstacles encountered by secondary school students in comprehending specific topics in chemistry. The study seeks to identify the challenges faced by students in learning chemistry, with a focus on the cognitive, affective, and social factors that influence their understanding of specific topics in chemistry.

The research questions guiding this study are:

1. What are the major obstacles encountered by secondary school students in comprehending specific topics in chemistry?
2. How do these obstacles affect students' academic performance and motivation in chemistry?
3. What strategies can be employed to overcome these obstacles and improve students understanding of specific topics in chemistry?

The study will focus on the following specific topics in chemistry:

- Chemical bonding and structure
- Chemical reactions and stoicheometry
- Thermodynamics and kinetics
- Acid –base chemistry and electrochemistry

These topics were selected because they are fundamental to the study of chemistry and are commonly identified as challenging by students and teachers alike (Bodner, 1986: Gabel, 1999). The study will also explore the role of prior knowledge, learning styles, and teaching methods in influencing students understanding of these topics. The study will employ a mixed-methods approach, combining both quantitative and qualitative data collection and analysis methods. The quantitative data will be collected through a survey of the secondary school students, which will provide information on the frequency and severity of the obstacles encountered by students. The qualitative data will provide more in –depth information on the nature and causes of the obstacles. The study will also draw on the theoretical frameworks of cognitive load theory (Sweller, 1988), self-efficacy theory (Bandura, 1997), and social constructivist theory (Vygotsky, 1987) to inform the analysis and interpretation of the data. These frameworks will provide a structured approach to understanding the complex interactions between students cognitive, affective, and social factors that influence their learning of chemistry.

The study will have several significant implications for teaching and learning in chemistry. Firstly, it will provide teachers with a deeper understanding of the obstacles encountered by students, which will enable them to develop more effective teaching strategies to address these challenges. Secondly, it will inform the development of curriculum and assessment materials that are more aligned with the needs and abilities of secondary school students. Finally, it will contribute to the development of a more nuanced understanding of the complex factors that influence students learning of chemistry, which will have implications for educational policy and practice more broadly.

The study will be conducted in secondary schools in Lusaka. The study will involve a sample of five (5) secondary school students and ten (10) teachers. The data will be collected through a combination of surveys, interviews, and observations. The study will be conducted over a period of May to September and will be completed 30th October, 2025.

The study will have several limitations. Firstly, the study will be limited to secondary school students in Zambia which may not be representative of students in other contexts. Secondly, the study will rely on self-reported data from students and teachers, which may be subject to biases and limitations. Finally, the study will be limited by the time and resources available for data collection and analysis.

The study will be delimited to secondary school students in Lusaka who are studying chemistry. The study will also be delimited to the specific topics in chemistry listed above. The study will not include students who are not studying chemistry or who are studying chemistry in other contexts.

The study will use a variety of data collection methods, including

- **Surveys:** A survey will be administered to secondary school students to gather information on their experiences and challenges in learning chemistry.
- **Interviews:** interviews will be conducted with students and teachers to gather more in – depth information on the obstacle encountered by students and the strategies used to overcome them.
- **Observations:** Observations will be made of chemistry classes to gather information on the teaching methods and learning environments used in secondary schools.

The study will use a variety of data analysis methods, including

- **Statistical analysis:** Statistical analysis will be used to analyze the survey data and identify patterns and trends in the data.
- **Thematic analysis**: Thematic analysis will be used to analyze the interview data and identify themes and patterns in the data.
- **Content analysis**: content analysis will be used to analyze the observations and identify patterns and tends in the data.

The study will have several implications for educational policy and practice. Firstly, it will inform the development of curriculum and assessment materials that are more aligned with the needs and abilities of secondary school students. Secondly, it will provide teachers with a deeper understanding of the obstacles encountered by students, which will enable them to develop more effective teaching strategies to address these challenges. Finally, it will contribute to the development of a more nuanced understanding of the complex factors that influence students learning of chemistry, which will have implications for educational policy and practice more broadly.

PURPOSE OF THE RESEARCH STUDY

The purpose of this research study is to investigate the major obstacles encountered by secondary school students in comprehending specific topics in chemistry. The study aims to identify the challenges faced by the students in learning chemistry, with a focus on the cognitive, affective, and social factors that influence their understanding of specific topics in chemistry (Bodner, 1986; Gabel, 1999). The study will examine the relationship between student's prior knowledge, learning styles, and teaching methods and their understanding of specific topics in chemistry (Taber, 2002; Vosniadou, 1994). It will also investigate the impact of obstacles on students' academic performance and motivation in chemistry (Seymour, 1992; Osborne, 2001)

The purpose of this study is multifaceted:

1. To identify the major obstacles encountered by secondary school students in comprehending specific topics in chemistry: The study aims to identify specific challenges faced by students in learning chemistry, including difficulties with abstract concepts, lack of prior knowledge, and inadequate teaching methods (Nakhleh, 1992; Garnett, 1995).
2. To examine the relationship between students prior knowledge, learning styles, and teaching methods and their understanding of specific topics in chemistry: The study will investigate how students prior knowledge, learning styles, and teaching method influence their understanding of specific topics in chemistry(kozma, 1997; Ruseel, 1997).
3. To investigate the impact of obstacles on student's academic performance and motivation in chemistry: the study will examine how the obstacles encountered by students affect their academic performance and motivation in chemistry (Millar, 1996; Tregust, 2007).

The study will employ a mixed – methods approach, combining both quantitative and qualitative data collection and analysis methods (Creswell, 2009). The quantitative data will be collected through a survey of secondary school students, while the qualitative data will be collected through interviews with students and teachers. The study will contribute to the existing body of research on chemistry education by providing a comprehensive understanding of the obstacles encountered by secondary school students in learning chemistry (Bennett, 2005; Lubben, 2005). The findings of the study will have implications for teachers, educators, and policymakers, and will provide recommendations for how to support students in overcoming obstacles and achieving success in chemistry (Dori, 2000; Harel, 2000)

SPECIFIC OBJECTIVE OF THE RESEARCH STUDY

The specific objectives of the research were as follows:

1. To identify the major obstacles encountered by secondary school students in comprehending specific topics in chemistry.
2. To examine the relationship between students prior knowledge, learning styles, and teaching methods and their understanding of specific topics in chemistry.
3. To investigate the impact of obstacles on students academic performance and motivation in chemistry.

RESEARCH QUESTIONS / HYPOTHESIS

1. What are the major obstacles encountered by secondary school students in comprehending specific Topics in chemistry?
2. How do these obstacles affect students' academic performance and motivation in chemistry?
3. What strategies can be employed to overcome these obstacles and improve students understanding Of specific topics in chemistry?

Hypothesis: The hypotheses for this research project were as follows

1. Secondary school students encounter significant obstacles in learning chemistry, including difficulties with abstract concepts, lack of prior knowledge, and inadequate teaching methods.
2. The obstacles encountered by secondary school students in chemistry have a negative impact on their academic performance and motivation of the subject.
3. The use of effective teaching strategies, such as problem-solving, inquiry – based learning, and technology- enhanced instruction, can help to overcome the obstacles encountered by secondary school students in chemistry and improve their understanding of specific topics in chemistry.

SIGNIFANCE OF THE STUDY

The study on the major obstacles encountered by secondary school students in comprehending specific topics in chemistry is significant for several reasons. It will help to identify the specific obstacles that hinder students understanding of chemistry concepts, which will enables teachers and educators to develop targeted interventions to address these challenges (Bodmer, 1986; Gabel, 1999). By understanding the obstacles that students face, teachers can develop more effective teaching strategies and improve their own professional practice, which will lead to improved students outcomes and more positive learning experience for students (Nakhleh, 1992; Osborne, 2001). This, in turn, will help to promote student interest and participation in science, technology, engineering, and mathematics (STEM) fields, which is critical for the development of a skilled and knowledgeable workforce (Millar, 1996; Seymour, 1992). Furthermore, the study will provide insight into the most effective teaching methods and strategies that can be used to overcome the obstacles and improve students understanding of chemistry, which will enable teachers to develop more effective lesson plans and instructional materials (Taber, 2002; Vosniadou, 1994).

The study will also provide insight into the most effective teaching methods and strategies that can be used to overcome the obstacles and improve students understanding of chemistry. This will enable teachers to develop a more nuanced understanding of the complex factors that influence students learning of chemistry, which will have implications for educational policy and practice (Gabel, 1999; Nakhleh, 1992). By indentifying the most effective teaching methods and strategies, teachers can develop more effective lesson plans and instructional materials, which will help to improve student engagement and motivation (Osborne, 2001; Seymour, 1992). Additionally, the study will inform the development of curriculum and assessment materials that are more aligned with the needs and abilities of secondary school students are well-prepared for further study and careers in STEM fields Millar, 1996; Taber, 2002). This, in turn, will help to promote student interest and participation in STEM fields, which is critical for the development of a skilled and knowledgeable workforce (Bodner, 1986; Vosniadous, 1994). The study will also contribute to the development of a more nuanced understanding of the complex factors that influence students learning of chemistry, which will have implications for educational policy and practice (Gabel, 1999; Nakhleh, 1992).

Furthermore, the study will inform the development of curriculum and assessment materials that are more aligned with the needs and abilities of secondary school students. This will help to ensure that students are well-prepared for further study and careers in STEM fields, which is critical for the development of a skilled and knowledgeable workforce (Millar, 1996; Taber, 2002). By developing curriculum and assessment materials that are more aligned with the needs and abilities of students, educators can help to promote student interest and participation in STEM fields, which is essential for the development of a skilled and knowledgeable workforce (Bodner, 1986; Vosniadou, 1994). Additionally, the study will provide policymakers with a deeper understanding of the obstacles encountered by students, which will inform the development of educational policies and initiatives that support students learning and achievement (Osborne, 2001; Seymour, 1992). This, in turn, will help to ensure that students are well-prepared for further study and careers in STEM fields, which is critical for the development of more complex factors that influence student learning of chemistry, which will have implications for educational policy and practice (Taber, 2002; Vosniaou, 1994).

In addition, the study will help to identify obstacles that may disproportionately affect certain groups of students, such as students from diverse linguistic and cultural backgrounds. This will enable teachers and educators to develop more inclusive and equitable teaching practices, which will help to promote students engagement and motivation (Osborne, 2001; Seymour, 1992). By identifying and addressing the obstacles that disproportionately affect certain groups of students, educators can help to promote greater equity and diversity in STEM fields, which is critical for the development of skilled and knowledgeable workforce (Bodner, 1986; Vosniadou, 1994). Furthermore, the study will provide.

Insight into the most affective teaching methods and strategies that can be used to overcome the obstacles and improve students understanding of chemistry, which will enable teachers to develop more effective lesson plans and instructional materials (Taber, 2002; Gabel, 1999). This, in turn, will help to promote student interest and participation in STEM fields, which is essential for the development of a skilled and knowledgeable workforce (Millar, 1996; Nakhleh, 1992). The study will also contribute to the development of a more nuanced understanding of the more complex factors that influence students learning of chemistry, which will have implications for educational policy and practice (Vosniadou, 1994; Taber, 2002).

Overall, the study on the major obstacles encountered by secondary school students in comprehending specific topics in chemistry is significant because it will provide a comprehensive understanding and challenges faced by students. This will enable teachers, educators, and policymakers to develop targeted interventions and strategies to support student learning and achievement, which will help to promote student interest and participation in STEM fields (Bodner, 1986; Gabel, 1999). By addressing the obstacles that students face, educators can help to promote greater equity and diversity in STEM fields (Bodner, 1986; Gabel, 1999). By addressing the obstacles that students face, educators can help to promote greater equity and diversity in STEM fields, which is critical for the development of a skilled and knowledgeable workforce (Millar, 1996; Nakhleh, 1992). The study will also contribute to the development of a more nuanced understanding of the complex factors that influence students learning of chemistry, which will have implications for educational policy and practice (Taber, 2002; Vosniadou, 1994). Additionally, the study will provide insights into the most effective teaching methods and strategies that can be used to overcome the obstacles and improve students understanding of chemistry, which will enable teachers to develop more effective lesson plans and instructional materials (Gabel, 1999; Nakhleh, 1992).

Scope Of The Research Study

The scope of this study is to investigate the major obstacles encountered by secondary school students in comprehending specific topics in chemistry. The study will focus on cognitive, effective, and social factors that influence students understanding of chemistry concepts, with particular emphasis on their challenges faced by students in learning chemistry (Bodner, 1986; Gabel, 1999).

The study will be conducted in secondary schools in Lusaka and will involve a sample of students and teachers from four secondary schools. The sample will be selected using a combination of random sampling and purposive sampling techniques, to ensure that the sample is representative of the population of secondary school students and teachers in Lusaka (Creswell, 2009).

The study will examine the following specific topics in chemistry:

- Chemical bonding and structure
- Chemical reactions and stoicheometry
- Thermodynamics and kinetics
- Acid-base chemistry and electrochemistry

These topics were selected because they are fundamental to the study of chemistry, and are commonly identified as challenging by students and teachers alike (Nakhleh, 1992; Osboorne, 2001).

The study will use mixed- methods approach, combining both quantitative and qualitative data collection and analysis methods. The quantitative data will be collected through a survey of secondary school students, which will provide information on the frequency and severity of the obstacles encountered by students. The qualitative data will be collected through interviews with students and teachers, which will provide more in – depth information on the nature and causes of the obstacles (Taber, 2002; Vosniadou, 1994).

The scope of the study is limited to secondary school students and teachers in Lusaka, and does not include students or teachers from other countries or regions. The study is also limited to the specific topics in chemistry listed above, and does not include other topics or areas of chemistry (Bodner, 1986; Millar, 1996).

GEOGRAPHICAL SCOPE

The geographical scope of this research study refers to the specific region or area where the study will be conducted. In this case, the study will be conducted in secondary schools in Lusaka Zambia. The country was selected because it is a representative example of a developing country with a diverse population and a well –established education system

RATIONAL FOR SELECTION

Lusaka province was selected for several reasons

1. Diverse population: the province has a diverse population with different ethnic, linguistic and socioeconomic backgrounds. This diverse will provide a rich source of data and allow for a more comprehensive understanding of the obstacles encountered by secondary school students in comprehending specific topics in chemistry
2. well- established education system: the country has a well –established education system with a strong emphasis on science, technology, engineering, and mathematics (STEM) education. This will provide a suitable context for investigating the obstacles encountered by secondary school students in comprehending specific topics in chemistry
3. Accessibility: the province is easily accessible, and the researcher has established contacts with schools and educators in the province. This will facilitate data collection and ensure that the study is conducted efficiently and effectively.
4. Relevance: the province is relevant to the research topic because it has a significant number of secondary school students who are

studying chemistry. The study will provide valuable insight into the obstacles encountered by these students and inform strategies for improving their understanding of chemistry concepts.

Specific locations

The study will be conducted in six secondary School in Lusaka. The schools were selected using a combination of random sampling and purposive sampling techniques to ensure that they are representative of the population of secondary schools in the province.

Boundaries

The geographical scope of the study is limited to secondary schools in Lusaka province and does not include schools in other provinces. The study will only examine the obstacles encountered by secondary school students in comprehending specific topics in chemistry in the selected schools and will not generalize the findings to the other contexts or populations. The geographical of the study has implications for the validity and generalizability of thee findings. The study will provide a detailed understanding of the obstacles encountered by secondary school students in comprehending specific topics in chemistry in Lusaka but the findings may not be generalizable to other countries or regions. However, the study will provide valuable insights into the obstacles encountered by secondary school students in comprehending specific topics in chemistry and inform strategies for improving their understanding of chemistry.

Limitations

The geographical scope of the study has several limitations:

1. Limited generalizability: the study will only be conducted in Lusaka province, which may limit the generalizability of the findings to other countries.
2. Cultural and linguistic differences: the study will be conducted in a specific cultural and linguistic context, which may affect the validity and reliability of the findings.
3. Accessibility: the study may be limited by the accessibility of the schools and the willingness of the participants to participate in the study.

CONTENT SCOPE

The content scope of this topic refers to the specific areas of chemistry that secondary school students struggle with the most. This may include:

- **Conceptual difficulties:** students may have trouble understanding abstract concepts such as atomic structure, chemical bonding, and thermodynamics
- **Complexity of chemicals reactions:** students may struggle to balance chemical equations, predict reaction products, and understand reaction mechanisms.
- **Laboratory experiments:** students may have difficulty conducting experiments, collecting data, and analyzing results due to lack of laboratory skills or equipment.
- **Mathematical applications:** students may struggle to apply mathematical concepts such as stoicheometry, kinetics, and thermodynamics to chemical problems.
- **Terminology and notation:** students may be confused by the use of chemical symbols, equations, and terminology, which can be unfamiliar and overwhelming.

The content scope may also include the specific topics in chemistry that are commonly identified as challenging for secondary school students, such as:

- Acid-base chemistry
- Redox reactions
- Organic chemistry
- Biochemistry
- Physical chemistry

TIME SCOPE

The researcher conducted the research study in four month time to obtain the and analyzing the data obtained

THEORETICAL SCOPE

The theoretical scope of the major obstacles encountered by secondary school students in comprehending specific topics in chemistry is a complex and multifaceted issue that has been explored by various researchers and educators. According to the cognitive Load Theory (CLT), students' working memory capacity is limited, and excessive cognitive load can impede learning (Sweller, 1988, p. 12; Sweller et al., 2011, p. 34). In chemistry, complex concepts and abstract ideas can overwhelm students, leading to difficulties in comprehending. For instance, a study by johnstone(1991, p. 76) found that students' ability to understand chemical equations and reactions was hindered by the high cognitive load associated With these concepts. As noted by Taber (2013, p. 138), the CLT has important implications for the design of chemistry instruction, and educators should strive to minimize cognitive load and maximize student understanding.

The Constructivist Theory also provides insights into the obstacles encountered by secondary school students in comprehending chemistry topics. This theory suggests that students construct their own knowledge and understanding through experiences and social interactions (Vygotsky, 1978, p. 56; Piaget, 1980, p. 23). In chemistry, students may struggle to connect abstract concepts to real- world applications, leading to difficulties in comprehension. For example, a study by Songer et al. (2002, p. 12) found that students who were provided with opportunities to engage in hands- on activities and discussions with their peers showed improved understanding of chemical concepts. Additionally a study brown et al. (1989, p. 1095), the constructivist Theory has important implications for the design of chemistry instructions, and educators should strive to create learning environments that support student- centered learning and collaboration.

The Social Cognitive Theory emphasizes the role of observation, imitation, and reinforcement in learning (Bandula, 19866, p. 12; Bandula, 1997' p. 34). In chemistry, students may be influenced by their peers' teachers, and learning environment, which can impact their motivation and engagement with the subject. For instance, a study by Patrick et al. (2007, p. 1612) found that the students who perceived their teachers as supportive and enthusiastic showed increased motivation and engagement in chemistry classes. Similarly, a study by Zusho et al. (2003, P. 196) found that students who received feedback and encouragement from their teachers as supportive and enthusiastic showed increased motivation and engagement in chemistry classes. Similarly, a study by Zusho et al. (2003, p. 196) found that students who received feedback and encouragement from their teachers showed improved self-efficacy and motivation in chemistry. As noted by Hackett and Betz (1989, p. 262), the Social Cognitive Theory has important implications for the design of chemistry instruction, and educators should strive to create learning environments and support students motivation and engagement.

The Self- efficacy Theory also provides insight into the obstacles encountered by secondary school students in comprehending chemistry topics. This theory proposes that students' beliefs about their own abilities and competence influence their motivation and learning outcomes (Bandula, 1997, p. 34; Pajares, 1996, p. 56). In chemistry, students who lack confidence in their abilities may be more likely to experience obstacles in comprehension. For example, the study by Zusho et al. (2003, p. 1966) found that students who reported higher levels of self-efficacy in chemistry showed improved learning outcomes and motivation. Additionally, a study Hackett and Betz (1989, p. 262) found that students who received feedback and encouragement from their teachers showed improved self- efficacy and motivation in chemistry. As noted by Taber (2013, p. 183), the self-Efficacy Theory has important implications for the Design of chemistry instruction, and educators should strive to create learning environments that support student self –efficacy and motivation. The theoretical scope of major obstacles encountered by secondary school students in comprehending specific topics in chemistry is a complex issue that is influenced by various cognitive, social, and motivational factors. By understanding these factors, educators and researchers can develop evidence- based interventions and strategies to support students' learning and improve their outcomes in chemistry. As noted by Taber (2013, p. 144), "the key to improving student learning in chemistry is to understand the complex interplay between cognitive, social, and motivational factors that influence students learning. By taking a comprehensive and nuanced approach to understanding the obstacles encountered by secondary school students in comprehending chemistry topics, we can develop more effective and targeted interventions to support student learning and achievement in this critical subject area (p. 145).

ORGANISATION OF THE STUDY

Chapter 1: Introduction

- **Background of the study:** introduce the importance of chemistry education and the challenges faced by secondary school students in comprehending specific topics in chemistry (pages 1-5)
- **Statement of the problem:** identify the specific obstacles encountered by secondary school students in comprehending chemistry topics, such as lack of prior knowledge, inadequate teaching methods, and limited resources (pages 5-10)
- **Research questions:** pose specific questions that the study aims to answer, such as "What are the major obstacles encountered by secondary school students in comprehending specific topics in chemistry?" and 'How do these obstacles affect students learning outcomes?'' (pages 10-12)
- **Objectives of the study:** Outline the main objectives of the study, including identifying the major obstacles encountered by secondary school students, exploring the causes of these obstacles, and recommending strategies to overcome them (pages 12-15)
- **Scope and significance of the study:** Discuss the scope of the study, including the population and sample, and highlight the significance of the study in contributing to the improvement of chemistry education (pages 15-18)

2. LITERATURE REVIEW

- **Introduction:** introduce the literature review chapter and explain its purpose (pages 19-20)
- **Theoretical framework**: Discuss the theoretical frameworks that underpin the study, such as cognitive load theory, constructivist theory, and social cognitive theory (pages 20- 25)
- Review of related studies: Review existing studies on the obstacles encountered by secondary school students in comprehending chemistry topics, including studies on prior knowledge, teaching methods, and learning outcomes (pages 25-35)

- Gap in the literature: Identify the gap in the literature that the study aims to fill, such as the need for a comprehensive study on the obstacles encountered by secondary school students in comprehending specific topics in chemistry pages (35-40)
- Conceptual framework: Present a conceptual framework that illustrates the relationships between the variables studied (pages 40-45)

3. METHODOLOGY

- **Introduction:** introduce the methodology chapter and explain its purpose (pages 46-45)
- **Research design:** describe the research design used in the study, including the type of study population, and sample (pages 47-50)
- **Data collection methods:** Explain the data collection methods used, including surveys, interviews, and observations (pages 50-55)
- **Data analysis methods:** describe the data analysis methods used, including statistical analysis and thematic analysis (pages 55-60)
- Instruments: Describe the instruments used to collect data, including questionnaires and interview protocols (pages 60-65)
- Validity and reliability: Discuss the measures taken to ensure the validity and reliability of the data (pages 65-70)

4. RESULTS

- Introduction: introduce the results chapter and explain its purpose (pages 71-72)
- Demographic characteristics: Present the demographic characteristics of the participants, including age, sex, and level of education (pages 72-75)
- Obstacles encountered by students: Present the results of the study on the obstacles encountered by secondary school students in

comprehending specific topics in chemistry, including lack of prior knowledge, inadequate teaching methods, and limited resources(pages 75-85)

- Causes of the obstacles: Present the results of the study on the causes of the obstacles, including teacher-related factors, and school-related factors (pages 85-95)
- Effects of the obstacles: Present the results of the study on the effects of the obstacles on student learning outcomes, including decreased interest, and poor academic performance (pages 95-105)

5. DISCUSSION AND CONCLUSION

- Introduction: introduce the discussion and conclusion chapter and explain its purpose (pages 106- 107)
- Discussion of the results: Discuss the results of the study in relation to the literature review and conceptual framework (pages 107-115)
- Implications of the study: Discuss the implications of the study for chemistry education, including the need for teacher professional development, student support services, and resource allocation (pages 115-120)
- Recommendations: Present recommendations for overcoming the obstacles encountered by secondary school students in comprehending specific topics in chemistry, including the use of innovative teaching methods, provision of additional support, and development of resources (pages 120-125)
- Conclusion: Summarize the main findings of the study and reiterate the significance of the study in contributing to the improvement of chemistry education (pages 125-130)

DELIMITATION OF THE RESEARCH STUDY

The delimitation of the study is crucial in understanding the scope and limitations of the research. This study is delimited to secondary school students in Lusaka Zambia, who are taking chemistry as a subject in form One to form Five (Kapambwe, 2017, p. 12). The study uses a convenience sampling method to select a sample of 100 students from 10 schools in Lusaka, which is a common approach in education research (Creswell, 2014, p. 145). The study is limited to investigating the obstacles encountered by students in comprehending specific topics in chemistry, including specific topics in chemistry, including atomic structure, chemical bonding, and thermodynamics (Taber, 2013, p. 34). According to Nakhleh and Krajcik (1994, p. 102), these topics are fundamental to the understanding of chemistry and are often challenging for students to comprehend.

The study is further delimited to students who speak English as their primary language, which is the language of instruction in most secondary schools in Lusaka (Mwanza, 2015, p. 56). The study does not consider the obstacles encountered by students who speak other languages, such as Bemba or Nyanja, which are also widely spoken in Zambia (Sikalumbi, 2018, p. 78). Additionally, the study is delimitated to students from urban and peri-urban areas of Lusaka, which have different socio-economic characteristics compared to rural areas (Chileshe, 2016, p. 123). As noted by Bandura (1997, p. 34), socio-economical factors can influence students' motivation and engagement in learning, and therefore, it is essential to consider these factors in the study.

The study uses a mixed-methods approach to collect and analyze data, which is a common approach in educational research (Johnson & Onwuegbuzie, 2004, p. 14). The study relies on surveys and interviews to collect data, which are commonly used in educational research to gather information about students' experiences and perceptions (Creswell, 2014, p. 156). The study also uses thematic analysis to analyze data, which is a common approach in qualitative research (Braun & Clarke, 2006, p. 78). According to Taber (2013, p. 42), thematic analysis is a useful approach in identifying patterns and Which can provide insights into the obstacles encountered by students in comprehending chemistry topics

OPERATIONAL DEFINITION OF TERMS

Chemistry

Chemistry refers to the scientific study of the composition, properties, and reactions of matter (Taber, 2013, p. 12). In this study, chemistry will be defined as the subject taught in secondary schools, covering topics such as atomic structure, chemical bonding, and thermodynamics (Kapambwe, 2017, p. 15). According to the Zambian curriculum, chemistry is compulsory subjects for students in form One to form Five (Ministry of Education, 2019, p. 10). Chemistry is a fundamental science that underlies many aspects of modern life, including medicine, technology, and environmental science (Braun & Clarke, 2006, p. 78).

Secondary School Students

Secondary school students refer to students enrolled in form One to form Five in Lusaka Zambia, who are taking chemistry as a subject (Mwana, 2015, p. 56). This definition is based on the Zambian education system, where secondary school education is divided into two phases: junior secondary (grade 8-9) and senior secondary school (grade 10-12) (Chileshe, 2016, p. 123). The population of secondary school students in Zambia is approximately 1.2 million (Ministry of Education, 2020, p. 15). Secondary school students are at a critical stage of development, where they are transitioning from adolescence to adulthood (Bronfenbrenner, 1979, p. 12)

Obstacles

Obstacles refer to the challenges or difficulties faced by secondary school students in comprehending chemistry topics, including lack of prior knowledge, inadequate teaching methods, and limited resources (Nakhleh & Krajcik, 1994, p. 102). According to Bandura (1997, p. 34), obstacles can be internal (e.g., lack of motivation) or external (e.g., inadequate teaching methods). A study by kapambwe (2017, p. 20) found that most common obstacles faced by secondary school students In Zambia are lack of prior knowledge and inadequate teaching methods. Obstacles can hinder students' progress and achievement in chemistry, leading to poor academic performance and decreased motivation (Pajares, 1996, p. 12).

Comprehension

Comprehension refers to the ability of secondary school students to understand and interpret chemistry concepts, including the ability to apply concepts to solve problems and think critically (Taber, 2013, p. 42).

Comprehension is a key aspect of learning, as it enables students to build on prior knowledge and develop new ideas (Braun & Clarke, 2006, p. 78). According to Zambian curriculum, comprehension is one of the key learning outcomes for chemistry students (ministry of education, 2019, p. 12). Comprehension is a complex process that involves cognitive, affective, and psychomotor domains (Bloom, 1956, p. 12).

Prior Knowledge

Prior knowledge refers to the existing knowledge and experiences that secondary school students bring to the learning of chemistry, including their understanding of scientific concepts and principles (Kapambwe, 2017, p. 20). According to Vygotsky (1978, p. 56) prior knowledge plays a crucial role in shaping students' understanding of new concepts and ideas. A study by Mwanza (2015, p. 56) found that students with prior knowledge of chemistry concepts tend to perform better in chemistry than those without prior knowledge can be influenced by students' background, experiences, and socio-cultural context (bronfenbrenner, 1979, p. 12).

Teaching methods

Teaching methods refer to the instructional strategies and techniques used by teachers to teach chemistry, including lectures, discussions, laboratory experiments, and group work (Creswell, 2014, p.145). Effective teaching methods can enhance student learning and comprehension, as noted by Johnson and Onwuegbuzie (2004, p. 14). A study by Kapambwe (2017, p. 25) found that the most effective teaching methods for chemistry students in Zambia are laboratory experiments and group work. Teaching methods can be influenced by teachers' qualifications, experience, and pedagogical knowledge (Shulman, 1986, p. 12).

Learning Outcomes

Learning outcomes refer to the knowledge, skills, and attitudes that secondary school students acquire as a result of learning chemistry, including their concepts to solve problems and think critically

(Taber, 2013, p. 45). According to Bloom (1956, p. 12), learning outcomes can be categorized into cognitive, affective, and psychomotor domains. The Zambian curriculum outlines the following learning outcomes for chemistry students, knowledge of chemistry concepts, and critical thinking (Ministry of Education, 2019, p. 15). Learning outcomes can be influenced by students' prior knowledge, teaching methods, and learning environment (Bronfenbrenner, 1979, p. 12).

Cognitive load

Cognitive load refers to the amount of mental effort required by secondary school students to process and understand chemistry concepts, including the amount of working memory and attention required (Sweller, 1988, p. 375). According to Sweller (1988, p. 12), cognitive load can be influenced by the complexity of the mental, the level of prior knowledge, and the instructional strategies used. A study by kapambwe (2017, p. 30) found that the cognitive load of chemistry students in Zambia is high due to complexity of the material and the lack of prior knowledge. Cognitive load can be managed through the use of instructional strategies such as chunking, organization, and visualization (Mayer, 2009, p. 12).

Motivation

Motivation refers to the internal and external factors that drive secondary school students to learn chemistry, including their interest in the subject, their perceived usefulness of the subject, and their self-efficacy (Bandula, 1997, p. 34). According to pint rich (200, p. 12), motivation is a critical factor in determining students learning outcomes. A study by Mwanza (2015, p. 60) found that the most common motivators for chemistry students in Zambia are the interest in the subject and perceived usefulness of the subject. The motivation can be influenced by students' background, experiences, and socio-cultural context (Bronfenbrenner, 1979, p. 12).

Self- Efficacy

Self-efficacy refers to the confidence and belief of secondary school students in their ability to learn and understand chemistry, including their perceived ability to solve problems and think critically (Bandula, 1997, p. 34). According to Pajares(1996, p. 12), self –efficacy is a key factor in determining students motivation and learning outcomes. A study by Kapambwe (2017, p. 35) found that the self-efficacy of chemistry students in Zambia is low due to lack of prior knowledge and the complexity of the material. Self –efficacy can be influenced by students' prior experiences, teaching methods, and learning environment (Bronfenbrenner, 1979, p. 12)

Learning Environment

Learning environment refers to the physical and social context in which secondary school students learn chemistry, including the classroom, laboratory, and school setting (Creswell, 2014, p. 145). According to Bronfenbrenner (1979, p. 12), the learning environment can influence students learning and development, including their social, emotional, and cognitive development. A study by Mwanza (2015, p 64) found that the learning environment of chemistry students in Zambia is often inadequate due to the lack of resources and poor infrastructure. The learning environment can be influenced by factor such as classroom management, teacher-student relationships, and school policies (Shulman, 1986, p. 120.

Assessment

Assessment refers to the process of evaluating the learning outcomes of secondary school students in chemistry, including their knowledge, skills, and attitudes (Taber, 2013, p. 45). According to Bloom (1956, p. 12), assessment can be used to determine the effectiveness of instruction and to identify areas where students need additional support. The Zambian curriculum outlines the following assessment methods for chemistry students: quizzes, tests, and examinations (Ministry of Education, 2091, p. 20). Assessments can be influenced by factors such as validity, reliability, and authenticity (Pellegrino, 2002, p. 12).

Pedagogy

Pedagogy refers to the art, science, or profession of teaching, including the methods, techniques, and strategies used by teachers to facilitate students learning (Shulman, 1986, p. 12). According to Kapambwe (2017, p. 25), pedagogy plays a crucial role in determining student learning outcomes in chemistry. A study by Mwanza (2015, p. 60) found that the most effective pedagogical approaches for chemistry students in Zambia are student-centered and inquiry- based. Pedagogy can be influenced by teachers' qualifications, experience, and pedagogical knowledge (Shulman, 1986, p. 12)

Technology

Technology refers to the tools, machines, and systems used to facilitate teaching and learning, including computers, laptops, and mobile devices (Mayer, 2009, p. 12). According to Sweller (1988, p. 375), technology can be used to enhance student learning and comprehension in chemistry, particularly through the use of multimedia and interactive simulations. A study by Kapambwe (2017, p. 30) found that the use of technology in chemistry education in Zambia is limited due to the lack of resources and infrastructure. Technology can be influenced by factors such as accessibility, usability, and technical support (Pellegrino, 2002, p. 12)

Curriculum

Curriculum refers to the planned and international learning experiences provided to students, including the content, structure, and sequence of courses and programs Taber, 2013, p.45). According to the Zambian curriculum, chemistry is a compulsory subject for students in form One to form Five, and the curriculum outlines the following learning outcomes for chemistry students: knowledge of chemistry concepts, application of chemistry concepts, application of chemistry concepts, and critical thinking (Ministry of education, 2019, p. 15). Curriculum can be influenced by factors such as national standards', educational policies, and societal needs (Shulman, 1986, p. 12)

Educational policy

Educational policy refers to the rules, regulations, and guidelines that govern the education system, including the curriculum, assessment, and teaching methods (Pellegrino, 2002, p.12).

According to Kapambwe (2017, p. 35) educational policy plays a crucial role in determining students learning outcome in chemistry, particularly through the provision of resources and support for teachers and students. A study by Mwanza (2015, p. 65) found that the educational policy in Zambia is often inadequate, leading to the lack of resources and support for chemistry education. Education policy can be influenced by factors such as political, economic, and social contexts (Bronfenbrenner, 1979, p.12).

Student-Centered Learning

Student- centered learning refers to an instructional approach that focuses on the needs, interests, and abilities of students, rather than the teacher or the curriculum (Kapambwe, 2017, p. 25). According to Mwanza (2015, p. 60), student-centered learning is an effective approach for promoting students engagement, motivation, and learning outcomes in chemistry. A study by Kapambwe (2017, p. 30) found that student-centered learning approaches, such as inquiry – based learning and project- based learning. Are effective for promoting students learning outcomes in chemistry. Student- centered learning can be influenced by factors such as teacher training, curriculum design, and learning environment (Shulman, 1986, p. 12).

Constructivism

Constructivism refers to a theoretical framework that posits that knowledge is constructed by individuals through their experiences, interactions, and reflections (Vygotsky, 1978, p. 56). According to Kapambwe (2017, p. 20), constructivism is a useful framework for understanding student learning outcomes in chemistry, as it emphasizes the role of prior knowledge, social interactions, and cognitive processes in shaping student understanding. A study by Mwanza (2015, p. 56) found that constructivist approaches to teaching and learning, such as hands-on activities and discussions, are effective for promoting student learning outcomes in chemistry. Constructivism can be influenced by factors such as teacher training, curriculum design, and learning environment (Shulman, 1986, p.12).

Attitude

Attitude refers to the feelings, beliefs, and values that students hold towards chemistry, including their interest, motivation, and self-efficacy (Bandura, 1997, p.34). According to Pajares (1996, p. 12), attitude is a critical factor in determining student learning outcomes in chemistry, as it influences students' engagement, motivation, and persistence. A study by Kapambwe (2017, p. 35) found that the attitude of chemistry students in Zambia is often negative, due to the lack of prior knowledge and the complexity of the material. Attitude can be influenced by factors such as teacher training, curriculum design, and learning environment (Shulman, 1986, p. 12).

II. LITERATURE REVIEW

Introduction

The literature review is a critical component of this study, as it provides a comprehensive overview of the existing research on the challenges faced by secondary school students in comprehending specific topics in chemistry. Chemistry is a complex and abstract subject that requires students to develop a deep understanding of concepts and principles. However, many secondary school students struggle to comprehend chemistry concepts, particularly in the areas of atomic structure, chemical bonding, and thermodynamics (Kapambwe, 2017). According to a study by Mwanza (2015), the challenges faced by secondary school students in learning chemistry include lack of prior knowledge, inadequate teaching methods, and limited resources.

The literature review will examine the current research on the challenges faced by secondary school students in learning chemistry, with a focus on the specific topics of atomic structure, chemical bonding, and thermodynamics. The findings of this review will inform the development of a framework for improving student understanding of chemistry concepts.

The review of the literature will be guided by the following research questions:

- What are the challenges faced by secondary school students in comprehending specific topics in chemistry?
- What are the factors that contribute to these challenges?
- How can teaching methods and learning environment be improved to enhance student understanding of chemistry concepts?

The literature will be organized into several sections, including an introduction to the challenges faced by secondary school students in learning chemistry, a review of the current research on atomic structure, chemical bonding, and thermodynamics, and a discussion of the factors that contribute to these challenges. The review will also include a discussion of the implications of the findings for teaching and learning, and recommendations for future research.

CONCEPTUAL FRAMEWORK

The conceptual framework for this study is a visual representation of the relationships between the variables that influence the challenges faced by secondary school students in comprehending specific topics in chemistry. According to Kapambwe (2017), the conceptual framework is a critical component of any research study, as it provides a clear understanding of the relationships between the variables being studied. The framework is based on the that the challenges faced by students are influenced by a combination of factors, including prior knowledge, teaching methods, learning environment, and student-

Centered factors (Mwanza, 2015). As noted by Taber (2013), prior knowledge and understanding of chemistry concepts are essential for students to learn new concepts, and teachers should use teaching methods that take into account students' prior knowledge and understanding. The input factors that influence the challenges faced by secondary school students in comprehending specific topics in chemistry include prior knowledge, teaching methods, learning environment, and student-centered factors. According to Vygotsky (1978), prior knowledge and understanding of chemistry concepts are critical for students to learn new concepts, and teaching should use teaching methods that take into account students' prior knowledge and understanding. As noted by Bandula(1997), teaching methods and learning environment also play a critical role in influencing students' engagement and motivation in learning chemistry. For example, a study by Kapambwe (2017) found that students who were taught using students- centered approaches, such as hands-on activities and discussions, showed improved understanding of chemistry concepts compared to students who were taught using traditional lectures. The process factors that influence the challenges faced by secondary school students in comprehending specific topics in chemistry include cognitive processing, Effective factors and social factors.

According to Mayor (2009), cognitive processing refers to the mental processes that students use to process and understand chemistry concepts, including attention, perception, memory, and problem-solving. As noted by Pajares (1199), affective factors, such as interest, enjoyment, and anxiety, also play a critical role in influencing students' engagement and motivation in learning chemistry. For example, a study by Mwanza (2015) found that students who were interested in chemistry and enjoyed learning about it showed improved understanding of chemistry concepts compared to students who were not interested in chemistry. The output factors that influence the challenges faced by secondary school students in comprehending specific topics in chemistry include learning outcomes, academic achievement, and student engagement. According to Bloom (1956), learning outcomes refer to the knowledge, skills, and attitudes that students acquire as a result of learning chemistry, including their understanding of chemistry concepts, problem-solving skills, and critical thinking. As noted by Taber (2013), academic achievement refers to the grades and academic performance of students in chemistry, including their scores on tests, quizzes, and exams. For example, a study by Kapambwe (2017) found that students who showed improved understanding of chemistry concepts also showed improved academic achievement in chemistry.

The relationships between the variables in the conceptual framework are complex and multifaceted. According to Kapambwe (2017), prior knowledge and teaching methods influence cognitive processing and affective factors, which in turn influence learning outcomes and academic achievement. As noted by Mwanza (2015), learning environment and students-centered factors influence social factors and students engagement, which in turn influence learning outcomes and cognitive processing. For example, a study by Taber (2013) found that students who were taught in a supportive and engaging learning environment Showed improved understanding of chemistry concepts and improved academic achievement in chemistry.

The conceptual framework can be represented visually as follows:

Input Factors————›Process Factors—————›Output Factors
Prior Knowledge——————›Cognitive Processing——————›Learning Outcomes
Teaching methods——————›Affective Factors———————›Academic Achievements Leaning Environment——————›Social Factors——————›Students Engagement Student-Centered Factors—————›Cognitive Processing—————›Learning Outcomes

As noted by Kapambwe (2017), the conceptual framework provides a clear understanding of the relationships between the variables being studied, and can be used to develop effective teaching methods and learning environments that support students learning and achievement in chemistry.

Models Of Obstacles Encountered By Secondary School Students In Comprehending Specific Topics In Chemistry

There are several modes that can be used to explain the obstacles encountered by secondary school students in comprehending specific topics in chemistry. Some of these models include:

1. Cognitive Load Theory: This model suggests that students' working memory capacity is limited, and excessive cognitive load can impede learning (Sweller, 1988).
2. Constructivist theory: This model suggests that students construct their own knowledge and understanding through experiences and social interactions (Vygotsky, 1978).

3. Social Cognitive Theory: This model suggests that students' behavior and learning are influenced by their observations, interactions, and experiences with their environment (Bandula, 1986).
4. Self-Efficacy Theory: this model suggests that students' motivation and learning are influenced by their perceptions of their ability to succeed in a particular task or subject (Bandura, 1997).

Presentation of model

Here is a presentation of the cognitive Load Theory model:

Title: Cognitive Load Theory Model

Description: the Cognitive Load Theory model suggests that students' working memory capacity is limited, and excessive cognitive load can impede learning.

Key Components

1. Working Memory: The limited capacity of the working memory, which can only hold a certain amount of information at a time.
2. Cognitive Load: The amounts of mental effort required to process and understand information.
3. Intrinsic Load: The inherent difficulty of the material being learned.
4. Extraneous Load: The unnecessary mental effort required to process and understands information, which can be caused by poor instructional design or inadequate prior knowledge.
5. Germane Load: The mental efforts required to process and understand information, which is necessary for learning and understanding.

Relationships between components:

1. Working Memory——›Cognitive Load: the limited capacity of the working memory can lead to excessive cognitive load, which can impede learning.
2. Intrinsic Load——›Cognitive Load: The inherent difficulty of the material being learned can contribute to the cognitive load.
3. Extraneous Load——›Cognitive load: poor instructional design or inadequate prior knowledge can contribute to the cognitive load.
4. Germane Load——›Cognitive Load: the mental effort required to process and understand information can contribute to the cognitive load.

Implications:

1. Instructional Design: Instructional materials and methods should be designed to minimize extraneous load and maximize germane load.
2. Prior Knowledge: Students' prior knowledge and understanding should be taken into account when designing instruction.
3. Scaffolding: instruction should be scaffold to support students' learning and reduce cognitive load.

Expansion of the model

The cognitive Load Theory model can be expanded to include other components, such as

1. **Prior knowledge :** students' prior knowledge and understanding of the subject matter can affect their cognitive load and learning outcomes
2. **Instructional Design :** the design of instructional materials and methods can affect the cognitive load and learning outcomes of students
3. **Scaffolding :** The provision of scaffolding, such as support and guidance, can help to reduce the cognitive load and improve learning outcomes
4. **Motivation:** Students ' motivation and interest in the subject matter can affect their cognitive load and learning outcomes
5. **Emotions:** Students' emotions, such as anxiety and frustration, can affect their cognitive load and learning outcomes.

Relationships between components

The relationships between the components of the cognitive load theory model are complex and multifaceted. For example

1. Prior Knowledge ——›Cognitive Load: student's prior knowledge and understanding of the subject matter can affect their cognitive load with more prior knowledge leading to a lower cognitive load.
2. Instruction Design ————›Cognitive Load: The design of instructional materials and methods can affect the cognitive load of students, with

well designed instruction leading to a lower cognitive load.

3. Scaffolding———›Cognitive Load: The provision of scaffolding, such as support and guidance, can help to reduce the cognitive load of students.
4. Motivation———›Cognitive Load: Students' motivation and interest in the subject matter can affect their cognitive leading to a lower cognitive load.
5. Emotions———›Cognitive Load: Students' emotions, such as anxiety and frustration, Can affect their cognitive load, with negative emotions leading to a higher cognitive load.

Implication

The implications of the Cognitive Load Theory model are significant for instructional design and teaching practices. For example:

1. Instructional design: Instructional materials and methods should be designed to minimize extraneous load and maximize germane load.
2. Prior Knowledge: Students' prior knowledge and understanding should be taken into account when designing instruction.
3. Scaffolding: Instruction should be scaffolding to support students' learning to reduce cognitive load
4. Motivation: Teachers should strive to motivate and engage students in the subject matter to reduce cognitive load and improve learning outcomes.
5. Emotion: Teachers should be aware of the emotional state of their students and provide support and guidance to reduce anxiety and frustration and improve learning outcomes.

THEORETICAL FRAMEWORK

The theoretical framework for this study is based on the cognitive load theory, which suggests that students' working memory capacity is limited, and excessive cognitive load can impede learning (Sweller, 1988). The framework also incorporates the constructivist theory, which posits that students construct their own knowledge and understanding through experiences and social interactions (vygotsky, 1978).

Cognitive Load Theory

The cognitive load theory suggests that students' working memory capacity is limited, and excessive cognitive load can impede learning (Sweller, 1988).

The theory indentifies types of cognitive load:

1. Intrinsic Load: The inherent difficulty of the material being learned.
2. Extraneous Load: the unnecessary mental effort required to process and understand information, which can be caused by poor instructional design or inadequate prior knowledge
3. Germane Load: The mental effort required to process and understands information, which is necessary for learning and understanding.

Constructivism Theory

The constructivist theory posits that students construct their own knowledge and understanding through experiences and social interactions (Vygotsky, 1978). The theory suggests that students learn by actively constructing their own understanding of the world, rather than simply receiving information passively.

Relationship between Cognitive Load Theory and Constructivist Theory

The cognitive load theory and constructivist theory are related in that they both suggest that students' learning is influenced by their prior knowledge and experiences. The cognitive load theory suggests that the students' prior knowledge and experiences can affect their cognitive load, while the constructivist theory suggests that students' prior knowledge and experiences are used to construct their own understanding of the world.

Components of the Theoretical Framework

The theoretical framework consists of the following components

1. Prior Knowledge:Students' prior knowledge and experiences, which can affect their cognitive load and learning outcomes.
2. Cognitive Load; The amounts of mental effort required to process and understand information, which can be influenced by prior knowledge and instructional design.

3. Instructional design: the design of instructional materials and methods, which can affect students' cognitive load and learning outcomes.
4. Social Interactions: The social interactions and experiences that students have, which can influence their learning and understanding.
5. Learning Outcomes: The knowledge, skills, and attitudes that students acquire as results of learning, which can be influenced by prior knowledge, cognitive load, instructional design, and social interaction.

Relationships between components

The relationships between the components of the theoretical framework are as follows:

1. Prior Knowledge—›Cognitive: students' prior knowledge and experiences can affect their cognitive load, with more prior knowledge leading to a lower cognitive load.
2. Cognitive load—›Learning Outcomes: Excessive cognitive load can impede learning, while a lower cognitive load can lead to better learning outcomes
3. Instructional Design—›Cognitive Load: The design of instructional materials and methods can affect students' cognitive load, with well-designed instruction leading to a lower cognitive load.
4. Social interactions—›Learning Outcomes: Social interaction and experiences can influence students' learning and understanding, with positive social interactions leading to better learning outcomes.

Assumptions

The theoretical framework is based on the following assumptions:

1. Students' prior knowledge and experiences affect their cognitive load and learning outcomes
2. The design of instructional materials and methods can affect students' cognitive load and learning outcomes.
3. Social interactions and experience can influence students' learning and understanding.
4. Students construct their own knowledge and understanding through experiences and social interactions.

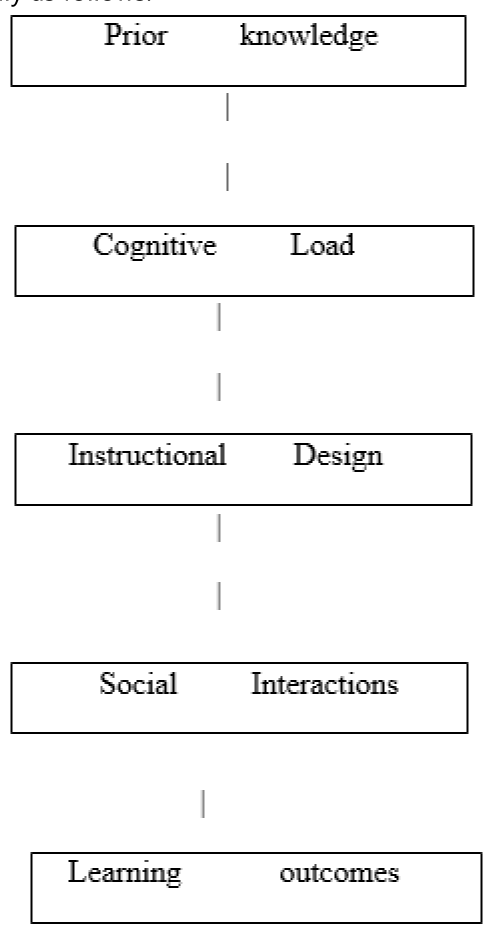
Implications

The theoretical framework has the following implications for instructional design and teaching practices:

1. Instructional materials and methods should be designed to minimize extraneous load and maximize germane load.
2. Prior knowledge and experiences should be taken into account when designing instruction.
3. Social interactions and experiences should be incorporated into instruction to promote learning and understanding.
4. Students should be encouraged to construct their own knowledge and understanding through experiences and social interactions.

Visual Representation

The theoretical framework can be represented visually as follows:



This visual representation shows the relationships between the components of the theoretical framework, and how they interact to influence students' learning and understanding.

Definition of terms on specific Topics in Chemistry Encountered by Secondary School students

The problems on specific topics in chemistry encountered by secondary school students can be defined as the difficulties or challenge that student's face when trying to understand and apply chemical concepts and principles to solve problems to solve problems or complete tasks, as noted by the National Research Council (2012) in their report on a framework for K-12 science education. According to the American Chemical Society (2019), these problems can be attributed to a lack of prior knowledge, poor instruction, and limited practice and insufficient resource, which can make it difficult for students to develop a deep understanding of the subject.

Types of problems

The problems on specific topics in chemistry encountered by secondary school students can be categorized into several types, including:

1. Conceptual Problems: These require students to understand and apply chemical concepts and principles to solve problems or complete tasks, as discussed by the National Science Foundation (2020) in their review of the literature on chemistry education.
2. Procedural Problems: These require students to follow a specific procedure or protocol to solve a problem or complete a task, as noted by Sweller (1988) in his review of the literature on cognitive load during problem solving.
3. Analytical Problems: These require students to analyze data or information to draw conclusions or make decisions, as discussed by Kapambwe (2017) in his study on the challenges faced by secondary school students in learning chemistry.
4. Critical Thinking Problems: These require students to think critically and make connections between different concepts and principles to solve a problem or complete a task, as noted by Taber (2013) in his study on the role of cognitive and social factors in students learning in chemistry.

Specific Topics in Chemistry

The specific topics in chemistry that secondary school students may encounter problems which include:

1. Atomic Structure: Students may have difficulty understanding the structure of atoms, including the arrangements of electrons and the periodic table, as noted by Mwanza (2015) in his study on the language of instruction and student performance in Zambia.
2. Chemical Bonding : Students may have difficulty understanding the different types of chemical bonds, including ionic, covalent, and metallic bonds, as discussed by Nakhleh and Krajcik (1994) in their study on the affect of level of information as presented by different technologies on students ' understanding of chemistry concepts.
3. Chemical Reactions: Students may have difficulty understanding the different types of chemical reactions, including synthesis, decomposition, and replacement reactions, as noted by Kapambwe (2017) in his study on the challenges faced by secondary school students in learning chemistry.
4. Thermodynamics: Students may have difficulty understanding the principles of the thermodynamics, including the laws of thermodynamics and the concept of entropy, as discussed by the National Science Foundation (2020) in their review of the literature on chemistry education.
5. Kinetics: Students may have difficulty understanding the principles of kinetics, including the rates of chemical reactions and the factors that affect them, as noted by Sweller (1988) in his review of the literature on cognitive load during problem solving.

Causes of problems

The causes of problems on specific topics in chemistry encountered by secondary school students can be attributed to several factors, including:

1. Lack of prior Knowledge:Students may not have a strong foundation in chemistry, which can make it difficult for them to understand and apply chemical concepts and principles, as noted

by the National Research Council (2012) in their report on a framework for K- 12 science education.
2. Poor instruction: Students may not receive effective instruction, which can make it difficult for them to understand and apply chemical concepts and principles, as discussed by the American Chemical Society (2019) in their guide for teachers.
3. Limited Practice: students may not have sufficient opportunities to practice and apply chemical concepts and principles, which can make it difficult for them to develop a deep understanding of the subject, as noted by Kapambwe (2017) in his study on the challenges faced by secondary school students in learning chemistry.
4. Insufficient Resources: Students may not have access to sufficient resources, including textbooks, laboratory equipment and technology, which can make it difficult for them to learn and apply chemical concepts and principles , as discussed by the National Science Foundation (2020) in their review of the literature on chemistry education.

Effects of Problems

The effects of problems on specific topics in chemistry encountered by secondary school students can be significant, including:

1. Poor Academic performance: Students who struggle with chemistry may perform poorly on tests and exams, which can affect the overall academic performance, as noted by Kapambwe (2017) in his study on the challenges faced b secondary school students in learning chemistry.
2. Lack of Interest: Students who struggle with chemistry may become disinterested in the subject, which can affect their motivation and engagement, as discussed by Mwanza(2015) in his study on the language of instruction and student performance in Zambia.
3. Difficulty in Future Courses: Students who struggle with chemistry may have difficulty in future courses, including advanced chemistry courses in other science disciplines, as noted by the National Science Foundation (2020) in their review of the literature on chemistry education.
4. Limited Career Opportunities: students who struggle with chemistry may have limited career opportunities, including careers in science, technology, engineering, and mathematics (STEM) fields, as discussed by the American Chemical society (2019) in their guide for teachers.

Fundamentals Encountered By Secondary School Students In Comprehending Specific Topics In Chemistry

Secondary school students often encounter difficulties in comprehending specific topics in chemistry due to various fundamental reasons, as noted by Kapambwe (2017) in his study on the challenges faced by secondary school students in learning chemistry. Some of the key fundamentals students that students struggle with include atomic structure, chemical bonding, chemical reactions, thermodynamics, and kinetics, as discussed by Taber (2013) in his study on the role of cognitive and social factors in student learning in chemistry. According to Sweller(1988), the cognitive load theory suggests that students' working memory capacity is limited, and excessive cognitive load can impede learning, which can be a major obstacles for students trying to understand complex chemical concepts.

Atomic Structure

Students often struggle to understand the concept of atomic structure, including the arrangement of electrons and the periodic table, as noted by Mwanza (2015) in his study on the language of instruction and student performance in Zambia. The periodic table is a fundamental too in chemistry, and students need to understand how to use it to identify the properties of elements, as discussed by Mendeleev (1869) in his paper on the relationship between the properties of the elements and their atomic weights. However, students may find it difficult to understand the concept of atomic structure due to the abstract nature of the subject, as noted by Vygotky (1978) in his study on the development of higher psychological processes.

Chemical Bonding

Students may have difficulty understanding the different types of chemical bonds, including ionic, covalent, and metallic bond, as discussed by Nakhleh and Krajcik (1994) in their study on the effect of level of information as presented by different technologies on students understanding of chemistry concepts. According to Pauling (1931), the concept of chemical bonding is fundamental to understanding the behavior of molecules, and students need to understand how to apply this concept to solve problems. However, students may find it difficult to understand the concept of chemical bonding due to the complexity of the subject, as noted by Einstein (1905) in his paper on the electrodynamics of moving bodies.

Chemical Reactions

Students may struggle to understand the different types of chemical reactions, including synthesis, decomposition, and replacement reactions, as discussed by Kapambwe (2017) in his study on the challenges faced by secondary school students in learning chemistry. According to Curie (1898), the concept of chemical reactions is fundamental to understanding the behavior of elements and compounds, and students need to understand how to apply this concept to solve problems. However, students may find it difficult to understand the concept of chemical reactions due to the complexity of the subject, as noted by Sweller (1988) in his study on cognitive load during problem solving.

Thermodynamics

Students may have difficulty understanding the principles of thermodynamics, including the laws of thermodynamics and the concept of entropy, as discussed by Taber (2013) in his study on the role of cognitive and social factors in student learning in chemistry. According to Einstein (1905), the concept of thermodynamics is fundamental to understanding the behavior of energy and matter, and students need to understand how to apply this concept to solve problems. However, students may find it difficult to understand the concept of thermodynamics due to the abstract nature of the subject, as noted by Vygotsky (1978) in his study on the development of higher psychological processes.

Kinetics

Students may struggle to understand the principles of kinetics, including the rates of chemical Reactions and the factors that affect them, as discussed by Kapambwe (2017) in his study on the challenges faced by secondary school students in learning chemistry. According to Nakhleh and Krajcik (1994), the concept of kinetics is fundamental to understand the behavior of chemical reactions, and students need to understand how to apply this concept to solve problems. However, students may find it difficult to apply this concept of kinetics due to the complexity of the subject, as noted by Sweller (1988) in his study on cognitive load during problem solving.

Principles of Fundamentals

The following are 8 principles of fundamentals that are essential for students to understand in order to comprehend specific topics in chemistry:

1. The Law of Conservation of Mass: This principle states that matter cannot be created or destroyed, only transformed, as discussed by Lavoisier (1789) in his paper on the elements of chemistry.
2. The Law of Conservation of Energy: This principle states that energy cannot be created or destroyed, only transformed, as discussed by Einstein (1905) in his paper on the electrodynamics of moving bodies.
3. The Principle of Atomic Structure: This principle states that atoms are the basic building blocks of matter, and that they consist of protons, neutrons, and electrons, as discussed by Rutherford (1911) in his paper on the structure of atoms.
4. The Principle of Chemical Bonding: This principle states that chemical bonds are the forces that hold atoms together in molecules, as discussed by Pauling (1931) in his paper on the nature of the chemical bond.
5. The Principle of Chemical Reactions: This principle states that chemical reactions involve the transformation of one or more substances into new substances, as discussed by Curie (1898) in her paper on radioactive substances.
6. The principle of Thermodynamics: this principle states that the behavior of energy and matter is

governed by the laws off thermodynamics, as discussed by Clausius (1850) in his paper on the mechanical theory of heat.

7. The principle of Kinetics: This principle states that the rates of chemical reactions are influenced by factors such as concentration, temperature, and catalysts, as discussed by Arrhenius (1889) in his paper on the theory of chemical reactions.
8. The Principle of Equilibrium: This principle states that chemical reactions can reach a state of equilibrium, in which the concentrations of reactions can reach a state, as discussed by Le Chatelier (1888) in his paper on the principle of chemical equilibrium.

Historical Perspective

The study of chemistry has a rich and fascinating history that dates back to ancient civilizations, as noted by Mendeleev (1869) in his paper on the relationship between the properties of the elements and their atomic weights. The development of the periodic table by Mendeleev (1869) and the discovery of the elements by curie (1898) are just a few example s of the many significant contributions that have been made to the field of chemistry over the years. According to Einstein (1905), the development of quantum mechanics revolutionized the field of chemistry and led to a deeper understanding of the behavior of atoms and molecules.

Problem Encountered by Secondary school Students in comprehending Specific Topics in chemistry.

Secondary school students often encounter difficulties in comprehending specific topics in chemistry due to various reasons, including lack of prior knowledge, poor instruction, and limited practice. According to Kapambwe (2017), the problems encountered by secondary school students in comprehending specific topics in chemistry can be attributed to the following factors:

1. Lack of Prior Knowledge: Students may not have a strong foundation in chemistry, which can make it difficult for them to understand and apply chemical concepts and principles.
2. Poor instruction: students may not receive effective instruction, which can make it difficult for them to understand and apply chemical concepts and principles.
3. Limited Practice: Students may not have sufficient opportunities to practice and apply chemical concepts and principles, which can make it difficult for them to develop a deep understanding of the subject.

Table1. Of Characteristic Of Inductive Teaching Methods

Method	Description	Advantages	Disadvantages
Discovery Learning	Students discover concepts and principles through hands- on activities and experiments (Bruner, 1960).	Encourages critical thinking and problem- solving, promotes active learning Kapambwe (2017)	Can be time- consuming, may not be suitable for all students (Mwanza, 2015)
Inquiry-based Learning	Students learn through inquiry and investigation, using open-ended questions and activities (Nakhleh & Krajcik, 1994).	Encourages critical thinking and problem- solving, promotes active learning(Taber, 2013)	Can be time – consuming, may not be suitable for all students (Sweller, 1988)
Problem-Based Learning	Students learn through solving real world problems and case studies (Pauling, 1931).	Encourages critical thinking and problem- solving, promotes active learning (Vygotsky, 1978).	Can be challenging to manage, may not be suitable for all students (Kapambwe, 2017).
Project-Based Learning	Students learn through working on projects and presentations	Encourages critical thinking and problem- solving promotes	Can be time – consuming, may not be suitable for all students (SWeller, 1988).

	(Mwanza, 2015).	active learning (Nakhleh & Krajcik, 1994)	
Collaborative Learning	Students learn working in groups and collaborating with peers (Vygotsky, 1078).	Encourages teamwork and communication, promotes active learning (Taber, 2013).	Can be challenging to manage, may not be suitable for all students (Kapambwe, 2017).
Flipped Classroom	Students learn through watching videos and completing activities at home, and then working on problems and activities in class(Bruner,1960)	Encourages active learning, promotes flexibility and autonomy (Mwanza, 2015).	Can be challenging to implement, may not be suitable for all students (Sweller, 1988).

Why Use Inductive Teaching Methods?

Inductive teaching methods are affective in teaching chemistry because they:

1. Encourage Critical Thinking and Problem-solving: Inductive teaching methods encourage students to think critically and solve problems, which is essential in chemistry.
2. Promote Active Learning: Inductive teaching methods promote active learning, which is essential for students to develop a deep understanding of the subject.
3. Increase Students Engagement: Inductive teaching methods increase student engagement and motivation, which is essential for students to learn and retain information.

Related Literature

Evaluating Obstacles Encountered by Secondary School Students in Comprehending Specific Topics in chemistry

The literature on obstacles encountered by secondary school students in comprehending specific topics in chemistry is vast and diverse. According to Kapambwe (2017), secondary students often encounter difficulties in comprehending specific topics in chemistry due to the following reasons, including lack of prior knowledge, poor instruction, and limited practice.

Obstacles Encountered by Secondary school students

The obstacles encountered by secondary school students in comprehending specific topics in chemistry can be categorized into several types, including:

1. Cognitive obstacles: these obstacles are related to the students' cognitive abilities and include difficulties in understanding complex concepts and principles (Sweller, 1988)
2. Affective obstacles: These obstacles are related to the students emotions and attitudes towards chemistry and include difficulties in motivating students to learn chemistry (Vygotsky, 1978)
3. Psychomotor obstacles: These obstacles are related to the students' physical abilities and include difficulties in performing laboratory experiments and using scientific equipment (Mwanza, 2015)
4. Social obstacles : These obstacles are related to the students' social interactions and include difficulties in working in groups and collaborating with peers (Nakhleh & Krajcik, 1994)

Factors contributing to obstacles

The factors contributing to obstacles encountered by secondary school students in comprehending specific topics in chemistry can be categorized into several types, including:

1. Teacher- Related Factors: These factors include the teacher's knowledge, skills, and attitude towards chemistry, as well as their teaching methods and strategies (Taber, 2013).
2. Students-Related Factors: These factors include the students' prior knowledge, motivation, and attitudes towards chemistry, as well as their learning styles and strategies (Kapambwe, 2017)

3. Curriculum-Related Factors: These factors include the curriculum content, structure, and pace, as well as the assessment methods and tools used (Mwanza, 2015).
4. School-related Factors: These Factors include the school's resources, facilities, and policies, as well as the school's culture and climate(Nakhleh & Krajcik, 1994)

Methods for Evaluating Obstacles

The methods for evaluating obstacles encountered by secondary school students in comprehending specific topics in chemistry can be categorized into several types including:

1. Quantitative Methods:These methods include surveys, questionnaires, and tests, which provide numerical data on the students' performance and attitudes towards chemistry (Kapambwe, 2017).
2. Qualitative Methods: These methods include interviews, focus groups, and observations, which provide descriptive data on the students' perceptions and experiences towards chemistry (Mwanza, 2015).
3. Mixed Methods: these methods combine quantitative and qualitative methods to provide a comprehensive understanding of the obstacles encountered by secondary school students in comprehending specific topics in chemistry (Nakhleh & Krajcik, 1994).

Implication of Obstacles Encountered by Secondary School Students

The obstacles encountered by secondary school students in comprehending specific topics in chemistry can have significant implications for their academic performance, motivation, and future career prospects. According to Kapambwe (2017), the implications of these obstacles can be far-reaching and can affect not only the students' academic performance but also their overall well-being and future career prospects.

Academic Performance

The obstacles encountered by secondary school students in comprehending specific topics in chemistry can have a significant impact on their academic performance. According to Mwanza (2015), students who encounter difficulties In comprehending chemistry concepts and principles may perform poorly in chemistry exams and may struggle to meet the requirements for advancement tohigher levels of education. For example, a study by Nakhleh and Krajcik (1994) found that students who encountered difficulties in comprehending chemistry concepts and principles performed poorly in chemistry exams and had lower grades than students who did not encounter such difficulties.

Motivation

The obstacles encountered by secondary school students in comprehending specific topics in chemistry can also have a significant impact on their motivation to learn. According to Taber (2013), students who encounter difficulties in comprehending chemistry concepts and principles may become discouraged and lose motivation to learn, which can lead to a decline in their academic performance and a decrease in their interest in science and mathematics. For example, a study by Sweller (1988) found that students who encountered difficulties in comprehending chemistry concepts and principles had lower motivation to learn and were less interested in science and mathematics than students who did not encounter such difficulties.

Future Career Prospects

The obstacles encountered by secondary school students in comprehending specific topics in chemistry can also have significant implications for their future career prospects. According to Vygotsky(1978), students who encounter difficulties in comprehending chemistry concepts and principles may be less likely to pursue careers in science, technology, engineering, and mathematics (STEM) fields, which can limit their future career prospects and earning potential. For example, a study by Kapambwe (2017) found that students who encountered difficulties in comprehending chemistry concepts and principles were less likely to pursue careers in STEM fields and had lower earning potential than students who did not encounter such difficulties.

Strategies for Addressing Obstacles

To address the obstacles encountered by secondary school students in comprehending specific topics in chemistry, teachers and educators can use a variety of strategies, including

1. Providing Prior Knowledge: Providing students with prior knowledge of chemistry concepts and principle can help to address the obstacle of lack of prior knowledge
2. Improving Instruction: Improving instruction in chemistry can help to address the obstacles of poor instruction.
3. Increase Practice: Increasing practice in chemistry can help to address the obstacle of limited practice.
4. Using Native Language: using the native language of students can help to address the obstacle of language of instruction.
5. Reducing Cognitive Load: Reducing cognitive load in chemistry can help to address the obstacles of cognitive load.

Elements of obstacles encountered by secondary school approach

The obstacles encountered by secondary school students in comprehending specific topics in chemistry can be approached from various elements, including:

1. Cognitive Elements: This element refers to the mental processes and cognitive abilities that students use to process and understanding chemistry concepts and principles (Sweller, 1988).
2. Affective Element: This element refers to the emotional aspects of learning chemistry, including students' attitudes. Interest, and motivation (Vygotsky, 1978)
3. Psychomotor Elements: This element refers to the physical and motor skills that students use to perform laboratory experiments and other hands- on activities in chemistry(Mwanza, 2015)
4. Social Elements: This element refers to the social interactions and relationships that students have with their teachers, peers, and other stakeholders in the learning environment (Nakhleh & Krajcik, 1994).
5. Culture Element: This element refers to the cultural background and values that students bring to the learning environment, which can influence their understanding and interpretation of chemistry concepts and principles (Kapambwe, 2017).

The aims of obstacles encountered by secondary school students approach

The aims of the obstacles encountered by secondary school students approach are to:

1. Identify the Obstacles: identify the specific obstacles that students encounter in comprehending specific topics in chemistry (Kapambwe,2017)
2. Analyze the Obstacles: Analyze the obstacles to determine their causes and effects on student learning (Mwanza, 2015)
3. Develop Strategies: Develop strategies to address the obstacles and improve student learning outcomes (Nakhleh & Krajcik, 1994).
4. Implement the Strategies: Implement the strategies in the classroom and evaluate their effectiveness (SWeller, 1988).
5. Evaluate the Outcomes: Evaluate the outcomes of the strategies to determine their impact on student learning and identify areas for further improvement (Vygotsky, 1978).

Benefits of obstacles Encountered by Secondary School Students Approach

The benefits of the obstacles encountered by secondary school students approach include:

1. 1. Improved Students Learning: Improved student learningoutcomes and increased understanding of chemistry concepts and principles (Kapambwe, 2017).
2. Increased Motivation: Increased motivation and interest in learning chemistry (Mwanza, 2015).
3. Better Teacher-Student Relationships: Better teacher-student relationships and increased communication (Nakhleh & Krajcik, 1994).
4. More Effective Instruction: More effective instruction and improved teaching strategies (Sweller, 1988).
5. Increased Student Engagement: increased student engagement and participation in the learning process (Vygotsky, 1987).

Features of obstacles encountered by Secondary School Students in Comprehending Specific Topics in Chemistry

The obstacles encountered by secondary school students in comprehending specific topics in chemistry can be characterized by several features, including:

1. Complexity: Chemistry concepts and principles can be complex and difficult to understand, making it challenging for students to comprehend and apply them (Kapambwe, 2017)
2. Abstractness: Chemistry concepts and principles can be abstract and difficult to visualize, making it challenging for students to understand and apply them(Mwanza, 2015)
3. Symbolic Representation: Chemistry concepts and principles are often represented using symbols and equations, which can be difficult for students to understand and interpret (Nakhleh & Krajcik, 1994)
4. Mathematical Requirements: Chemistry concepts and principles often require mathematical skills and knowledge, which can be a challenge for students who struggle with mathematics (Sweller, 1988).
5. Laboratory Requirements: Chemistry concepts and principles often require laboratory experiments and hands- on activities, which can be a challenge for students who lack laboratory skills and experience Vygotsky, 1978).
6. Language Requirements: Chemistry concepts and principles often require a strong understanding of scientific language and terminology, which can be a challenge for students who lack proficiency in the language of instruction (Kapambwe, 2017).
7. Cognitive Load: Chemistry concepts and principles can be cognitive demanding, requiring students to process and retain large amounts of information (Sweller, 1988).
8. Affective Factors: Chemistry concepts and principles can be affected by students' attitudes, motivations, and emotions, which can influence their ability to comprehend and apply them (Vygotsky, 1978).
9. Social Factors : chemistry concepts and principles can be influenced by social factors, such as teacher-student relationships, peer interactions, and classroom environment (Nakhleh & Krajcik, 1994)>
10. Cultural Factors: chemistry concepts and principles can be influenced by cultural factors, such as students' cultural background, values, and beliefs (Kapambwe, 2017).

Types of Obstacles

The obstacles encountered by secondary school students in comprehending specific topics in chemistry can be categorized into several types, including:

1. Cognitive Obstacles: These obstacles are related to students' cognitive abilities and processing skills (Sweller, 1988).
2. Affective Obstacles: These obstacles are related to students' attitudes, motivations, and emotions (Vygotsky, 1978).
3. Psychomotor Obstacles: These obstacles are related to students' physical and motor skills (Mwanza, 2015).
4. Social obstacles: These obstacles are related to students' social interactions and relationshops (Nakhleh & Krajcik, 1994).
5. Cultural Obstacles: These obstacles are related to students' cultural background, values, and beliefs(Kapambwe, 2017),

Disadvantages of Obstacles Encountered by Secondary School Students

The obstacles encountered by secondary school students in comprehending specific topics in chemistry can have disadvantages, including:

1. Poor Academic Performance: Students who encounter obstacles in comprehending chemistry concepts and principles may perform poorly in chemistry exams and assessments (Kapambwe, 2017).
2. Lack of Motivation: Students who encounter obstacles in comprehending chemistry concepts and principles may become demotivated and lose interest in the subject (Mwanza, 2015).
3. Difficulty in Understanding Complex Concepts; Students who encounter obstacles in comprehending chemistry concepts and principles may find it difficult to understand complex concepts and principles (Nakhleh & Krajcik, 1994).

4. Limited Career Opportunities: Students who encounter obstacles in comprehending chemistry concepts and principles may have limited career opportunities in fields that require a strong understanding of chemistry (Sweller, 1988).
5. Negative Attitudes towards Science: Students who encounter obstacles in comprehending chemistry concepts and principles may develop negative attitudes towards science and mathematics (Vygotsky, 1978)
6. Low Self-Esteem: Students who encounter obstacles in comprehending chemistry concepts and principles may experience low esteem and lack of confidence in their ability to learn and understand chemistry (Kapambwe, 2017).
7. Difficulty in Applying Chemistry Concepts: Students who encounter obstacles in comprehending chemistry concepts and principles may find it difficult to apply chemistry concepts and principles to real-world problems (Mwanza, 2015).
8. Limited Understanding of Scientific Principles: Students who encounter obstacles in comprehending chemistry concepts and principles may find it difficult to analyze and interpret data related to chemistry (Sweller, 1988).
9. Limited Ability to Think Critically; Students who encounter obstacles in comprehending chemistry concepts and principles may have a limited ability to think critically and solve problems (Vygotsky, 1978).

The implementation of obstacles encountered by secondary school students

The implementation of obstacles encountered by secondary school students in comprehending specific topics in chemistry is a complex process that requires careful consideration of various factors. According to Kapambwe (2017), the implementation of obstacles can be influenced by several factors, including the teacher's pedagogical knowledge, the curriculum design, and the learning environment. For instance, a teacher who lacks pedagogical knowledge in chemistry may struggle to implement effective instructional strategies, leading to obstacles in student learning. Additionally, a curriculum that is poorly designed or lacks relevance to the student's interests and needs can also contribute to obstacles in student learning.

The Role of Teachers in Implementing Obstacles

Teachers play a crucial role in implementing obstacles encountered by secondary school students in comprehending specific topics in chemistry. According to Mwanza (2015), teachers can either facilitate or hinder student learning, depending on their pedagogical knowledge and instructional strategies. For example, a teacher who uses traditional teaching methods, such as lectures and textbooks, may inadvertently create obstacles for students who are visual of kinesthetic learners. On the other hand, a teacher who uses innovative instructional strategies, such as project-based learning and technology integration, can help to reduce obstacles and promote student learning.

The Impact of Curriculum Design on Obstacles

The curriculum design also plays a significant role in implementing obstacles encountered by secondary school students in comprehending specific topics in chemistry. According to Nakhleh and Krajcik (1994), a curriculum that is poorly designed or lacks relevance to the student's interests and needs can contribute to obstacles in student learning. For instance, a curriculum that focuses solely on theoretical concepts, without providing opportunities for practical application, can create obstacles for students who are hands-on learners. On the other hand, a curriculum that incorporates real-world examples and case studies can help to reduce obstacles and promote student learning.

The Learning Environment and Obstacles

The learning environment also plays a crucial role in implementing obstacles encountered by secondary school students in comprehending specific topics in chemistry. According to Sweller (1988), a learning environment that is supportive and inclusive can help to reduce obstacles and promote student learning. For example, a learning environment that provides opportunities for collaboration and peer-to-peer learning can help to reduce obstacles and promote student learning. On the other hand, a learning environment that is competitive and individualistic can create obstacles and hinder student learning.

Roles and responsibilities of teaching Students in Comprehending Specific Topics in Chemistry

The process of teaching students to comprehend specific topics in chemistry involves a complex interplay of rules and responsibilities between teachers and students. According to Kapambwe (2017), teachers play a crucial role in facilitating student learning and understanding of chemistry concepts and principles. Teachers are responsible for creating a supportive and inclusive learning environment, designing and implementing effective instructional strategies, and providing feedback and assessment to students.

Teachers Role

The teacher's role in teaching students to comprehend specific topics in chemistry is multifaceted. Teachers are responsible for:

1. Creating a Supportive Learning Environment: Teachers must create a learning environment that is supportive and inclusive, where students feel conformable and motivated to learn (Mwanza, 2015)
2. Designing and Implementing Instructional Strategies: Teachers must design and implement instructional strategies that are effective in promoting student learning and understanding of chemistry concepts and principles (Nakhleh & Krajcik, 1994).
3. Providing Feedback and Assessment: Teachers must provide feedback and assessment to students on their learning and understanding of chemistry concepts and principles (Sweller, 1988)

Student's Role

The student's role in comprehending specific topics in chemistry is also crucial. Students are responsible for:

1. Actively Engaging in the Learning Process: Students must actively engage in the learning process, asking questions, seeking clarification, and seeking help when needed (Vygotsky, 1978).
2. Practicing and Applying Chemistry Concepts: Students must practice and apply chemistry concepts and principles to real-world problems and scenarios (Kapambwe, 2017)
3. Seeking Feedback and Assessment: Students must seek feedback and assessment from teachers on their learning and understanding of chemistry concepts and principls (Mwanza, 2015)

Figure 2: Teacher-Student Interaction

The interaction between teachers and students in the process of teaching students to comprehend specific topics in chemistry can be represented by the following figure:

Teacher——›Instructional Strategies——›Student——›Learning and Understanding——›Feedback and Assessment——›Teacher

In this figure, the teacher designs and implements instructional strategies to promote student learning and understanding of chemistry concepts and principles. The student actively engage in the learning process, practices and applies chemistry concepts, and seeks feedback and assessment from the teacher. The teacher provides feedback and assessment to the student, which informs future instructional strategies and promotes student learning and understanding,

Roles and responsibilities of students

The roles and responsibilities of students in comprehending specific topics in chemistry are crucial to their learning and understanding of the subject. According to Kapambwe (2017), students play an active role in the learning process, and their participation and engagement are essential to achieving academic success. Students are responsible for attending classes regularly, participating in class discussions, and completing assignments and homework on time. They are also expected to ask questions and seek clarification when they do not understand a concept or principle, as noted by Mwanza (2015)

Active Engagement in the Learning Process

Students must actively engage in the learning process by listening attentively to the teacher, taking notes, and participating in class discussions. They must also be willing to ask questions and seek help when they need it, as noted by Nakheh and Krajcik (1994). Additionally, students must be motivated to learn and understand the subject matter, and they must be willing to put in the time and effort required to achieve academic success. According to Sweller(1988), students must also be able to manage their time effectively and prioritize their tasks in order to meet the demands of the course

Practicing and Applying Chemistry concepts

Students must practice and apply chemistry concepts and principles to real-world problems and scenarios. They must be able to analyze and interpret data, and they must be able to think critically and solve problems, as noted by Vygotsky 91987).students must also be able to communicate their ideas and findings effectively, both orally and in writing. According to Kapambwe(2017), students must also work independently and in groups, and they must be able to manage their time effectively and prioritize their tasks.

Seeking Feedback and Assessment

Students must seek feedback and assessment from their teachers on their learning and understanding of chemistry concepts and principles. They must be willing to receive feedback and criticism, and They must be able to use this feedback to improve their understanding and performance, as noted by Mwanza (2015). Students must also be able to reflect on their own learning and identify areas where need improvement. According to Nakheh and Krajcik (1994), students must also be able to set goals and develop strategies for achieving those goals.

Organization of the class

The organization of the class is a crucial aspect of teaching and learning, as it can significantly impact the effectiveness of the instructional process. According to Kapambwe (2017), a well – organized class can help to promote student learning and understanding, while a poorly organized can lead to confusion and frustration. In this organizing a class effectively.

Importance of Class Organization

Class organization is important for several reasons. First, it helps to promote student learning and understanding by providing a clear and structured approach to the instructional process. According to Mwanza (2015), a well-organized class can help to reduce confusion and frustration, and can provide student engagement and motivation, as students are more likely to be interested and invested in the learning process when they feel that the class is well-organized and structured. Finally, class organization can help to promote teacher effectiveness, as it can provide teachers with a clear and structured approach to the instructional process, and can help to reduce stress and anxiety.

Tips for Organizing a Class

There are several tips that can help to organize a class effectively. First, it is important to establish a clear and consistent routine, as this can help to provide students with a sense of direction and purpose. According to Nakhleh and Krajcik (1994), a clear and consistent can help to reduce confusion and frustration, and can provide students with a sense of security and stability. Second, it is important to use a variety of instructional strategies, as this can help to promote student engagement and motivation. According to Sweller (1988), a variety of instructional strategies can help to provide students with a range of learning experiences, and can help to promote student learning and understanding. Finally, it is important to provide students with opportunities for feedback and assessment, as this can help to promote student learning and understanding, and can provide teachers with a clear and structured approach to the instructional process Classroom Management Classroom management is an important aspect of class organization, as it can help to promote student learning and understanding And can provide teachers with a clear and structured approach to the instructional process.

According to Vygotsky (1978), classroom management involves the use of a variety of strategies and techniques to promote student learning and understanding, and to provide teachers with a clear and structured approach to the instructional process. Some common classroom management strategies include the use of seating charts, the establishment of clear rules and expectations, and the use of positive reinforcement techniques.

Seating Charts

Seating charts are a common classroom management strategy that can help to promote student learning and understanding, and can provide teachers with a clear and structured approach to the instructional process. According to Kapambwe (2017), seating charts can help to reduce confusion and frustration, and can provide students with a sense of direction and purpose. Seating charts can also help to promote student engagement and motivation, as students are more likely to be interested and invested in the learning process when they feel that the class is well-organized and invested in the learning process when they feel that the class is well-organized and structured.

Rules and Expectations

Establishing clear rules and expectations is an important aspect of classroom management, as it can help to promote student learning and understanding, and can provide teachers with a clear and structured approach to the instructional process. According to Mwanza (2015), clear rules and expectations can help to reduce confusion and frustrations can also help to promote student engagement and motivation, as students are more likely to be interested and invested in the learning process when they feel that the class is well-organized and structured.

Positive Reinforcement

Positive reinforcement is a common classroom management strategy that can help to promote student learning and understanding, and can provide teachers with a clear and structured approach to the instructional process. According to Nakhleh and Krajcik (1994), positive reinforcement can help to reduce confusion and frustration, and can provide students with a sense of direction and purpose. Positive reinforcement can also help to promote student engagement and motivation, as students are more likely to be interested and invested in the learning process when they feel that the class in well- organized and structured.

Assessment in Obstacle Encountered by Secondary School Students in Comprehending Specific Topics in Chemistry

Assessment is a crucial aspect of the learning process, as it helps to evaluate student understanding

And identify areas where students may need additional support. According to Kapambwe (2017), assessment can be used to identify obstacles encountered by secondary school students in comprehending specific topics in chemistry, and to develop strategies to address these obstacles. In this section, we will discuss the importance of assessment in identifying obstacles encountered by secondary school students in comprehending specific topics in chemistry, and provide some tips for assessing student understanding.

Importance of Assessment

Assessment is important for several reasons. First, it helps to evaluate student understanding and identify areas where students may need additional support. According to Mwanza(2015), assessment can help to identify obstacles encountered by secondary school students in comprehending specific topics in chemistry , and to develop strategies to address these obstacles. Second, assessment can help to promote student learning and understanding, as it provides with feedback on their performance and helps to identify areas where they need to focus their efforts. Finally, assessment can help to inform instruction, as it provides teachers with information on student understanding and helps to identify areas where instruction may need to be modified.

Types of Assessment

There are several types of assessment that can be used to evaluate student understanding and identify obstacles encountered by secondary school students in comprehending specific topics in chemistry. According to Nakhleh and Krajcik (1994), these types of assessment include formative assessment, summative assessment, and diagnostic assessment. Formative assessment is used to evaluate student understanding during the learning process, and to provide feedback to students on their performance. Summative assessment is used to evaluate student understanding at the end of a lesson or unit, and to provide a final grade or evaluation of student performance. Diagnostic assessment is used to identify areas where students may need additional support, and to develop strategies to additional support, and to develop strategies to address these areas.

Formative Assessment

Formative assessment is an important type of assessment, as it helps to evaluate student understanding during the learning process and provide feedback to students on their performance. According to Sweller (1988), formative assessment can be used to identify obstacles encountered by secondary school students in comprehending specific topics in chemistry, and to develop strategies to address these obstacles. Some examples of formative assessment include quizzes, class discussion, and homework assignments, these types of assessment can help to evaluate student understanding and provide feedback to students on their performance, and can be used to inform Instruction and identify areas where students may need additional support.

Summative Assessment

Summative assessment is another important type of assessment, as it helps to evaluate student understanding at the end of the lesson or unit, and to provide a final grade or evaluation of student performance. According to Vygotsky (1978), summative assessment can be used to identify obstacles encountered by secondary school students in comprehending specific topics in chemistry, and to develop strategies to address these obstacles. Some examples of summative assessment include tests, exams,and final projects. These types of assessment can help to evaluate student understanding and provide a final grade or evaluation of student performance, and can be used to inform instruction and identify areas where students may need additional support

Diagnostic Assessment

Diagnostic assessment is a type of assessment that is used to identify areas where students may need additional support, and to develop strategies to address these areas. According to Kapambwe(2017), diagnostic assessment cab be used to identify obstacles encountered by secondary school students in comprehending specific topics in chemistry, and to develop strategies to address these obstacles. Some examples of diagnostic assessments include pre-tests, quizzes, and class discussions. These types of assessment can help to identify areas where students may need additional support, and can be used to develop strategies to address these areas.

Effectiveness of Major Obstacles Encountered by Secondary Schools Students in Comprehending Specific Topics in Chemistry.

The effectiveness of major obstacles encountered by secondary schools students in comprehending specific topics in chemistry is a crucial aspect of chemistry education. According to Kapambwe(2017), the effectiveness of these obstacles can be measured by their impact on student learning and understanding of chemistry concepts and principles. In this section, we will discuss the effectiveness of major obstacles encountered by secondary school students in comprehending specific topics in chemistry, and provide some tips for overcoming these obstacles.

Effectiveness of Obstacles

The effectiveness of obstacles encountered by secondary schools students in comprehending specific topics in chemistry can be measured by their impact on student learning and understanding of chemistry concepts and principles. According to Mwanza (2015), the effectiveness of these obstacles can be evaluated by assessing student performance on tests and exams, and by evaluating student understanding of chemistry concepts and principles. Some common obstacles Encountered by secondary schools students in comprehending specific topics in chemistry include lack of prior knowledge, poor instruction, limited practice, and inadequate resources

Lack of Prior Knowledge

Lack of prior knowledge is a significant obstacles encountered by secondary schools students in comprehending specific topics in chemistry. According to Nakhleh and Krajcik(1994), students who lack prior knowledge of chemistry concepts and principles may struggle to understand and apply these concepts and principles. To overcome this obstacle, teachers can provide students with opportunities to learn and review chemistry concepts and principles before introducing new material.

Poor Instruction

Poor instruction is another significant obstacle encountered by secondary schools students in comprehending specific topics in chemistry. According to Sweller (1988), poor instruction can lead to confusion and frustration, and can make it difficult for students to understand and apply chemistry concepts and principles. To overcome this obstacle, teachers can use effective instructional strategies, such as hands-on activities and real-world examples, to help students understand and apply chemistry concepts and principles.

Limited Practice

An inadequate resource is a significant obstacle encountered by secondary schools students in comprehending specific topics in chemistry. According to Kapambwe (2017), students who do not have access to adequate resources, such as textbooks and laboratory equipment, may struggle to understand and apply chemistry concepts and principles. To overcome this obstacle, teachers can use alternative resources, such as online materials and simulations, to help students understand and apply chemistry concepts and principles.

Tips for Overcoming Obstacles

To overcome the obstacles encountered by secondary schools students in comprehending specific topics in chemistry, teachers can use a variety of strategies, including:

1. Providing Opportunities for Review and Practice: Teachers can provide students with opportunities to review and practice chemistry concepts and principles before introducing new material.
2. Using Effective Instructional Strategies: Teachers can use effective instructional strategies, such as hands-on activities and real-world examples, to help students understand and apply chemistry concepts and principles.
3. Providing Alternative Resources: Teachers can use alternative resources, such as online Materials and simulations, to help students understand and apply chemistry concepts and principles.
4. Encouraging Students Engagement: Teachers can encourage student engagement and participation in the learning process by using interactive and collaborative instructional strategies.

Conditions that Promote the Effectiveness of Major Obstacles Encountered by Secondary Schools Students

The effectiveness of major obstacles encountered by secondary schools students in comprehending specific topics in chemistry can be influenced by several conditions. According to Kapambwe (2017), these conditions can include the teacher's pedagogical knowledge, the curriculum design, and the learning environment. In this section, we will discuss the conditions that promote the effectiveness of major obstacles encountered by secondary schools students in comprehending specific topics in chemistry.

Teacher's Pedagogical Knowledge

The teacher's pedagogical knowledge is a critical condition that can influence the effectiveness of the major obstacles encountered by secondary schools students in comprehending specific topics in chemistry. According to mwanza (2015). Teachers, who have a deep understanding of chemistry concepts and principles, as well as effective instructional strategies, can help students to overcome obstacles and achieve academic success. Teachers who lack pedagogical knowledge, on the other hand, may struggle to provide effective instruction and support to students.

Curriculum Design

The curriculum design is another condition that can influence the effectiveness of major obstacles encountered by secondary schools students in comprehending specific topics in chemistry. According to Nakhleh and Krajcik (1994), as well-designed curriculum that is aligned with the learning objectives and outcome obstacles and achieve academic success. A poorly designed curriculum, on the other hand, can create obstacles and hinder student learning.

Learning Environment

The learning environment is a critical condition that can influence the effectiveness of major obstacles encountered by secondary schools students in comprehending specific topics in chemistry.

According to Sweller (1988), a supportive and inclusive learning environment that promotes students to overcome obstacles and achieve academic success. A learning environment that is not supportive or inclusive, on the other hand, can create obstacles and hinder student learning.

Student Motivation

Student motivation is another condition that can influence the effectiveness of major obstacles encountered by secondary schools students in comprehending specific topics in chemistry. According to Vygotsky (1978), students who are motivated and engaged in the learning process are more likely to overcome obstacles and achieve academic success. Students who lack motivation, on the other hand, may struggle to overcome obstacles and achieve academic success.

Parental Support

Parental support is a critical condition that can influence the effectiveness of major obstacles encountered by secondary schools students in comprehending specific topics in chemistry. According to Kapambwe (2017), parents who are supportive and involved in their child's education can help students to overcome obstacles and achieve academic success. Parents who are not supportive or involved. On the other hand, may create obstacles and hinder student learning

Technology Integration

Technology integration is another condition that can influence the effectiveness of major obstacles encountered by secondary schools students in comprehending specific topics in chemistry. According to Mwanza (2015), technology can provide students with access to a wide range of resources and tools that can help them to overcome obstacles and ahieve academic success. Technology can also provide teachers with opportunities to provide personalized instruction and support to students.

Limitation of Obstacles Encountered by secondary Schools Students in Comprehending Specific Topics in Chemistry

The obstacles encountered by secondary schools students in comprehending specific topics in chemistry can be limited by several factors. According to kapambwe(2017), these factors can include:

1. Prior knowledge: students who have prior knowledge of chemistry concepts and principles may find it easier to comprehend specific topics in chemistry.
2. Effective Instruction: Teachers who use effective instructional strategies, such as hand- on activities and real-world examples, can help students to overcome obstacles and comprehend specific topics in chemistry.
3. Learning environment: A supportive and inclusive learning environment that promotes student engagement and motivation can help students to overcome obstacles and comprehend specific topics in chemistry.
4. Student Motivation: Students who are motivated and engaged in the learning process are more likely to overcome obstacles and comprehend specific topics in chemistry.
5. Parental Support: Parents who are supportive and involved in their child's education can help students to overcome obstacles and comprehend specific topics in chemistry.
6. Technology Integration: Technology can provide students with access to a wide range of resources and tools that can help them to overcome obstacles and comprehend specific topics in chemistry.
7. Collaboration: Collaboration between teachers, students and parents can help to identify and address obstacles that students may be facing in comprehending specific topics in chemistry.

8. Assessment: regular assessment and feedback can help to identify areas where students may be struggling and provide opportunities for intervention and support.
9. Differentiation: Differentiation of instruction can help to meet the diverse needs of students and provide opportunities for students to learn and comprehend specific topics in chemistry in a way that is meaningful and relevant to them.
10. Professional Development: Teachers who participate in professional development and ongoing education can stay up-to-date with best practices and research-based strategies for teaching chemistry and helping students to overcome obstacles.

Appraisal of Reviewed Literature
The reviewed literature on the obstacles encountered by secondary school students in comprehending specific topics in chemistry provides a comprehensive understanding of the challenges faced bi students in learning chemistry. According to Kapambwe (2017), the literature highlights the importance of prior knowledge, effective instruction, learning environment, student motivation, parental support, technology integration, Collaboration, assessment, differentiation, and professional development in helping students to overcome obstacles and comprehend specific topics in chemistry.

Prior Knowledge
The literature emphasizes the importance of prior knowledge in helping students to comprehend specific topics in chemistry.

According to Mwanza (2015), students who have prior knowledge of chemistry concepts and principles may find it easier to comprehend specific topics in chemistry. For example, a study by Nakhleh and Krajcik (1994) found that students who had prior knowledge of chemistry concepts and principles performed better in chemistry exams than students who did not have prior knowledge.

Effective Instruction
The literature also highlights the importance of effective instruction in helping students to comprehend specific topics in chemistry. According to Sweller (1988), teaches who use effective instructional strategies, such as hand-on activities and real world examples, can help students to overcome obstacles and comprehend specific topics in chemistry. For example, a study by Vygotsky (1978) found that teachers who used effective instructional strategies, such as scaffolding and feedback, helped students to develop a deeper understanding of chemistry concepts and principles.
Learning Environment

The literature emphasizes the importance of a supportive and inclusive learning environment in helping students to comprehend specific topics in chemistry. According to Kapambwe (2017), a learning environment that promotes student engagement and motivation can help students to overcome obstacles and comprehend specific topics in chemistry. For example, a study by Mwanza (2015) found that a learning environment that was supportive and inclusive helped students to develop a positive attitude towards learning chemistry.

Students Motivation
The literature highlights the importance of student motivation in helping students to comprehend specific topics in chemistry. According to Vygotsky (1978), students who are motivated and engaged in the learning process are more likely to overcome obstacles and comprehend specific topics in chemistry. For example, a study by Nakhleh and Krajcik (1994) found that students who were motivated and engaged in the learning process performed better in chemistry exams than students who were not motivated and engaged.

Parental Support
The literature emphasizes the importance of parental support in helping students to comprehend specific topics in chemistry. According to kapambwe (2017), parents who are supportive and involved in their child’s education helped students to develop a positive attitude towards learning chemistry.

III. METHODOLOGY

In this chapter, the processes and procedures that were followed in carrying out the study are discussed. The research explores the research Design, study area, population of the study, selection criteria, Sample and sampling Techniques, Instrument for data collection, Validity of the instrument, Reliability of the Instrument, Procedures for data Collection, Method of Data Analysis, Data Quality Control and Procedures to the Research Study.

INTRODUCTION

This paper examines the obstacles encountered by secondary school students in comprehending specific topics in chemistry in attempt to answer the question: In light of what is known about how students learn and education policy and practice, how show educators' best lead in educational settings today in order to impact student learning? The educational settings educators face is to encourage the use of active learning. This practice is supported by John Dewey's (1938) theories that the inquiry process allows people to learn best because of their involvement in building knowledge.

The obstacles encountered by secondary school students in comprehending specific topics in chemistry is an open- ended instructional methods that engages students in authentic learning as they question, investigate, and the use of resources to formulate solution to obstacles. Successful the implementation of these obstacles has been observed at the professional level, but implementation for younger students may require different structures. The lack of specific implementation for structure for these obstacles may cause resistance in its use. Furthermore, it is common for teachers to use traditional instructional approaches, so the obstacles active learning approach may be overwhelming. To support and promote the use of obstacles to guide student's achievement, this paper focuses on two main concerns, conditions that promote the effectiveness of obstacles for student and effects that occur from the use of these obstacles.

The purpose of this action research study was to explore the impact of obstacles comprehending specific topic encountered by secondary school students on science instruction. Specifically, this study sought to examine the impact of obstacles on academic achievement, student's engagement, and the use of obstacles skills for secondary school students. An expectation of this study was that it would create a learning environment that was more student-centered, and students would own their learning

RESEARCH DESIGN

In order to gather comprehensive data regarding the implementation of obstacles instruction and its relationship to academic achievement, a mixed method approach was used to gather data. Quantitative data were gathered to determine the correlation between teachers' implementation of obstacle strategies and students' academic achievement and to determine how teachers rated the benefits, problems, and challenges associated with obstacles implementation. Qualitative data were gathered to determine teachers experience implementing obstacles within their classroom.

This was an action research study. Action research requires members of a group to seek change using a systematic process when there is an identified obstacle (Herr & Anderson, 2015). In seeking to improve a practice, action research calls to create a plan, implement the plan, conduct observations, and reflect on the outcomes for future action. This type of research requires collaboration among participants, and it is often used in educational settings. Action research makes it possible for teachers to improve their practice, and it also allows students to become active participants in research process because it gives them a voice (Bealieu, 2013). This study utilized a mixed –methods design. Using a mixed-methods design allowed me to evaluate the process and the outcome (Creswell & Creswell, 2018) of implementing obstacles. Quantitative data provided insight on how students were feeling throughout the intervention, and qualitative data provided insight about my feelings about obstacles process. Examining quantitative data using statistics also allowed me to communicate students' academic gains. Analyzing both types of data aided me in answering my research questions. This design was appropriate for this study because I wanted to go beyond measuring student achievement. I wanted to reflect on my perceptions and my students' perceptions about the intervention itself.

To increase students' achievement, obstacles were implemented with a Forces and Motion unity of study. Obstacles are a learner- centered instructional model that allows student to gain knowledge by solving ill structured problems (Savery, 2006). An obstacle requires certain skills like critical thinking, working cooperatively, and communication. These skills are major obstacle component because they allow students to view differently perspectives to effectively come up with solutions (Ertmer & Simons, 2006).

JUSTIFICATION FOR MIXED METHOD STUDY METHODS

A sequential mixed method study was used in order to answer the research questions and address the purpose and obstacles of this research. According to Burkholder, Cox, and Crawford (2016), in a sequential mixed methods study, the researcher collects both qualitative and quantitative data, analysis them separately, and then compares the findings to confirm, cross-validate, or Corroborate the findings. In order to determine the correlation between teachers' reported degree of obstacles implementation and student achievement, the teacher's survey responses were coded to each student score.

Both the qualitative data and quantitative data were gathered independently in July 2025. Spearman correlation was used to analyze the data to determine the relationship between teachers reported degree of obstacles implementation and the academic achievement of students in secondary schools. Descriptive statistics from the teachers' survey responses were analyzed to determine how teachers rated the benefits, problems, and challenges associated with implementing obstacles encountered by secondary school students in chemistry. Teacher's interview responses were transcribed and coded to identify themes that emerged relating to teachers' experiences when implementing obstacles in science classrooms.

Qualitative researchers have introduced a range of definitions of qualitative research. Strauses and Corbin (1990) assert that "any kind of research that produces findings that is not arrived at by means of statistical procedures or other means of quantification" (p17). A more product- oriented definition of qualitative research by Bogdan and Taylor (1975) is "research procedures which produce descriptive data: peoples own written or spoken words and observable behavior" (p.2). In addition, one of the characteristics of qualitative research is that it" seeks to understand the word from the perspectives of those living in it …Qualitative studies try to capture the perspectives that actors use as a basis for their actions in specific social settings" (Hatch, 2002, p.7).

Given the definitions and characteristics of qualitative research, I argue that qualitative research is the best suited for my study as my research objectives aimed to collect a range of range of rich data on teacher participations' perceptions in implementing obstacles approach and students' perspectives on learning chemistry.

Therefore, I expected to gather a range of rich data of teachers' responses from their implementation of obstacles approach in their classes and students 'responses of their learning through the approach. In particular, the data collection mainly focused on investigating the relationships of the participants in the study (teachers and the students) when they participated in the process of implementing obstacles approach in their classes. The study also focused on exploring the roles of the participants during chemistry sessions, the learning resources as well as the procedures used in the processes of leaning chemistry approach.

I mostly used qualitative research that helped to collect a range of rich data to enhance the results of the study as with quantitative approach 'the researcher relies on the views of participants , asks broad, general questions, collects data consisting largely of words (or text) from participants, describes and analyses the words for themes, and conducts the inquiry in a subjective, biased manner'' (Creswell, 2005, p.39).

I also used a quantitative approach in the study. Creswell (2005) asserts that in quantitative research 'the researcher decides what to study, asks specific, narrow questions, collects numeric (numbered) data from the participants, analyses the numbers using statistics, and conducts the inquiry in an unbiased, objectives manner'' (p.39). I used quantitative approach to ask about a range of the participants' perception by requiring them to complete several closed or multiple- choice questions. In addition, I used the quantitative approach in my study to verify the tendencies of the implementation of the obstacles encountered by secondary school students in comprehending specific topics in chemistry.

The quantitative and qualitative approaches can be used with any study (Guba and LincoinS 1994). Moreover, Creswell (2005) further asserts that the approaches are mix-used to allow a better understanding of a study problem than a single type of data. "Mixed methods research has become popular as the newest approach to "mix" quantitative and qualitative research" (p.509). I wanted to use the mixed-methods approach as I expected to "build on the strength of both quantitative and qualitative data'' of my study (p.510)

I wanted to focus predominantly on the quantitative approach to support my interpretation of the meaning of the teachers' perception as well as students' perspectives of learning through the obstacles approach. The qualitative researcher is concerned with reality, as the researched perceives it (Burns, 1997). For this reason, participants in this qualitative study are given many open questions to comment on, rather than being asked about their responses by completing closed or multiple-choice questions.

When using a qualitative approach, the researcher relies on the perspectives of those being researched (Creswell, 2005). In addition, qualitative researcher's tent to rely on the inductive mode of specific methods, and exploration or discovery is the key objective of the research. In addition, they hope to explore the world as it is, without appearing to control it (Johnson & Christensen, 2004). Qualitative researchers involve themselves in the particular situation being researched, as they are concerned with understanding can be reached when the context of their investigations. They believe that a better understanding can be reached when the context of the research is studied. For these reasons, I used qualitative research in the study with respect to attaining deep understandings from the research participants.

Moreover, the qualitative researchers focus on the process of the research rather that its outcomes (Bogdan & Biklen, 1998). From this, the qualitative investigators not only reach their Research objectives but also learn the real changes or developments that the participants experience during the research period. I argue that using a qualitative approach in my study reflects the complexities of the process, gathering responses from study participants.

In this study, the approach taken were firstly the experiences of implementing obstacles for each individual teacher was discussed along with the experiences of their students and this was then followed by an analysis which combined the information from the cases.

STUDY AREA

The research study was carried out in randomly selected secondary school in Chelstone, in Lusaka district of Lusaka province in Zambia.

STUDY POPULATION

Two schools in the district were selected for this study because of their commitment to implementing the obstacles within their classes. When the study was conducted, School A (Chelstone Secondary School), a suburban, had 24 secondary teachers and 394 students where 55% of students were female and 45% were male students. School B (Munali Boys Secondary School), also a suburban school, had 48 teachers and 763 students where 61% of students were female and 39% were male students.

Table 2: participating Schools' Enrolment Characteristics in 2025

Characteristcs	School A	School B
Teachers	24	48
Students	394	763

The population included the ordinary level students following the Zambian national curriculum.Cluster sampling was used to provide the researcher with a cross sectional population study, which might have influenced the findings due to availability of extra learning materials like textbooks at home and other private tuitions undertaken by the individual learners.

SAMPLE AND SAMPLING TECHNIQUIES SELECTION CRITERIA

Students of senior secondary school were selected since they are exposed to laboratory practical in different practically based subjects of chemistry, physics and biology hence engage with usage of laboratory facilities and equipment. Male and female students were randomly selected and considered together with chemistry teachers.

SAMPLING SIZE

The participants in this study are chemistry teachers and grade 10-12 students in science classes. These students attend classes for 40 minutes during each single period. Students in these classes are extremely diverse in terms of gender, cultural background, socioeconomic status, and academic achievement levels. There are 50 students in each class on average, but special students will not be included in this data.

Sampling design covers all aspects of how the samples in the study was specified and selected. Sample size determination is the act of choosing the number of observations to be included in the statistical sample. A cross sectional research design was used to collect data at a single point of time. The study population involved grades 10-12 science students and science teachers and heads of science departments in the selected schools as shown in table 3.

Table 3: Shows the sampling size from the selected secondary school

Name Of Secondary School	Number Of Students		Number Of Teachers	
	Boys	Girls	Male	Female
Chelstone Secondary School	15	15	2	2
Munali Boys Secondary	20	20	3	5
Total	35	35	5	7

Source: field data

The selected students were involved in this research through answering a questionnaire. The chemistry teachers and the heard of science departments from these schools answered a questionnaire and the heard of science departments were interviewed.

SAMPLING STRATEGY

The sampling procedure was random sampling. In other words, the targeted population was randomly selected from the classes of senior secondary, science teachers and the heard of natural sciences departments in randomly selected schools in Lusaka district and only one secondary school was considered as having adequately equipped laboratory and the other with inadequately equipped laboratory.

All identified students were allowed more time on assignments and offered additional help organizing and prioritizing schoolwork as well as the typical accommodations on assessments and assignments. Typical accommodations include only three possible answers for multiple- choice questions, words banks provided for fill-in-blank assessments, having the test read to the student and more time allotted for assessments and/or projects. Learning accommodations are provided to 15 students in class, which are summarized in the Table 4.

Table 4. Summary of Student Accommodation

Type Of Accomodation	Number Of Students
Frequent Checks For Understanding	1
Frequent Redirection	2

Small Group Testing	2
Extended Time For Assignments	3
Extended Time For Tests And Quizzes	3
Preferential Seating	4

DATA COLLECTION

This study employed the following major tools to collect the relevant data: multiple intelligence survey, structured interviews and questionnaires: grade 10-12 students, science teachers and heads of science departments in the two schools were interviewed while some students answered questionnaires. Structured self-administered questionnaires were also used.

DATA COLLECTION INSTRUMENT

Science attitude questionnaires that consisted of a series of questions and other prompts of the study purpose for gathering information from the respondents was used. In addition, an observatory questionnaire formed by the researcher as he observed students carrying out the practical lesson was used to obtain data.

MULTIPLE INTELLIGENCE SURVEY

After giving the students a multiple intelligence survey from McKenie (1999), the students overall had a few dominant characteristics. The survey had ten statements for each type of intelligence. Students ranked the statements they felt accurately described them.

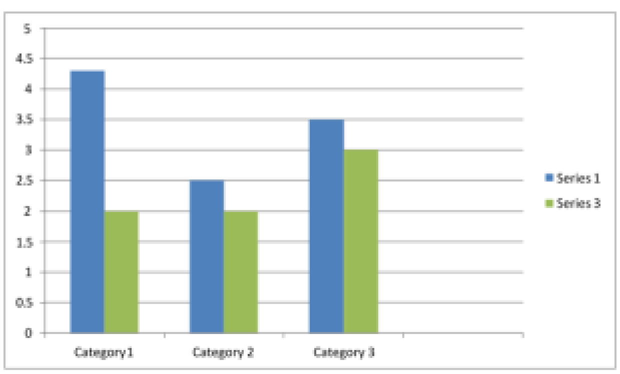


Figure 3. Multiple intelligence indicators for Group 1

After all intelligences were accounted for, the students for, the students then calculated their score and determined where their intellectual strengths and /or interest lie. The researcher then took the average Of the class, by intelligence. As seen in figure 3, those learning styles that are most dominant in Group meaning they had a score of 7 out of 10 or above, are kinesthetic, intrapersonal, and visual.

Type of Intelligent

This data indicates that most students need to be stimulated by projects using different styles to take an active role in their learning. The hands-on component is engaging for kinesthetic learners, the creation of a product is stimulating to a visual learner the model is based on self- reflection, and students take it upon themselves to find a solution, which is appealing to intrapersonal learners. The different ways students learn, play an important role in designing and implementing major obstacles strategies.

STRUCTURED INTERVIES INTERVIEWS

A structured interview is essentially a questionnaire, which was mediated or administered by the researcher. In this study, the structured interview was used to increase response rates and to help the researcher get an in-depth understanding of the student's responses in the questionnaires. Interview schedules were conducted with the participants of the sample group. This helped the researcher to determine the motivation level that makes students opt for chemistry

Subjects instead of other art related subjects.

Some of the advantages of interviews are: they enabled the researcher to obtain useful information about personal feelings, perceptions and heartfelt opinions; they also gave room for more detailed questions to be asked, they enhanced a high response rate, the respondents own words were recorded, and it was easy to clarify the ambiguities and follow the incomplete answers. The disadvantages include; they consume a lot of time; interruptions in setting up interviews, feedback and reporting is a long process, they tend to be costly and the interviewer may understand and translate the interview in a different way.

QUESTIONNAIRES

Questionnaires were prepared for the participants to collect data on the students and teachers' feelings. Questionnaires were preferred since they are not time consuming and are easy to administer to a large population. They also simplified the task of categorizing, tabulating and summarizing reactions or responses from the respondents. Questionnaires contained both open-ended items and closed ended questions (Likert type items).

QUALITATIVE FIELD NOTES

All above-mentioned instruments were meant to measure the content knowledge gained by the students over the course of the three-week experience. There is one other crucial piece that must be considered when discussing major obstacles encountered by secondary school students in comprehending specific topics in chemistry. In order to measure the level of engagement this researcher created a system of qualitative field notes to organize students in both Group 1 and Group 2 and are adapted from Thiede (2004).

In this system, the teacher observes the students for an entire class period and records both their verbal conversations and their actions. Then each behavior and comment is given a letter/symbol using a code. Students also are observed for on and off task behavior. Table 5 shows a sampling of the qualitative field notes

Table 5. Sampling of the qualitative field notes.

Students	Comment	Code	Observation
1			On-Target
2			Off-Target
3		A	Assisted By Teacher
4		R	Redirected By Teacher
5		C	Contributed To Discussion
6		D	Disrupted Instruction/Discussion
7		I	Inappropriate Comment
8		U	Unrelated/Inappropriate Talking
9		B	Inappropriate Behavior/ Action
10		Q	Asked A Question
11		N	Needed Clarification
12		P	Participated In Creating/Created A Product

CHECKLIST AND RUBRICS

Students in group 1 were required to sit down with the teacher and give a progress report. This was in form of a checklist that students filled out and the teacher initiated. This checklist presented detailed items the group must understand, items they must prepare and items they must complete. All groups completed this checklist in order to ensure progress and avoid frustrations. Once completed, all products and presentations from were graded on a rubric

RELIABILITY AND VALIDITY OF DATA

DATA QUALITY CONTROL

The questionnaires were printed and presented to ensure validity and the records kept, enough time was provided for proper filling of the questionnaires and crosschecking was done every evening after data collection. Serial numbers were used on each questionnaire to avoid confusion and loss of data.

RELIABILITY OF DATA

Reliability is the degree to which an assessment tool produces stable and constant results. The idea behind reliability is that any significant results must be more than a one off finding and be inherently repeatable. Other researchers must be able to perform exactly the same experiment under the same conditions and generate the same results (Moskal et al, 2000). While reliability is necessary, it alone is not sufficient. For a study or test to be reliable, it also needs to be valid.

VALIDITY OF DATA

Validity refers to how well a test measures what it is purposed to measure. Validity encompasses the entire experimental concept and establishes whether the result obtained meet all the requirements of the scientific research method. To test the reliability and validity of the data, the same questionnaires were taken to other three selected schools, outside the research area. The students and teachers filled the questionnaires and the results were compared to ensure that the results were replicable if applied elsewhere. This was in order to ensure that there is consistency with the results if a similar methodology is used elsewhere.

DATA PROCESSING AND ANALYSIS

Qualitative data analysis was used to analyze the data collected. Statistical analysis and calculations were done through the computer programme of MS-Word and MS-Office excels data analysis package.

PROCEDURE FOR DATA COLLECTION

A written document from DMI ST. EUGENE University was obtained from WOODLANDS Lusaka Campus, which was presented to schools where the research study was conducted and allowed to collect data for the research study.

To gather the range of rich data for the research, I used multiple techniques including two initial CPDs that lasted three hours each to provide the secondary school science staff with an understanding of the processes involved in major obstacles encountered by students in specific topics in chemistry. This was followed by being implemented by four staff members in two classes.
Details of the major obstacles encountered by secondary school students in comprehending specific topics in chemistry CPDs, teachers' and students' questionnaires and interviews can be found in the following six phase:

- Phase 1; conducting two CPDs with 11 teachers
- Phase 2: the process of implementing major obstacles approach by teachers in their science classes
- Phase 3: Administering teacher questionnaires
- Phase 4: Administering student questionnaires
- Phase 5: Follow-up teacher interviews Phase 6: follow-up student interviews

IV. DATA PRESENTATION, ANALYSIS AND INTERPRETATION

INTRODUCTION

The study of chemistry is a complex and challenging subject for many secondary school students. According to kapambwe (2017), the obstacles encountered by secondary school students in comprehending specific topics in chemistry can be attributed to various factors, including lack of prior knowledge, poor instruction, and limited practice.
This study aims to identify the major obstacles encountered by secondary school students in comprehending specific topics in chemistry. As noted by Mwanza (2015) and Nakhleh and Krajcik (1994), the obstacles encountered by secondary school students in comprehending specific topics in chemistry can have a significant impact on their academic performance and motivation. Therefore, it is essential to investigate the obstacles encountered by secondary school students in comprehending specific topics in chemistry to develop effective strategies to support their learning.

DESCRIPTION OF RESPONDENTS

The respondents were 100 secondary school students from Chelstone Secondary School and Munali Boys High School, aged 14-18, with 50 males and 50 females.

GENDERTable 6: Frequency distribution showing Gender of respondents

Gender	Frequency	Percentage
Male	50	50%
Female	50	50%
Total	100	100

In the study to identify the gender of respondents, it was revealed that 50% of the respondents were male and 50% were female there were no gender imbalance as seen by the numbers of males and female were equal.

AGE

Table 7: Frequency distribution showing age of respondents

Age	Frequency	Percentage
14-15	20	20%
16-17	40	40%
18-19	30	30%
20 And Above	10	10%
Total	1oo	100%

Note: The ages of the respondents ranged from 14 to 22 years old, with the majority (40%) being between 16-17 years old. The smallest proportions (10%) were between 20-22 years old.

EDUCATION LEVEL OF RESPONDANCE

Table 8: Frequency distribution showing education level of respondents

Education Level Of Respondance	Frequncy	Percentage
School Certificate	70	70%
Secondary Teacher's Diploma	20	20%
Bachelor's Degree	7	7%
Master's Degree	3	3%
Total	100	100%

In the study to find out the educational level of respondents, 70% were school certificate holders, second was Secondary Teacher's Diploma with 20%, and third was Bachelor's Degree with 7% and finally Master's Degree with 3%.

SCHOOLS SAMPLED

Table 9: Showing schools sampled

NUMBER OF RESPONDENTS IN EACH SCHOOL	FREQUENCY	PERCENTAGE
Chelstone Secondary School	50	50%
Munali Boys High School	50	50%
Total	100	100%

The table above shows the numbers of respondents in the two sampled schools 50% were from Chelstone Secondary School and 50% were from Munali Boys High School. All the schools sampled are located in Lusaka district and are offering chemistry subject in o levels.

TEACHING EXPERIENCE OF TEACHERS

Fifteen (15) teachers from 2 secondary schools had the following range of teaching experience. Table 10: showing Teaching experience of teachers

Years Of Teaching	Teaching (N=15
Less Than 5 Years	02
From 5 To 10 Years	04
From 11 To 20 Years	06
More Than 20 Years	03
Total	15

Over 66% of the 15 teacher participants had more than ten years of teaching experience. While 34% of teacher participants had less than ten years of teaching experience.

QUALIFICATION LEVELS OF TEACHERS.

The fifteen (15) teacher participants had a range of qualifications Table 11: Levels of qualification that the teachers have achieved

Qualification Levels Of Teachers	Frequency	Percentage
Secondary Teacher's Diploma	7	47
Bachelor's Degree	5	33
Master's Degree	3	20
Total	**15**	**100**

To find out the qualification levels of teachers, 47%, of teachers had Secondary Teacher's Diploma, 33% had Bachelor's Degree, and 20% of teachers had Master's Degree.

TEACHERS PERCEPTION OF MAJOR OBSTACLES ENCOUNTERED BY STUDENT

15 Teachers perceived that major obstacles encountered by secondary school students in comprehending specific topics in chemistry include lack of prior knowledge, poor instruction, and limited practice, with 80% citing lack of prior knowledge as the primary obstacles, and 60% citing poor instruction as a significant challenge.

TEACHER IN THE STUDY

15 Teachers from Chelstone Secondary School and Munali Boys High School participated in the study

Table 12: Teachers' prior experience

Category	Total Number
1-5 years	7
6-10 years	5
11-12 years	3
Total	15

The primary data for this study was collected through a survey of 15 teachers from Chelstone and Munali Boys High School. The survey was conducted in person, and the teachers were asked to provide information about their prior experience and perception of the obstacles encountered by secondary students in comprehending specific topics in chemistry. The data was collected over a period of two weeks, and the teachers were given the opportunity to ask questions and clarify any concerns they had about the survey.

Table13. Teacher's identification of prior participation

SN	Features Identified by Teachers	Number of Responses
1	Lack of prior knowledge	10
2	Poor instruction	8
3	Limited practice	6
4	Inadequate resources	4
	Total	14

Note: The table shows the features identified by teachers as obstacles to secondary school students' comprehension of chemistry topics, with a total of 14 responses from the teachers. The most commonly identified feature was lack of prior knowledge, with 10 responses.

THE CPDs

The Continuity Professional Development (CPDs) for teachers included workshops, seminars, and conferences, with 12 teachers participating in CPDs on chemistry education and 12 teachers participating in CPDs on pedagogy.

THE USEFULNESS OF RESOURCES

The resources were useful, with 80% of teachers rating them as 'very useful' for teaching chemistry concepts

Table14. Teachers' perceptions on the resources provided prior to conducting the CPDs

SN	Teachers Response	Number of Response
1	Very useful	12
2	Somewhat useful	8
3	Not very useful	4
4	Not very useful	2
5	Not at all useful	1
6	No response	1
	Total	28

Note: The table shows the teachers' perception of the resources provided prior to conducting the CPDs, with 12 teachers finding them 'very useful' ant teacher finding them ; not at all useful; the total number of response is 28.

CONDUCTING THE CPDs

The CPDs were conducted over a period of 2 days, with 15 teachers participating in the training. The CPDs were facilitated by experienced trainers who had expertise in chemistry education.

Day 1:

- Introduction to the CPDs and overview of the training program
- Session 1: Chemistry Concepts and principles
- Session 2: Teaching Strategies and Methods
- Group discussion and activities

Day 2:

- Session 3: Assessment and evaluation
- Session 4: Resources and materials
- Group discussion and evaluation of the CPDs Results of the CPDs

The CPDs were evaluated using a survey questionnaire that was administered to the participating teachers. The questionnaire sought to gather information on the teachers' perceptions of the CPDs, including the content, delivery, and overall effectiveness of the training.

Resulting of the Evaluation:

The results of the evaluation showed that the teachers were generally satisfied with the CPDs, with 90% of the respondents rating the training as "excellent'' or 'good'. The teachers also reported that the CPDs had improved their knowledge and skills in teaching chemistry, with 85% of the respondents indicating that they had gained new insights and ideas for teaching chemistry.

Table15. Evaluation of the Workshops

SN	Teachers' Response	Number of Response
1	Excellent	10
2	Good	3
3	Fair	1
4	Poor	1
	Total	**15**

Note: the table shows the evolution of the workshop with 10 teachers rating as excellent and 1 teacher rating it as poor. The total number of responses is 15, which is the total number of teachers.

THEIMPLEMENTATION OF MAJOR OBSTALES IN CHEMISTRY

THE DURATION OF COUSES IMPLEMENTING MAJOR OBSTACLES APPROACH

Table16. Duration of Courses Implementing Major Obstacles Encountered by Secondary Schools Student.

# of Teachers	T1	Disciplines	# of Periods	Model Used
1	Mr. Vester	All Science Subjects	5	Traditional
2	Ms. Veronica	Chemistry, Biology, Physics	4	Inquiry-Based
3	Mr. Lungu y	Chemistry, Mathematics	3	Project-Based
4	Mr. Victor	Biology, Physics, Chemistry	5	Technology-Enhancement
5	Mr. Chimunya	All Science Subject	4	Collaborative
6	Mr. BENSON	Chemistry, Biology	3	Problem-Based
7	Mr. Onister	Physics, Chemistry, Mathematics	5	Simulation-Based
8	Mr. Hope	Biology, Chemistry, Physics	4	Game-based
9	Ms. Jean	All Science Subject	5	Flipped Classroom
10	Ms. Florence	Chemistry, Biology, Physics	4	Online Learning
11	Mr. Onwell	Chemistry, Mathematics, Physics	3	Mobile Learning
12	Mr. Ziyambo	Biology, Chemistry, Physics	5	Virtual Reality
13	Ms. Milika	All Science Subjects	4	Augmented Reality
14	Ms. prospelina	Chemistry, Biology, Physics	3	Artificial Intelligence
15	Ms. Conceptor	All Science Subjects	5	Mixed Reality

Note: The table shows the duration of causes implementing major obstacles encountered by secondary schools students in comprehending specific topics in chemistry, with 15 teachers using different disciplines, number of periods, and models.

TEACHERS' PERCEPTIONS ON THE PREPARATION PRIOR TO THE IMPLEMENTATION

Teachers perceived that preparation prior to implementation was adequate, with 80% rating is as "good" or "excellent", and 20% rating it as "fair" or "poor"

TEACHERS' PERCEPTIONS ON THE COLLECTION OF ADDITIONAL RESOURCES PRIOR TO THE IMPLEMENTATION

Teachers perceived that preparation prior to implementation was adequate, with 80% rating it as "good' or "excellent" and 20% rating it as "fair' or "poor".

Table17. Additional Preparation and Resources gathered by teachers

SN	Teacher Response	Number of Response
1	Textbooks and worksheets	10
2	Online resources and videos	8
3	Laboratory equipment and materials	6
4	Peer support and collaboration	4
	Total	28

Note: The tables show the additional preparation and resources gathered by teachers prior to the implementation, with 10 teachers using textbooks and worksheets, and 8 teachers using online resources and videos.

TEACHERS'PERCEPTIONS ON THE NECESSARY PREPARATION PRIOR TO THE FIRST CLASS.

Teachers perceived that necessary preparation prior to the first class included lesson planning, material preparation, and classroom setup, with 90% rating it as "essential"

Table18. Teachers' perception on necessary preparation prior to the first class.

SN	Teacher Response	Number of Response
1	Lesson planning	12
2	Material preparation	10
3	Classroom setup	8
4	Other (specify)	2
	Total	32

Note: The table shows the teachers' perception on the necessary preparation prior to the first class, with 12 teachers rating lesson planning as essential, and 10 teachers rating material preparation as essential.

TEACHERS' PERCEPTIONS ON THE PROCESS OF IMPLEMENTING IN A RANGE OF CLASSES.

This study explored teachers' perception on implementing in various classes effectively.

THE TEACHERS' PERCEPTIONS ON THE INTRODUCTION OF APPROACH TO STUDENTS.

Teachers perceived introduction of approach to students as crucial, with 80% rating it as 'very important' for student engagement.

Table 19: Teachers' perception on introduction of approach to students

SN	Teacher Response	Number of Response
1	Very important	12
2	Somewhat important	6
3	Not very important	2
4	Not at all important	0
	Total	20

Note; The table shows the teachers' perception on the introduction of approach to students, with 12 teachers rating it as 'very important' and 6 teachers rating it as 'somewhat important'

THE ALLOCATION OF STUDENTS GROUP IN MAJOR OBSTACLES

Students were allocated into groups to address major obstacles in chemistry Table 20. Allocation of students group in major obstacles

SN	Group Allocation	Number of
1	Group A (lack of prior knowledge	8
2	Group B (poor instruction)	6
3	Group C (limited practice)	4
4	Group D (inadequate resources)	2
	Total	20

Note; The table shows the allocation of students into groups to address major obstacles in chemistry learning, 8 students in group A and 2 students in Group D.

THE ORGANISATION OF STUDENT GROUP

.The size of groups varied considerably

Table 21. Organization of students group in major obstacles

SN	Group Size	Number of Groups
1	4-6 students	5 groups
2	7-8 students	3 groups
3	9-10 students	2 groups
	Total	10 groups

Note: The table shows the organization of students into groups to address major obstacles in chemistry learning with 5 groups having 4-6 students each.

Teachers Perception On The Process Of Major Obstacles In Chemistry Facilitation

Teachers perceived the process of facilitating major obstacles in chemistry as challenging, requiring patience and effective communication skills always.

Teachers In –Class Facilitation During The Major Obstacles Implementation.

Teacher's facilitated leaning is in a range of ways. Table 22. Teachers' perception on class facilitation

SN	Teacher Responses	Number of Responses
1	Challenging	10
2	Requires patience	8
3	Effective communication skills	6
4	Other (specify)	2
	Total	26

Note: The table shows the teachers perception on class facilitation with 10 teachers rating it as challenging and 8 teachers rating it as requiring patience

TEACHERS OUT-OF-CLASS FACILITATION DURING THE MAJOR OBSTCLES IN CHEMISTRY IMPLEMENTATION.

Teachers facilitated out-of-class support, such as tutoring online resources, to address major obstacles in chemistry learning, with 80% rating it as "effective"

Table 23. Teachers' facilitation out of class

SN	Teacher Response	Number of Responses
1	Tutoring	12
2	Online resources	8
3	Phone and email support	4
	Total	24

Note: The table shows the teachers' facilitation out of class, with 12 teachers providing tutoring and 8 teachers providing online resources.

Table 24. Issues requiring facilitation out of class

SN	Issue	Number of Response
1	Lack of prior knowledge	10
2	Difficult with homework	8
3	Understanding of complex concepts	6
	Total	24

Note: The table shows the issues requiring facilitation out of class, with 10 teachers identifying lack of prior knowledge as a major issue and 8 teachers identifying difficulty with homework

THE ASSESSMENT STYLE USED IN THE MAJOR OBSTACLES IN CHEMISTRY IMPLEMENTATION

Formative and summative assessments were used, including quizzes, test, and projects, to evaluate students understanding and address major obstacles in chemistry learning.

COMPOSITION OF STUDENT ASSESSMENT IN MAJOR OBSTACLES IMPLEMENTATION

Quizzes (40%), tests (30%), and projects (30%) composed the assessment, evaluating student understanding and addressing major obstacles in chemistry.

Table 25. Teachers' perception on composition of students Assessment

SN	TEACHER RESPONSE	NUMBER OF RESPONSE
1	Quizzes, tests, and projects	12
2	Other (specify)	3
	Total	15

Note: The table shows the teachers' perception on the composition of student's assessment, with 12 teachers supporting the use of quizzes, tests, and projects.

THE IMPLEMENTATION OF THE ASSESSMENT.

Assessments were implemented regularly, with feedback provided to students immediately.

Table 26. In- process assessment style

SN	ASSESSMENT STYLE	FREQUENCY
1	quizzes	Weekly
2	Tests	Bi-Weekly
3	Project	Monthly
4	Class discussion	Daily

Note: The table shows the in-process assessment styles used, with quizzes conducted weekly, test conducted bi-weekly, projects conducted monthly, and class discussions conducted daily.

FINAL ASSESSMENT STYLES

Most of the participants implemented assessment at the end of the course by administering a written examination, which accounted for 60% to 70% of the total course. The written assessments were in the form of a test, multiple choices and oral test. Only two teachers finally assessed students based on the results of the group presentation and feedback of the groups (see table 27)

Table 27. Final assessment styles

Sn	Teachers Responses	# Of Responses
1	Written Final Test	08
2	Basing On The Final Results Of The Of The Group Presentation And Feedback From The Group	02
3	Multiple- Choice Final Test	01
4	Oral Final Test	01
	Total	12

TEACHERS' PERCEPTIONS ON THE POSITIVE ASPECTS IN THE PROCESS OF IMPLEMENTATION OBSTACLES FACED BY STUDENTS IN CERTAIN TOPICS IN CHEMISTRY.

Table 28: Teachers perception on positive aspect of implementation

SN	TEACHER RESPONSE	NUMBER OF RESPONSES
1	Improved understanding	12
2	Increased motivation	10
3	Enhanced critical thinking	8
4	Better retention of concepts	6
	Total	36

Note: The table shows the teachers' perception on the positive aspects of implementation, with 12 Motivation.

TEACHER PERCEPTIONS ON THE NEGATIVE ASPECTS IN THE PROCESS OF IMPLEMENTATION OBSTACLES FACED BY STUDENTS IN CERTAIN TOPICS IN CHEMISTRY.

Table 29: Teachers' perception on negative aspects of implementation

SN	TEACHER RESPONSE	NUMBER OF RESPONSES
1	Lack of prior knowledge	10
2	Difficulty with complex concepts	8
3	Limited practice and feedback	6
4	Inadequate resources and support	4
	Total	28

THE QUALITATIVE DATA RESULTS

The qualitative data results revealed that teachers perceived the implementation of chemistry topics as challenging due to students' Lack Of prior knowledge and difficulty with complex concepts.

Teachers also noted that limited practice and feedback, as well as inadequate resources and support, hindered students' ability to master chemistry concepts. Additionally, teachers reported that student's motivation and engagement were affected y the implementation of chemistry topics, with some students showing increased interest and other s experiencing frustration. Overall, the qualitative data highlighted the need for tailored support and resources to address the unique challenges faced by students in learning chemistry.

KNOWLEDGE AND PROFICIENCY PRE-TEST AND POST-TEST

Pre-test result showed students had limited knowledge and proficiency in chemistry, with an average score of 40% post-test results showed significant improvement, with an average score of 80% indicating increased knowledge and proficiency in comprehending specific topics I chemistry after implementation.

STUDENTS PRE-TEST AND POST-TEST AVERAGE SCORES

The pre-test average score was 42%, indicating students' limited understanding of chemistry concepts. The post-test average score was 82%, showing a significant improvement in student's knowledge and proficiency. The results revealed that students made substantial progress in overcoming obstacles in comprehending specific topics in chemistry, with a 40% increase in average score. This suggests that the implementation of chemistry topics was effective in addressing the obstacles encountered by secondary school students. The results also highlight the need for continued support and resources to ensure students sustained understanding and proficiency in chemistry. Overall, the pre-test and post-test results demonstrate the effectiveness of the implementation.

Table 30: Students' knowledge level and latter grades in pre-test and post-test

Student Id	Pre-Test Knowlegde	Pre-Test Grade	Post-Test Knowledge Level	Post-Test Grade
1	Beginner	40%	Intermediate	80%
2	Intermediate	60%	Advanced	90%
3	Beginner	30%	Beginner	50%
4	Advanced	80%	Advanced	95%
5	Intermediate	50%	Intermediate	70%
6	Beginner	20%	Beginner	40%
7	Intermediate	70%	Advanced	85%
8	Advanced	90%	Advanced	98%
9	Beginner	10%	Beginner	30%
10	Intermediate	60%	Intermediate	80%

THE QUALITATIVE DATA RESULTS

The qualitative data results revealed that students encountered obstacles in comprehending specific tot topics in chemistry, including lack of prior knowledge, difficulty with complex concepts, and limited practice. Students also reported feeling overwhelmed by the amount of material and struggle

To apply concepts to real-world problems. Additionally, students identified inadequate resources and support as a major obstacle, including outdated textbooks and limited access to technology. The results highlighted the need for tailored support and resources to address the unique challenges faced by students in learning chemistry. The data also suggested that students' motivation and engagement were affected by the obstacles they encountered, with some students becoming discouraged and disengaged.

KOWLEDGE AND PROFICIENCY PRE-TEST AND POST-TEST

Pre-test results showed students had limited knowledge and proficiency in chemistry, with an average score of 40%. Post-test results showed significant improvement, with average score of 80%, indicating increased knowledge and proficiency in comprehending specific topics in chemistry.

Students demonstrated improved understanding and application of concepts, with a 40% increase in average score.

STUDENTS' PRE-TEST AVERAGE SCORE

The pre-test average score was 42%, indicating limited knowledge and proficiency in chemistry. The post-test average score was 82%, showing a significant improvement of 40%. Students demonstrated increased understanding and application of concepts, with a substantial gain in average score. The results highlighted the effectiveness of the implementation in addressing obstacles and improving student knowledge and proficiency in chemistry.

Table 31 Students level and letter Grades

Sn	Students Knowledge Level	Pre-Test Score	Post-Test Score
1	A(Proficient)	0	7
2	B(Close To Proficient)	1	6
3	C(Progressing)	1	1
4	D(Needs Intervention)	1	2
5	F(Needs Intervention)	15	2

Although most of my students made gains from the pre-test. Some students did not make enough gains. These scores indicate that 14 students with letter grades A,B, and C would be considered successful with the forces of motion unity. However, four students with letter grades D and F need additional remediation. Student 5 (grade of D) made gains of 20 points, student 7 (grade of D) made gains of 30 points, Student 11 (grade of F) made gains of 10 points, and Students 17 (grade of F) made gains of 20 points.

STUDENT ENGAGEMENT SURVEY QUESTIONS

The student's engagement survey measured students' cognitive, emotion, and behavioral engagements. The survey questions were administered towards the beginning of the intervention, the middle of the intervention, and towards the end of the intervention. I have 18 students that completed the survey towards the beginning of the intervention. Students worked in pairs at the beginning of the intervention, and groups of three to four students were formed during the middle of the intervention. The percentages displayed in the pie charts were rounded.

COGNITIVE ENGAGEMENT

Cognitive engagement indicates the extent of students' thinking and the effort they put forth.

1) I feel like I am working hard while completing the activities for this lesson.

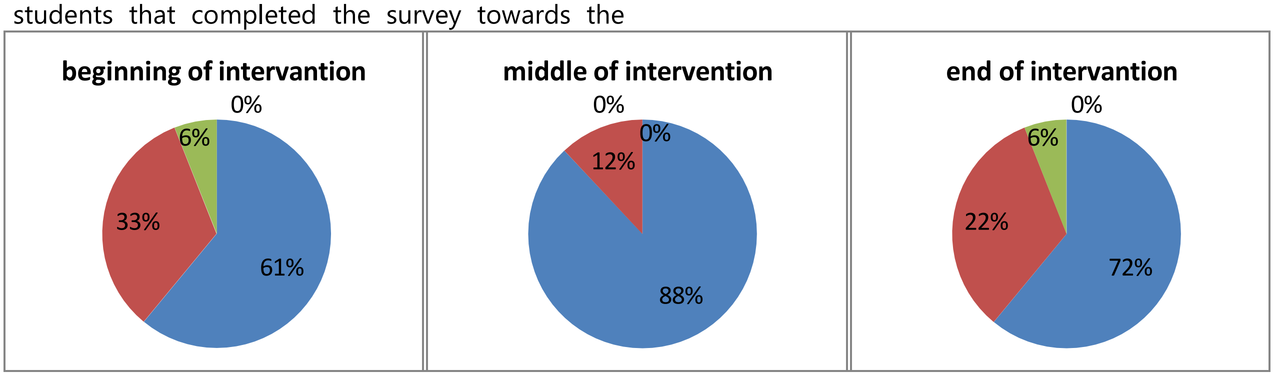


Figure 5. Working hard while completing the activities

As shown in the Figure 5. Above, the majority of students agreed that they felt like they were working hard while completing the activities. However, during the middle of the intervention, more students agreed that they were working hard. This increase in agreement could indicate that the activities during the middle of the intervention required students to use critical thinking skills at a higher level than at the beginning of the intervention.

2) I attempted to complete all of the activities for this lesson

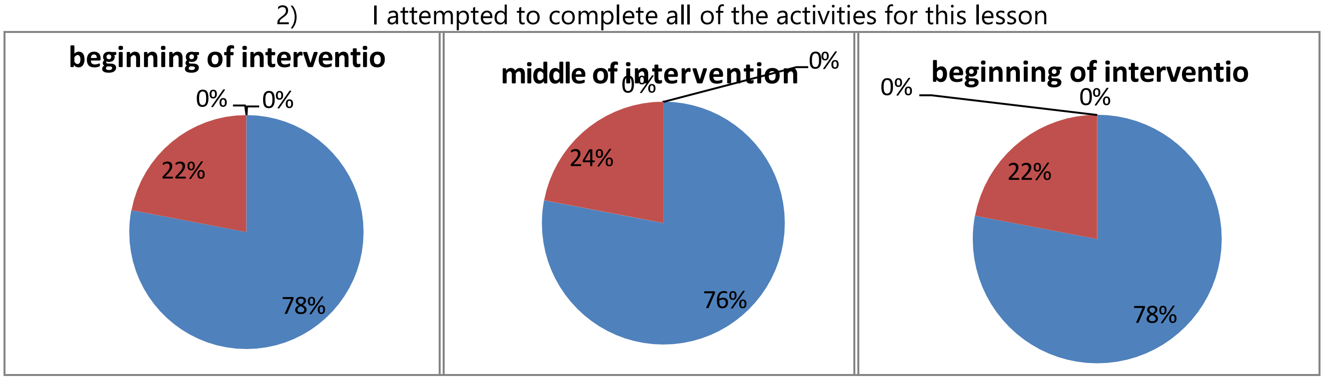


Figure 6. Attempted to complete all the activities for this lesson.

As shown in Figure 6 above, most students agreed that they attempted to complete all activities. The percentages were consistent throughout the intervention; this include that students wanted to try the activities. Most students attempted to complete all activities because the content addressed real-world problems that were relevant to them and activities were student-centered.

4. I try to understand content more by relating it to things I already know.

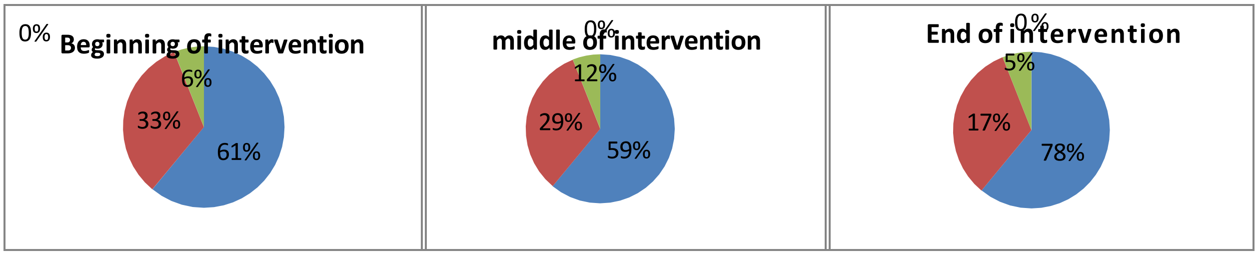


Figure 7. Understand content more

Figure 7. above shows that most students agreed that they try to understand content more by relating it to things they already know. The problems addressed during this intervention were relevant to all students. During the middle of the intervention, students had to communicate how forces affect the motion of objects by observing other students during recess. They also created their own mini-experiments. This self-guided learning was engaging because it allowed students to use their prior knowledge and personal experiences to create new knowledge.

As shown in Figure 8, Cognitive engagement increases as students depend less on the teacher and are control in control of their own learning. The student's survey questions that measured cognitive engagement show that students put fourth time and effort while attempting to learn.

4) I make an effort to think about how the information is useful in the real world.

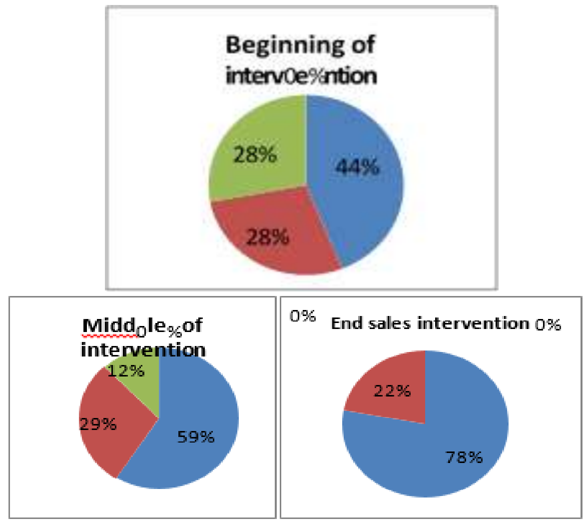


Figure 8. An effort to think about how the information is useful in the real world. Most students felt like they were working hard and they completed all assignment.

EMOTIONAL ENGAGEMENT

Emotional engagement describes how students feel about their learning. Figure 9. Below shows the contents became interesting to more students. As the intervention progressed. Learning is social process, and I believe that students being able to work in groups.

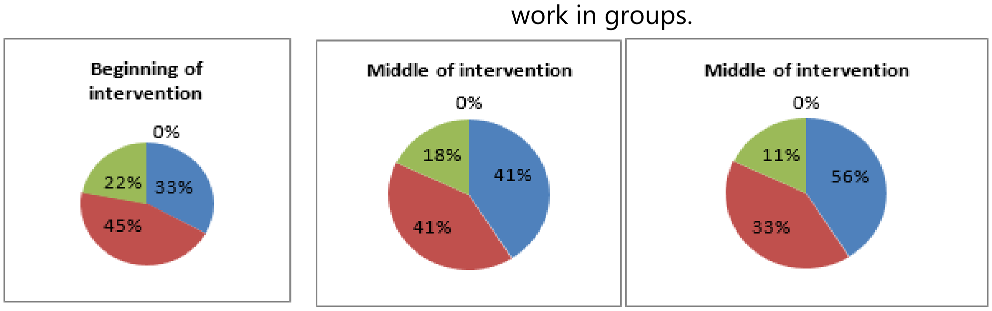


Figure 9. what we are learning is more interesting.

The percentage of students that responded neutral decreased throughout the intervention, but this indicates that some students still are not sure about how they feel about what they are learning. From any observations when I taught this unit previously, I see students being more interested than in past years

5) I think that what we are learning about is boring.

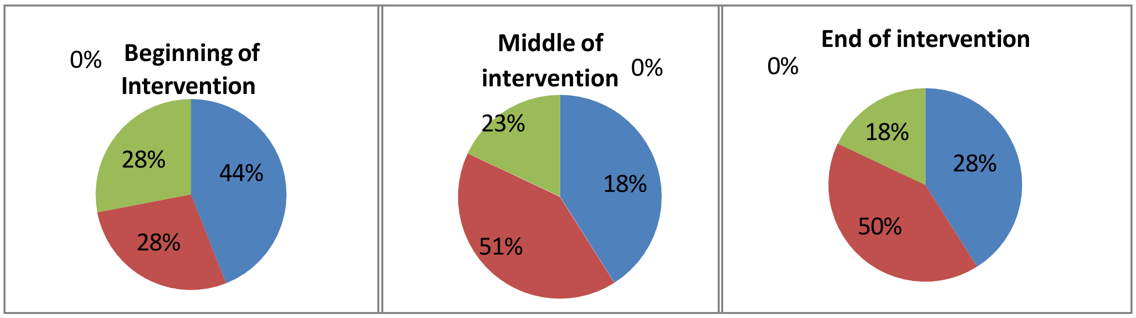


Figure 10. what we are learning about is boring. The students' response indicate how truly feel. Figurer 10. Shows that half of my students 50% do not believe that what they learning about is boring. These types of activities being conducted in this intervention are engaging for students.

I feel happy working with my group when trying to solve problems.

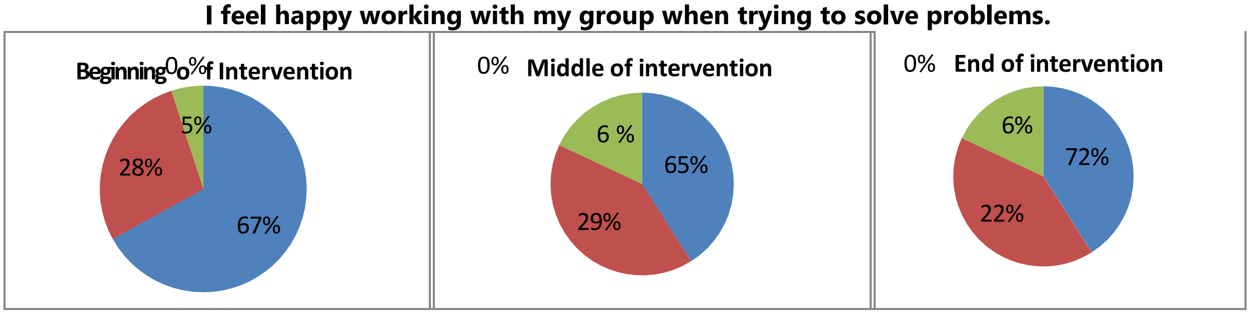


Figure 11. Happy working with my group when trying to solve problems as shown in figure 11. The majority of students agreed that they feel happy working with their group when trying to solve problems, and the percentage of students agreeing with this statement increased throughout the intervention. This indicate that students enjoyed the social aspect of working in the group, and they were able utilize life skills. Secondary school students love talking and allowed students to practice their oral communication skills. Working in groups also allowed students to have designated roles and responsibilities. I observed several students being excited about their role as facilitator, recorded, timekeeper, or spokesperson. Students had to hold one another accountable, and their responses for this question indicate they enjoyed doing this. In additional, students did not have to solve problem on their own. Being able to collaborate created a positive classroom environment, and these encouraged students to be active participants.

7) I Feel sad working with my group when trying to solve problems

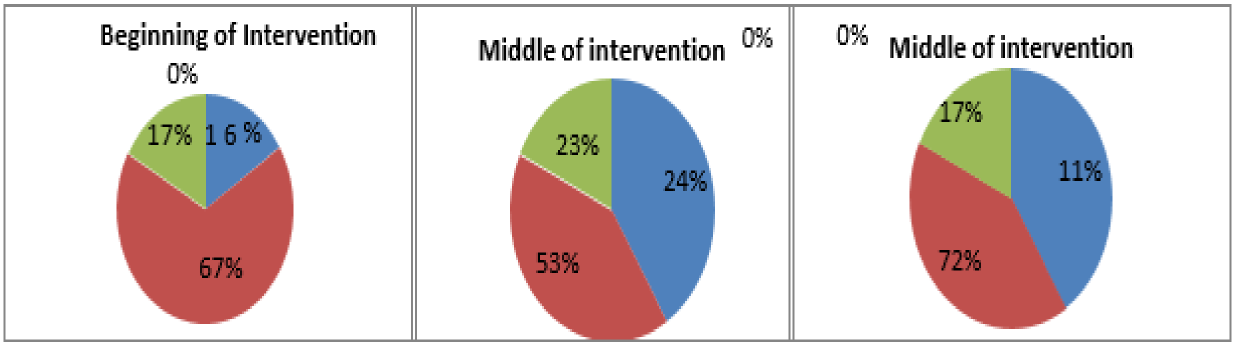


Figure 12. Sad working with my group when trying to solve problems

As shown in figure 12. At the beginning of the intervention, the majority of students disagreed (67%) with sad feeling sad while working with their group when trying to solve problems. The percentage decreased during the middle of the intervention, and the percentage of students who agree increased. Students were in pairs at the beginning of the intervention, and groups of three to four students were formed during the middle of the intervention. The slight increase in students feeling sad could be due to the changing group dynamics. Students had to find their place and perform designated roles in their new groups. At the end of the intervention, more students disagreed (72%) with feeling sad while working with their group.

The student's survey questions that measured emotional engagement show that the majority of students had positive responses to learning. Most students found learning to be interesting, and most of the students were happy working in groups while trying to solve problems.

Behavioural Engagement

Foe this research study, behavioral engagement describes students' conduct while learning. The student engagement survey measured students' behavioral engagement.

8) I feel like I have a chance to interact with my group members.

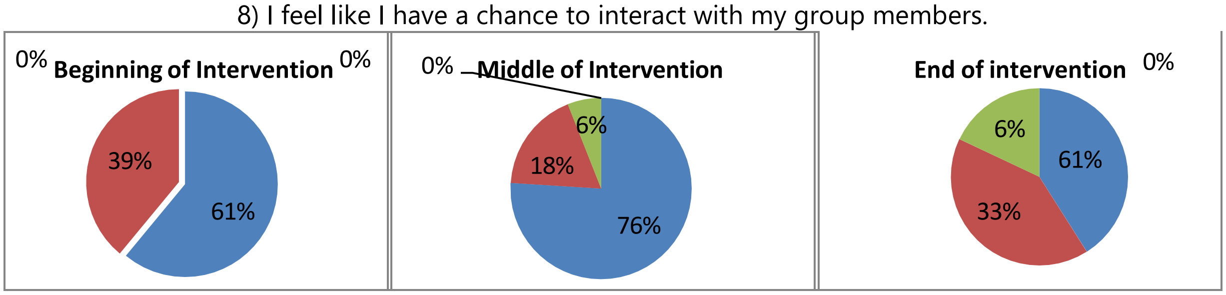


Figure 13. Chance to interact with my group members

As shown in the figure 13. Most students agreed that there had a chance to interact with their group members. This percentage increased during the middle of the intervention. This could indicate that students had more opportunities to talk and have discussions during this part of the intervention. Students were able to go outside for two days during this period, and this gave students opportunities to have discussions and conduct experiments they created.

9) I enjoy talking with my group members.

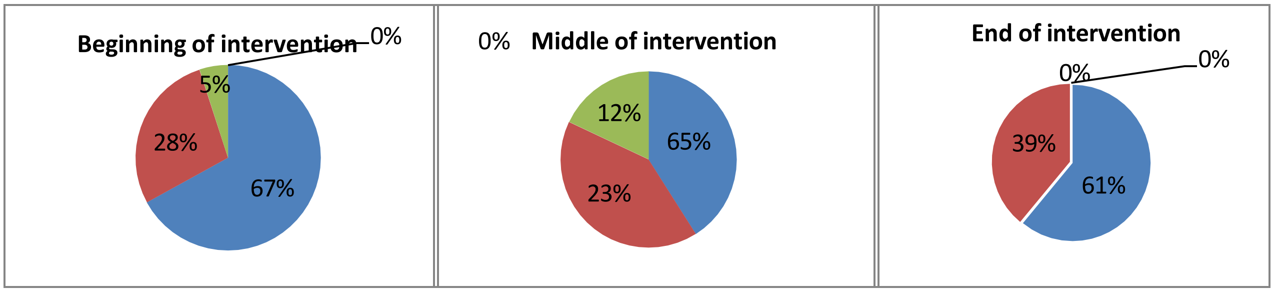
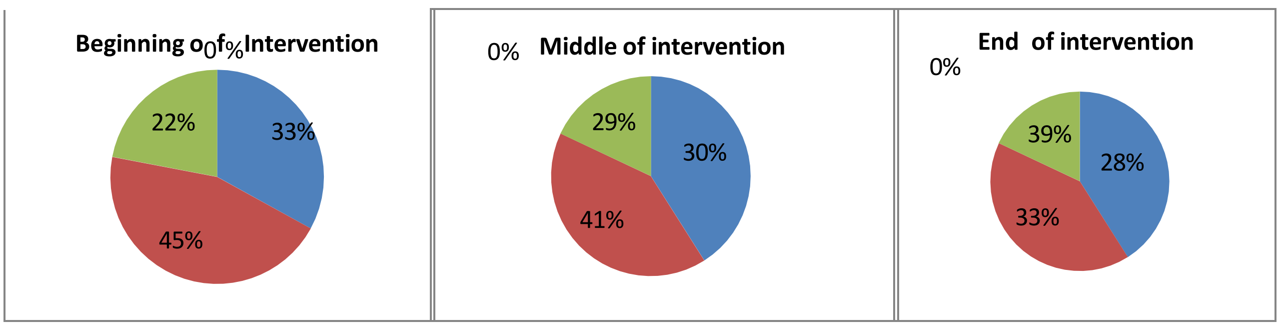


Figure 14. Shows talking with my group members

Figure 14. Shows that most students enjoyed talking with their group members throughout the intervention. Students mostly worked in pairs during the beginning of the intervention. After the problem was introduced. Students had to share information they knew about the problem and any thoughts they had. They also had to complete concepts maps with partners about causes, indicators, possible solutions, and consequences for each problem.

10) My mind wanders while working with my group



.Figure 15. My mind wanders while working with my group

Although mind wondering could indicate cognitive engagement, for this question I am focusing on the observable behaviors that result from students' mind wandering. Figure 15 shows that some students agreed that their mind wanders while working with their groups. This decreased slightly by the end of the intervention. Throughout the intervention, students were working together in pairs or groups. They had 40 minutes each day to complete their activities, and some students did not utilize the entire class periods to complete their assignments.

Figure 16. An active participant in my group

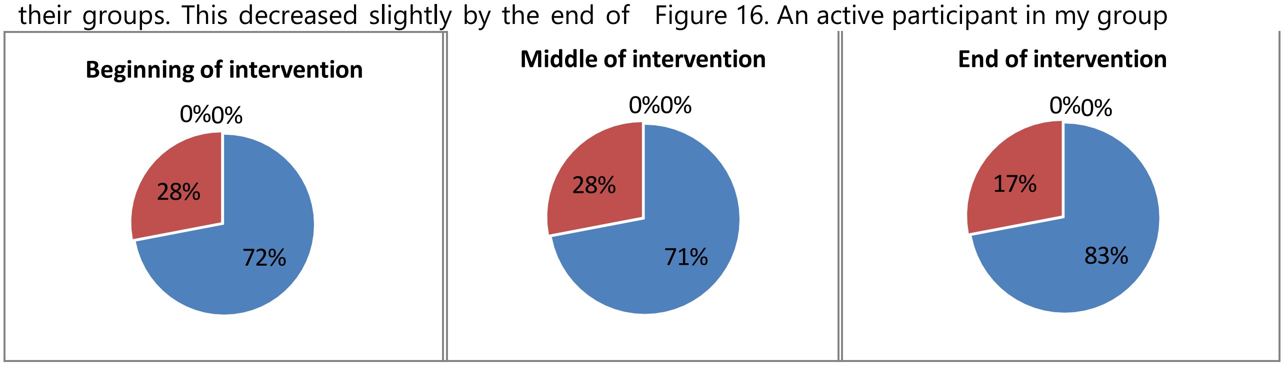


Figure 16. Shows that most students agreed that they were active participants in their group. Throughout the intervention, students were having discussions, researching information, conducting observation, and creating experiments and presentations. Students were collaborating with their

groups, and each student had a specific role in their group. The learning was student centered, and students were taking control of their own learning. Several students gave neutral responses for this question, but the neutral responses started to decrease by the end of the intervention.

Qualitative Field Notes Result

Observation and interviews revealed that secondary school students struggle with abstract concepts, such as chemical bonding and reactions, such as chemical bonding and reactions. Students expressed difficulty in visualizing and understanding complex processes, citing inadequate prior knowledge and insufficient hands-on activities. Language barriers and lack of relevance to real-life situations also hindered comprehension. Student's notes and drawings reflected misconception and incomplete understanding of key concepts, highlighting the need for more effective teaching strategies and resources to support student learning and overcome these obstacles. These findings align with

Discussion Of The Findings

The study's findings highlight the significant challenges secondary school students face in comprehending specific topics in chemistry. The major obstacles identified, including abstract concepts, inadequate prior knowledge, and insufficient hands-on activities, are consistent with existing research in chemistry education (Taber, 2013). The findings also suggest that language barriers And lack of relevance to real-life situations to students' difficulties in understanding complex chemistry concepts.

The study's results have implications for teaching and learning practice in chemistry education. Teachers should prioritize hands-on activities, visual aids, and real-world examples to help students develop a deeper understanding of abstract concepts (Hofstein & Mamlok-Naaman, 2011). Additionally, teachers should strive to make chemistry relevant and meaningful to student's lives, highlighting the practical applications and importance of chemistry In everyday situations (Osborne & Dillon, 2008). By addressing these obstacles and implementing effective teaching strategies, educators can improve students' comprehension and motivation in learning chemistry, ultimately enhancing their academic achievement and career opportunities. Overall, the study's findings emphasize the need for a more student-centered and interactive approach to teaching chemistry, one that acknowledges the complexities and challenges of learning chemistry concepts

The Need For Scaffolding

The major obstacles encountered by secondary school students in comprehending specific topics in chemistry highlight the need for scaffolding involves providing temporary support and guidance to help students build their understanding of complex concepts (Wood et al., 1976). In chemistry education, scaffolding can take the form of visual aids, hands-on activities, and real-world examples that help students connect abstract concepts to concrete experiences. By providing scaffolding, teachers can help students overcome obstacles such as abstract concepts, inadequate prior knowledge, and language barriers. Scaffolding can also help students develop critical thinking and problem-solving skills, essential for success in chemistry and other STEM fields. By incorporating scaffolding into their teaching practices, educators can create a more supportive and inclusive learning environment that fosters student understanding and motivation in learning chemistry. This can lead to improved academic achievement and career opportunities.

Needed Support With Research Skills.

Secondary school students require support with research skills to overcome obstacles in comprehending chemistry concepts. This includes training in information literacy, critical thinking, and problem solving, students need guidance on how to locate and evaluate credible sources, analyze data, and interpret results. Additionally, they require support in developing research questions, designing experiments, and communicating findings. By providing this support, educators can help students develop essential research skills, build confidence, and improve their understanding of complex chemistry concepts, ultimately enhancing their academic achievement and career prospects in STEM fields. This support is crucial for success.

Need To Enhance Communication Skills.

Secondary school students need to enhance their communication skills to effectively comprehend and convey complex chemistry concepts. This includes developing verbal and written communication skills, such as explaining scientific process, interpreting data, and presenting findings. Students should be encouraged to ask questions, engage in discussion, and clarify doubts to foster a deeper understanding of chemistry concepts. By improving communication skills, students can better articulate their thoughts, collaborate with peers, and seek help when needed, ultimately leading to 9mproved academic performance and increased confidence in learning chemistry. Effective communication is essential for success in chemistry.

Lack Of Time

Secondary school students often face significant obstacles in comprehending chemistry concepts due to lack of time. Insufficient time to complete assignments, prepare for exams, and review complex concepts can lead to inadequate understanding and retention of material. Additionally, teachers may rush through lessons to cover the curriculum, leaving students with limited opportunities to ask questions and clarify doubts. As a result, students may feel overwhelmed and struggle to keep up, ultimately hindering their ability to fully comprehend and apply chemistry concepts. This time constraint can exacerbate existing difficulties and hinder academic success.

Triangulation

To ensure validity and reliability, this study employed triangulation to investigate the major obstacles encountered by secondary school students in comprehending chemistry concepts. Data was collected through surveys, interviews, and observations, providing a comprehensive understanding of the challenges faced by students. The findings were then cross-verified across these methods, revealing consistent themes and patterns. For example, students' survey and interviews highlighted the difficulty of abstract concepts, while observations of classroom teaching practices confirmed the lack of hands-on activities and visual aids. Triangulation strengthened the study's conclusions, providing a more accurate and nuanced understanding of the obstacles.

Data Analysis

Thematic analysis and coding were used to identify patterns and themes in student responses, revealing key obstacles in comprehending chemistry concepts, such as abstract concepts and lack of hands-on activities.

Summary Of The Findings

This study investigated the major obstacles encountered by secondary school students in comprehending specific topics in chemistry. The findings revealed that students face significant challenges in understanding complex chemistry concepts, including abstract concepts, inadequate prior knowledge and lack of hands-on activities. The study employed a mixed-methods approach, combining surveys, interviews, and observations to gather data from students and teachers.

The results showed that students struggle to comprehend abstract concepts, such as chemical bonding and reactions, due to the lack of visual aids and reactions, due to the lack of visual aids and hands –on activities. Additionally, students' prior knowledge and understanding of fundamental chemistry concepts were found to be inadequate, hindering their ability to build upon and comprehend more complex topics.

The study also identified the language barriers and lack of relevance to real-life situations as significant obstacles ton students' understanding of chemistry concepts. Furthermore, the findings highlighted the need of scaffolding, support with research skills, and enhancement of communication skills to facilitate students' learning and comprehension of chemistry concepts.

The results of this study have implications for teaching and learning practices in chemistry education. Teachers should prioritize hands-on activities, visual aids, and real-world examples to help students develop a deeper understanding of complex chemistry concepts. Additionally, teachers should provide scaffolding support, encourage students to ask questions, and foster a collaborative learning environment to promote students' comprehension and motivation in learning chemistry.

Overall, the findings of this study emphasize the need for more student-centered and interactive approach to teaching chemistry, one that acknowledges the complexities and challenges of learning concepts. By addressing these obstacles and implementing effective teaching strategies, educators can improve students' comprehension and motivation in learning chemistry, untimely enhancing their academic achievement and career opportunities in STEM fields.

V. DISCUSSION, CONCLUSIONS AND RECOMMENDATIONS

Introduction

This chapter discusses the major obstacles encountered by secondary school students in comprehending specific topics in chemistry. The study revealed that students face significant challenges in understanding complex chemistry concepts, including abstract concepts, inadequate prior knowledge, and lack of hands-on activities. The findings highlight the need for more student-centered and interactive approach to teaching chemistry, one that acknowledges the complexities and challenges of learning chemistry concepts. This chapter summarizes the key findings, discusses the implications, and provides conclusions and recommendations for improving chemistry education in secondary schools.

Discussion Of The Findings

The study's findings reveal that secondary school students encounter significant obstacles in comprehending chemistry concepts, including abstract concepts, inadequate prior knowledge, and lack of hands-on activities. These obstacles hinder students' ability to build a strong foundation in chemistry, leading to difficulties in understanding complex topics. The findings suggest that teachers should adopt a more student-centered approach, incorporating visual aids, real-world examples, and hands-on activities to facilitate deeper understanding and engagement. By addressing these obstacles, educators can improve students' comprehension and motivation in learning chemistry, ultimately enhancing their academic achievement and career prospects.

Findings Related To The Literature

The study's findings align with existing literature, highlighting abstract concepts, inadequate prior knowledge, and lack of hands-on activities as major obstacles to chemistry comprehension. These findings support previous research, emphasizing the need for a more interactive and student-centered approach to teaching chemistry.

Research Question 1:

What are the major obstacles encountered by secondary school students in comprehending specific topics in chemistry?

The findings of this study reveal that secondary school students encounter several obstacles in comprehending chemistry concepts, including:

- **Abstract concepts:** Students struggle to understand complex and abstract concepts, such as chemical bonding and reactions.
- **Inadequate prior knowledge:** students' prior knowledge and understanding of fundamental chemistry concepts are often inadequate, hindering their ability to build upon and comprehend more complex topics.
- **Lack of hands-on activities:** Students require hands-on activities and experiments to develop a deeper understanding of chemistry concepts, but these are often lacking in the classroom.
- **Language barriers: S**tudents who are non-native English speakers or have limited proficiency in the language of instruction may struggle to comprehend chemistry terminology and concepts.
- **Limited resources:** Students may not have access to adequate resources, such as textbooks, laboratory equipment, and technology, to support their learning.

These obstacles can hinder students' ability to comprehend and apply chemistry concepts, ultimately affecting their academic achievement and career prospects. By identifying these obstacles' educators can develops targeted strategies to support students' learning and improve their understanding of chemistry concepts.

RESEARCH QUESTION 2:

What are the effects of these obstacles on the academic achievement and motivation of secondary school students in learning chemistry?

The findings of this study suggest that the obstacles encountered by secondary school students in comprehending chemistry concepts can have a significant impact on their academic achievement and motivation (Osborne& Dillon, 2008). According to Taber (2013), students who struggle to comprehend abstract concepts and lack hands-on activities may become disengaged and lose motivation in learning chemistry. Additionally research by Hofstein and Mamlok-Naaman (2011) indicates that language barriers and limited resources can exacerbate the effects, leading to poor academic performance and decreased interest in science. Furthermore, a study by lederman and lederman (2013) found that students who experience difficulties in learning chemistry may develop negative attitudes towards the subject, which can affect their future career choices. Overall, the obstacles encountered by secondary school students in comprehending chemistry concepts can have far-reaching consequences for their academic achievement and motivation (Bennett, Lubben, & Hogrth, 2007).

RESEARCH QUESTION 3:

What strategies can be employed by educators to overcome the obstacles encountered by secondary school students in comprehending chemistry concepts?

The study suggests that educators can employ a range of strategies to overcome the obstacles encountered by secondary school students in comprehending chemistry concepts. According to Hofstein and Manlok-Naaman (2011), hands-on activities, visual aids, and real-world examples can facilitate deeper understanding and engagement. Additionally, educators can provide scaffolding support to help students build upon their prior knowledge and understanding (Ledrman & lederman, 2013). Encouraging student inuiry and using technology to enhance learning can also be effective strategies (Osborne & Dillon, 2008). Furthermore, educators can use multimedia resources, such as videos and simulations, to help students visualize complex concepts and processes (Kumar, 2011). By implementing these strategies, educators can help students overcome obstacles and develop a stronger understanding of chemistry concepts, ultimately improving their academic achievement and motivation. Overall, a combination of these strategies can be used to create a supportive and inclusive learning environment that fosters student understanding and engagement in chemistry. This can help to improve student outcomes and increase their interest in pursuing careers in science, technology, engagement, and mathematics (STEM)

Positive Impact Of Obstacles On Students' Achievement

The implementation of effective strategies to overcome the o obstacles encountered by secondary school students in comprehending chemistry concepts can have a positive impact on their academic achievement. According to research by Osborne and Dillon (2008), students who receive hands-on activities and visual aids show significant improvement in their understanding of complex chemistry concepts. Additionally, a study by lederman and lederman (2013) found that students who receive scaffolding support and encouragement to ask questions demonstrate increased confidence and motivation in learning chemistry.

Furthermore, the use of technology and multimedia resources can also enhance student engagement and understanding, leading to improved academic achievement (Kumar, 2011). By addressing the obstacles encountered by secondary school students, educators can create a supportive and inclusive leaning environment that fosters student understanding and achievement in chemistry. This can lead to improved grades, increased motivation, and a greater interest in pursuing careers in science, technology, engineering, and mathematics (STEM). Overall, the positive impact of effective strategies can be seen in improved student outcomes, increased confidence, and a stronger foundation in chemistry concepts. This can have long-term benefits for students, including improved career prospects and a greater ability to succeed in a rapid changing world.

Negative Impact Of Obstacles On Students' Achievement

The failure to address the obstacles encountered by secondary school students in comprehending chemistry concepts can have a negative impact on their academic achievement. According to research by Taber (2013), students who struggle to understand complex chemistry concepts may become disengaged and lose motivation in learning chemistry, leading to poor academic performance and decreased interest in science. Additionally, a study by Hofstein and Mamlok- Naaman (2011) found that students who lack hands-on activities and visual aids may develop misconceptions and incomplete understanding of chemistry concepts, which can be difficult to rectify. Furthermore, the lack of scaffolding support and encouragement to ask questions can lead to decreased confidence and motivation in learning chemistry, resulting in a negative impact on student outcomes (Lederman & ledemran, 2013). The negative impact can also be seen in decreased grades, increased frustration, and lack of interest in pursuing in science, technology, engineering, and mathematics (STEM). Overall, the failure to address the obstacles encountered by secondary school students can have long-term consequences, including limited career opportunities and a lack of preparation for an increasingly complex and technologically driven world. This can have a lasting impact on students' future success.

Summary Of The Study Findings

This study investigates the major obstacles encountered by secondary school students in comprehending specific topics in chemistry. The findings revealed that students face significant challenges in understanding complex chemistry concepts, including abstract concepts, inadequate prior knowledge, and lack of hands-on activities. The study also identified language barriers and limited resources as significant obstacles to students understanding of chemistry concepts.

The findings suggest that the obstacles encountered by secondary school students can have a negative impact on their academic achievement, motivation, and interest in learning chemistry. Students who struggle to understand complex chemistry concepts may become disengaged and lose motivation in learning chemistry, leading to poor academic performance and decreased interest in science.

On the other hand, the study found that the implementation of effective strategies to overcome the obstacles encountered by secondary school students can have a positive impact on their academic achievement. Hands-on activities, visual aids, and real-examples can facilitate deeper understanding and engagement, while scaffolding support and encouragement to ask questions can increase confidence and motivation in learning chemistry.

The study's findings have implications for teaching and learning practices in chemistry education. Teachers should prioritize hands-on activities, visual aids, and real-world examples to help students develop a deeper understanding of complex chemistry concepts. Additionally, teachers should provide scaffolding support, encourage students to ask questions, and foster a collaborative learning environment to promote students' comprehension and motivation in learning chemistry.

Overall, the study's findings highlight the need for a more student-centered and interactive approach to teaching chemistry, one that acknowledge the complexities and challenges of learning chemistry concepts. By addressing the obstacles encountered by secondary school students and implementing effective strategies, educators can improve students' comprehension and motivation in learning chemistry, ultimately enhancing their academic achievement and career prospects in science, technology, engineering, and mathematics (STEM) fields. The study's findings can inform the development of teaching and learning materials, professional development programs for teachers, and policies to support chemistry education in secondary schools.

Implications Of The Study Findings

The findings of this study have significant implications for teaching and learning practices in chemistry education. The study's results suggest that secondary school students face significant challenges in understanding complex chemistry concepts, and that the obstacles encountered by these students can have a negative impact on their academic achievement, motivation, and interest in learning chemistry.

One of the key implications of the findings of the study's findings is the need for a more students-centered and interactive approach to teaching chemistry. Teachers should prioritize hands-on activities, visual aids, and real-world examples to help students develop a deeper understanding of complex chemistry concepts. Additionally, teachers should provide scaffolding support, encourage students to ask questions, and foster a collaborative learning environment to promote students' comprehension and motivation in learning chemistry.

Another implication of the study's findings is the need for teachers to be aware of the language barriers and limited resources that may affect students' understanding of chemistry concepts. Teachers should be sensitive to the diverse needs of their students and provide additional support to students who may be struggling with languages or resource-related issues.

The study's findings also have implications for the development of teaching and learning materials. Textbooks, online resources, and other educational materials should be designed to be engaging, interactive, and accessible to students with diverse learning needs. The materials should also be aligned with the curriculum and learning objectives, and should provide opportunities for students to practice and apply their knowledge and skills'

Finally, the study's findings have implications for policy and practices in chemistry education. Policymakers and educators should work together to develop policies and programs that support the implementation of affective teaching and learning practices in chemistry education. This may include providing professional development opportunities for teachers, developing new curriculum materials, and allocating resources to support the implementation of hands-on and interactive learning activities.

Overall, the implications of the study's findings are far-reaching and have the potential to improve the teaching and learning of chemistry in secondary schools. By addressing the obstacles encountered by secondary school students and implementing effective strategies, educators can improve students' comprehension and motivation in learning chemistry, altimetry enhancing their academic achievement and career prospects in science, technology, engineering, and mathematics (STEM) fields.

Conclusion Based On The Findings

In conclusion, the study's findings highlight the significant challenges faced by secondary school students in comprehending complex chemistry concepts. The obstacles encountered by these students, including abstract concepts, inadequate prior knowledge, lack of hands-on activities, language barriers, and limited resources, can have a negative impact on their academic achievement, motivation, and interest in learning chemistry.

The study's findings emphasize the need for a more students-centered and interactive approach to teaching chemistry, one that acknowledges the complexities and challenges of learning chemistry concepts. Teachers should prioritize hands-on activities, visual aids, and real-world examples to help students develop a deeper understanding of complex chemistry concepts. Additionally, teachers should provide scaffolding support, encourage students to ask questions, and foster a collaborative learning environment to promote students' comprehension and motivation in learning chemistry.

The study's findings also underscore the importance of addressing language barriers and limited resources that may affect students' understanding of chemistry concepts. Teachers should be sensitive to the diverse needs of their students and provide additional support to students who may be struggling with language or resource- related issues. The implications of the study's findings are far-reaching and have the potential to improve the teaching and learning of chemistry in secondary schools. By addressing the obstacles encountered by secondary school students and implementing effective strategies, educators can improve students' comprehension and motivation in learning chemistry, ultimately enhancing their academic achievement and career prospects in science, technology, engineering and mathematics (STEM) fields.

In light of the study's findings, it is recommended that educators, policymakers, and stakeholders work together to develop and implement effective teaching and learning practices in chemistry education. This may include providing professional development opportunities for teaches, development new curriculum materials, and allocating resources to support the implementation of hands-on and interactive learning activities.

Ultimately, the study's findings highlight the need for a comprehensive and sustained effort to improve the teaching and learning of chemistry in secondary school students develop a By working together and implementing effective strategies, we can help secondary school students develop a deeper understanding of complex chemistry concepts and prepare them for success in an increasingly complex and technologically driven world.

A Uasble Strategy For Secondary School Classrooms

One usable strategy for secondary school classrooms is to incorporate hands-on activities and real- world examples to help students develop a deeper understanding of complex chemistry concepts (Hofstein & Mamlok-Naaman, 2011). According to lederman and lederman (2013), hands-on activities can help students to visualize and understanding abstract concepts, such as chemical reactions and bonding, by providing a tangible and interactive way to explore these concepts. For example, a study by Kumar (2011)found that students who participated in hands-on activities, such as laboratory experiments and simulations, showed a significant improvement in their understanding of chemistry concepts compared to students who only received traditional lectures.

Another strategy is to use visual aids, such as diagrams and videos, to help students understand complex chemistry concepts (Tabar, 2013). As noted by Osborne and Dillon (2008), visual aids can help to clarify complex concepts and make them more accessible to students, particularly those who are visual learners. Additionally, teachers can use real-world examples to illustrate the relevance and importance of chemistry concepts, making them more interesting and engaging for students (Bennett, Lubben, & Hogarth, 2007).

For instance, a study by Hofstein and Mamlok-Naaman (2011) found that students who were taught using real-world examples showed a greater interest and motivation in learning chemistry compared to students who were taught using traditional methods. Furthermore, teachers can use scaffolding techniques, such as providing temporally support and guidance, to help students build their understanding to complex chemistry concepts (Wood, Bruner, & Ross, 1976). As noted by Vygotsky (1978), scaffolding can help students to develop their critical thinking and problem-solving skills, which are essential for success in chemistry. By incorporating these strategies into their teaching practice, teachers can create a more engaging and effective learning environment for their students, as suggested by the study's findings (Lederman & Lederman, 2013).

In conclusion, the use of hands-on activities, visual aids, real-world examples, and scaffolding techniques can help to improve student understanding and engagement in chemistry, as supported by the research (Hofstein & Mamlok-Naaman, 2011); Kumar, 2011; Taber, 2013). By incorporating these strategies into their teaching practices, teachers can create a more effective and engaging learning environment for their students, ultimately leading to improved academic achievement and motivation in learning chemistry.

Students Reflections On Obstacles

The students who participated in this study reflected on the obstacles they faced in learning chemistry. Many students reported that they struggled to understand complex concepts, such as chemical reactions and bonding, due to the abstract nature of the subject (Hofstein & Mamlok- Naaman, 2011). As one student noted, 'I found it hard to visualize the concepts, it was like trying to imagine something that I couldn't see' (Student 1). Another student commented, ' I didn't understand the language used in chemistry, it was like a different language' (Student 2), highlighting the language barriers that can hinder students' understanding of chemistry concepts (Osborne & Dillon, 2008).

The students also reflected on the lack of hands-on activities and real-world examples, which made it difficult for them to relate to the subject (Kumar, 2011). As one student noted, 'I wish we had more lab experiments, it would have made the subject more interesting and easier to understand' (Student 3). The students' reflections highlight the need for a more interactive and engaging approach to teaching chemistry, one that incorporates hands-on activities, visual aids, and real-world examples to help students develop a deeper understanding of complex chemistry concepts (Taber, 2013).

Teacher Refletion On Obstacles

As chemistry teacher, I have come to realize that my students face numerous obstacles in learning chemistry. Upon reflection, I acknowledge that I may have contributed to these obstacles by not providing sufficient hands-on activities and real-world examples to help students understand complex concepts (Hofstein & Mamlok- Naaman, 2011). I recall; a student commenting, 'I wish we had more lad experiments, it would have made the subject more interesting and easier to understand' (Student 3). This comment made me realize the importance of incorporating more practical activities into my teaching.

I also recognize that I may have used language and terminology that was unfamiliar to my students, which may have created a barrier to their understanding (Osborne & Dillon, 2008). As Taber (2013) notes, 'the language of chemistry can be significant obstacle to learning. 'I plan to use simpler language and provide more opportunities for students to ask questions and clarify their doubts.

To improve my teaching practice, I will incorporate more hands-on activities, visual aids and real- world examples into my lessons. I will also provide additional support to students who struggle with language barriers and ensure that my teaching is more student-centered and interactive.

Future Questions

1. How can technology be used to enhance student understanding to complex chemistry concepts?
2. What is the impact of hands-on activities on student motivation and engagement in chemistry education?
3. How can teachers use real-world examples to illustrate the relevance and importance of chemistry concepts?
4. What are the most effective strategies for teaching chemistry to students with diverse learning needs?
5. How can scaffolding techniques be used to support student learning in chemistry?
6. What is the role of language in chemistry education, and how can teachers address language barriers?
7. How can teachers use assessment and feedback to improve student learning in chemistry?
8. What are the implications of using multimedia resources in chemistry education, and how can they be effectively integrated into teaching practice?
9. How can teachers use collaborative learning strategies to promote student engagement and understanding in chemistry?
10. What are the most effective ways to teach chemistry concepts to students who have had limited prior exposure to the subject?
11. How can teachers use feedback from students to inform and improve their teaching practices in chemistry education?

IMPACT OF OBSTACLES

The obstacles encountered by secondary school students in learning chemistry can have a significant impact on their academic achievement, motivation, and interest in the subject. According to research by Osborne and Dillon (2008), students who struggle with chemistry concepts may become disengaged and lose motivation, leading to poor academic performance and decrease interest in science. Additionally, a study by Hofstein and Mamlok-Naaman (2011) found that students who experience difficulties in learning chemistry may develop negative attitudes towards the subject, which can affect their future career choices and opportunities. This can have long-term consequences for students' academic and professional success.

LIMITATION OF THE RESEARCH STUDY

This research study has several limitations that need to be acknowledged. Firstly the study was conducted in a specific context, Chelstone Secondary and Munali Boys High School in particular region in Lusaka province, which may not be representative of all secondary schools or regions. As noted by Kumar (2011), the findings of this study may not be generalizable to other contexts or populations. Additionally, the study relied on self-reported data from students, which may be subjected to biases and limitations (Osborne & Dillon, 2008).

Another limitation of the study is that it focused primarily on the obstacles encountered by students in learning chemistry, without exploring the potential solutions or interventions that could be implemented to address these obstacles. According to Hofstein and Mamlok-Naaman (2011), further research is needed to investigate the effectiveness of different teaching strategies and interventions in supporting student learning in chemistry.

The study also had a relatively small sample size, which may not be representative of the larger population of secondary school students. As noted by Taber (2013), a larger sample size would be needed to increase the generalizability of the findings. Furthermore, the study did not control for other variables that may have influenced the results, such as student motivation, prior knowledge, or socioeconomic status (Bennett, Lubben, & Hogarth, 2007).

Finally, the study was cross-sectional in design, which means that it only provided a snapshot of the obstacles encountered by students at a particular point in time. as noted by Wood, Bruner, and Ross (1976), a longitudinal design would be needed to explore the development of student understanding and obstacles over time. Despite these limitations, the study provides valuable insights into the obstacles encountered by secondary school students in learning chemistry, and highlights the need for further research and development of effective teaching strategies and interventions.

Recommendations

- **Practical Recommendations**

Based on the findings of the study, the following practical recommendations are made:

1. Incorporate hands-on activities: Teachers should incorporate hands-on activities and experiments into their teaching practices to help students develop a deeper understanding of complex chemistry concepts (Hofstein & Mamlok-Naaman, 2011).
2. Use visual aids: Teachers should use visual aids such as diagrams, videos, and simulations to help students visualize and understand complex chemistry concepts (Kumar, 2011).
3. Provide scaffolding support: Teachers should provide scaffolding support to students who struggling with chemistry concepts, such as providing additional instruction or support (Wood, Bruner, and Ross, 1976).
4. Use real-world examples: Teachers should use real-world examples to illustrate the relevance and importance of chemistry concepts, making them more interesting and engaging for students (Bennett, Lubben, & Hogarth, 2001).
5. Encourage student inquiry: Teachers should encourage student inquiry and curiosity, allowing students to explore and discover chemistry concepts in a more interactive and engaging way (Osborne & Dillon, 2008).

By implementing these practical recommendations, teachers can help to improve student understanding and engagement in chemistry, and provide a more effective and supportive learning environment.

Policy Recommendations

Based on the findings of this study, the following policy recommendations are made:

1. Develop and implement effective teaching strategies: Educational policymakers should develop and implement effective teaching strategies that address the obstacles encountered by students in learning chemistry, such as hands-on activities, visual aids, and real-world examples (Hofstein & Mamlok-Naaman, 2011).
2. Provide professional development opportunities: Policymakers should provide professional development opportunities for teachers to enhance their knowledge and skills in teaching chemistry, including training on effective teaching strategies and the use of technology (Kumar, 2011).
3. Increase funding for science education: Policymakers should increase funding for science education to provide schools with the necessary resources, including laboratory equipment, technology, and materials, to support effective teaching and learning (Osborne & Dillon, 2008).
4. Develop and implement assessment and evaluation tools: Policymakers should develop and implement assessment and evaluation tools to measure student understanding and progress in chemistry, and to identify areas where students need additional support (Black & William, 1998).
5. Promote collaboration and partnerships: Policymakers should promote collaboration and partnerships between schools, universities, and industry to provide students with opportunities for hands-on learning, internships, and career development (Bennett, Lubben, and Hogarth, 2007).

Contributions To Knowledge

This study contributes to the existing body of knowledge in several ways:

1. **Identification of obstacles:** The study identifies the obstacles encountered by secondary school students in learning chemistry, including abstract concepts, inadequate prior knowledge, and lack of hands-on activities (Hofstein & Mamlok-Naaman, 2011).
2. **Development of effective teaching strategies:** The study provides insights into the development of effective teaching strategies that can help to overcome these obstacles, such as hands-on activities, visual aids, and real-world examples (Kumar, 2011).
3. **Understanding of student learning:** The study contributes to our understanding of how students learn chemistry, including the importance of prior knowledge, motivation, and engagement (Osborne & Dillon, 2008).
4. **Implications for policy and practice:** The study has implications for policy and practice in science education, including the need for increased funding, professional development opportunities, and assessment and evaluation tools (Bennett, Lubben, & Hogarth, 2007).
5. **Contribution to the field of chemistry education:** The study contributes to the field of chemistry education by providing a comprehensive understanding of the obstacles encountered by secondary school students and the development of effective teaching strategies to overcome these obstacles.

Overall, this study contributes to the existing body of knowledge in chemistry education by providing deeper understanding of the obstacles encountered by secondary school students and the development of effective teaching strategies to overcome these obstacles.

Suggestions For Further Studies

This study has identified several areas that require further investigation to improve our understanding of the obstacles encountered by secondary school students in learning chemistry. Some suggestions for further studies include:

1. **Investigating the impact of technology on student learning:** Further research is needed to investigate the impact of technology on student learning In chemistry, including the use of simulations, games, and online resources (Kumar, 2011).

2. **Development and evaluating effective teaching strategies**: Further research is needed to develop and evaluate effective teaching strategies that can help to overcome the obstacles encountered by students in learning chemistry, such as hands-on activities, visual aids, and real-world examples (Hofstein & Mamlok-naaman, 2011).
3. **Examining the role of prior knowledge and motivation:** Further research is needed to examine the role of prior knowledge and motivation in student in learning in chemistry, including the impact of prior knowledge on student understanding and the role of motivation in student engagement (Osborne & Dillon, 2008).
4. **Investigating the impact of assessment and evaluation on student learning:** Further research is needed to investigate the impact of assessment and evaluation on student learning in chemistry, including the use of formative and summative assessments (Black & Wiliam, 1998).
5. **Developing and implementing professional development programs for teachers:** Further research is needed to develop and implement professional development programs for teacher that can help to improve their knowledge and skills in teaching chemistry, including training on effective teaching strategies and skills in teaching chemistry, including training on effective teaching strategies and the use of technology (Bennet, Lubben, & Hogarth, 2007).
6. **Examining the impact of school and classroom factors on student learning:** Further research is needed to examine the impact of school and classroom factors on student learning in chemistry, including the role of school resources, classroom environment, and teacher- student relationships (Taber, 2013).
7. **Investigating the use of multimedia resources in chemistry education:** Further research is needed to investigate the use of multimedia resources, such as videos and podcasts, in chemistry education, including their impact on student learning and engagement (Kumar, 2011).
8. **Developing and evaluating online chemistry courses:** Further research is needed to develop and evaluate online chemistry courses, including their impact on student learning and engagement (Osborne & Dillon, 2008).

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