STUDENTS PERCEPTION ON THE USE OF MULMEDIA AND METACOGNITIVE LEARNING STRATEGIES FOR INTEGRATED SCIENCE EDUCATION ENHANCEMENT

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JANUARY, 2026

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A PROJECT IS SUBMITTED TO THE DEPARTMENT OF CURRICULUM AND INSTRUCTIONAL TECHNOLOGY (C.I.T), FACULTY OF EDUCATION IN PARTIAL FULFILLMENT OF THE REQUIREMENT FOR THE AWARD OF THE BACHELOR OF SCIENCE DEGREE IN INTEGRATED SCIENCE EDUCATION [B.SC. (Ed.)], UNIVERSITY OF BENIN, BENIN CITY.

JANUARY, 2026

CERTIFICATION

This is to certify that this project work was carried out by Yvonne IYERE with Matriculation Number EDU2106467 in the Department of Curriculum and Instructional Technology, Faculty of Education, University of Benin, Benin City, in partial fulfillment of the requirement for the award of Bachelor Degree in Education [B.Sc. (Ed)] in Integrated Science

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DEDICATION

This work is solely dedicated to Almighty God who is the author of knowledge and wisdom for his loving kindness, grace and mercies throughout my academic

ACKNOWLEDGEMENTS

The success story of this work has been made possible by two distinct personalities, God and man. First and foremost, I would like to appreciate God Almighty for His role in my entire life and education. I would not be here without Him.

I sincerely express my profound gratitude to my highly esteemed and dedicated supervisor, Dr. I. L. Osemwegie Ero, for his patience, scholarly guidance, constructive criticism, and invaluable supervision throughout the course of this project. His intellectual input, encouragement, and prompt responses were instrumental to the success of this work. I am truly grateful, sir.

My appreciation also goes to the academic staff of the Department of Curriculum and Instructional Technology, University of Benin, particularly Dr. F. O. Idehen, the Head of Department, for providing an enabling academic environment. I extend special thanks to Dr. M. Ighineweka, Chairman of Teaching Practice, and Dr. (Mrs.) I. K. Oteze, for their guidance and administrative support. I am especially grateful to my Course Advisor, Dr. P. E. Ikuereye, for his accessibility, mentorship, and consistent academic support throughout my programme.

I would also like to appreciate the staff of the departmental office, Mr H.O Obaraye, Mrs H. Oamen, Mr A. Badamasi, Mrs E.T Efekimo, for their kindness, patience, and willingness to assist whenever the need arose. Your friendly disposition and support contributed greatly to the smooth completion of my academic programme. My heartfelt gratitude goes to my beloved parents, Mr. and Mrs. Edwin Iyere, for their unwavering love, sacrifices, prayers, and encouragement. Your belief in me and your continuous support laid a solid foundation for this achievement. I am deeply thankful to my uncles,Mr Arthur Iyere and Mr Unity Iyere, for their generous sponsorship and financial assistance, which played a significant role in my academic success. I also appreciate my aunties, Mrs Faith, Mrs Toyin, Miss Charity, Mrs Elizabeth and my uncle Mr Prosper Iyere for their care, encouragement, and moral support throughout my studies. I am grateful to my wonderful siblings, Blessing, Pamela, and Divine, for their love, patience, motivation, and constant reassurance during challenging moments. Your presence and support meant so much to me.

Special appreciation goes to my special friend Fortune, for his continuous encouragement, unwavering belief in my abilities, and consistent support throughout this academic journey. Your words of motivation, reassurance, and quiet strength made this journey easier and more meaningful.

I also extend my sincere appreciation to my friends those who became more than friends Peace, Merrimet, Grandmistress, Godstime, Loveth, Joy, Kulture, Olly, Dera, Judith, Ruyi, Kome, Gift, Ayomide, Dorcas, Fisayomi, Favour Rex, Tega, Kenneth, Chris and Casablanca. Thank you all for your support, encouragement, shared laughter, understanding, and moments of joy that carried me through this journey. My appreciation would be incomplete without acknowledging the WCF Secretariat brethren for their spiritual support, prayers, and encouragement. I am also deeply grateful to my WCF family, who treated me as their own Mama T, Fejiro, Praise, Nemi, Michael,

Sir Ochuoko, Jonathan, and Dave. Your love, fellowship, and sense of belonging strengthened me both spiritually and emotionally, and I remain truly thankful.
I sincerely appreciate Pastey Isaac for his spiritual backing, teachings and constant guidiance. His advice, love and care played a meaningful role in my journey, and i do not take it for granted.

I am deeply grateful to Sir Maxwell for his immense help and unwavering support throughout my university years. His mentorship, guidance, and constant encouragement shaped my academic journey in ways I will always cherish. Beyond being a mentor, he was truly my school mummy, always supportive, intentional, and present. His intelligence and creativity have greatly contributed to the person I am today, and his consistent push challenged me to grow, improve, and become a better version of myself.

Finally, and most importantly, I wish to acknowledge myself. I celebrate my resilience, courage, discipline, and unwavering determination. In the face of pressure, uncertainty, exhaustion, and silent struggles, I stood firm. I showed up even on days it felt overwhelming, remained committed when giving up seemed easier, and trusted the process despite the challenges. This work is a reflection of my strength, growth, perseverance, and belief in my dreams. I am proud of how far I have come.

To everyone not mentioned here but who contributed in one way or another to the success of this work, I remain profoundly grateful.

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ABSTRACT

This study examined students' perceptions of the use of multimedia and metacognitive learning strategies for enhancing Integrated Science education at the University of Benin, Edo State, with emphasis on students' awareness, perceptions, and learning experiences.

A descriptive survey research design was adopted for the study. The population comprised undergraduate students of Integrated Science Education at the University of Benin, from which a suitable sample was selected using an appropriate sampling technique. Data were collected using a validated and reliable structured questionnaire and analyzed using descriptive statistics such as mean and standard deviation

Findings revealed that students generally had positive perceptions of multimedia and metacognitive learning strategies, as they enhanced understanding, engagement, critical thinking, and retention of scientific concepts. However, challenges such as inadequate instructional facilities, limited access to multimedia resources, insufficient lecturer expertise, and time constraints were identified. The study concluded that these strategies can significantly enhance Integrated Science education when effectively implemented.

CHAPTER ONE

INTRODUCTION

Background of the Study

Science education plays a vital role in promoting national development, technological advancement, and the cultivation of scientifically literate citizens capable of addressing contemporary global challenges. In Nigeria, Integrated Science occupies a strategic position within the educational system because it brings together core scientific disciplines such as biology, chemistry, physics, and earth science into a unified curriculum. This interdisciplinary structure promotes a holistic understanding of scientific concepts and equips learners with the foundational knowledge necessary for further studies in Science, Technology, Engineering, and Mathematics (STEM) fields (National Commission for Colleges of Education [NCCE], 2020).

Scholars have emphasized the importance of Integrated Science in national and sustainable development. Obo (2023) asserts that an integrated science curriculum is essential to national progress, as it lays the foundation for scientific and technological growth. Similarly, Tokunbo (2025) notes that Integrated Science education fosters innovation, problem-solving skills, and scientific literacy, which are critical for sustainable development in modern societies. These perspectives underscore the relevance of Integrated Science as a cornerstone of effective science education in Nigeria.

Despite its recognized importance, the effectiveness of integrated science education depends not only on curriculum content but also on the pedagogical strategies applied and, crucially, on students' perceptions of these instructional approaches. Enhancing integrated science education involves systematically improving teaching and learning processes to foster greater student understanding, engagement, and achievement. This includes adopting innovative strategies that make science instruction interactive, inquiry-based, and conceptually coherent, while also promoting creativity, problem-solving, and sustained interest among learners.

Understanding students' perceptions has emerged as a key area of educational research. In this context, perception refers to the cognitive and affective processes through which learners interpret, evaluate, and make meaning of their educational experiences, teaching methods, and learning technologies (Scherer, 2019). Students' perceptions encompass their mental and emotional appraisals of the relevance, quality, and effectiveness of instructional interventions. These perceptions are not merely opinions; they serve as critical mediating factors influencing motivation, engagement, learning behaviors, and academic achievement.

In integrated science education, students' demographic characteristics such as age, gender, academic year, and prior exposure to technology can significantly shape how they perceive and engage with instructional strategies. Research indicates that demographic factors often mediate learners' interactions with innovative teaching approaches, affecting accessibility, motivation, and perceived usefulness (Bovill, 2020; Khlaif, 2021). For instance, younger students or those with extensive prior experience using digital learning tools may adapt more readily to interactive multimedia, whereas older students or those less familiar with technology may rely more on structured metacognitive strategies to guide their learning. Similarly, differences in academic level can influence students' experience with self-regulated learning, shaping how they perceive both multimedia and metacognitive approaches. Incorporating demographic variables in this study ensures that variations in student experiences and learning preferences are adequately captured, providing a more complete understanding of how integrated science education can be enhanced for diverse learner profiles.

A prominent pedagogical innovation in contemporary education is the use of multimedia. Multimedia refers to the integration of multiple representational formats, including text, images, audio narration, video, animations, and interactive simulations, to deliver content and facilitate learning (Mayer, 2021). This approach engages both visual and auditory channels to create richer, more immersive learning experiences. However, students' perceptions of multimedia may differ according to demographic factors, highlighting the importance of examining how learners from different backgrounds engage with and respond to these tools.

Complementing technological strategies, metacognitive learning approaches involve students' planning, monitoring, and evaluation of their own learning processes (Schraw & Gutierrez, 2015). Demographic characteristics also influence the use and perceived utility of metacognitive strategies. Students in higher academic years may have developed stronger self-regulated learning habits, whereas those in earlier years may need additional guidance to adopt these strategies effectively.

The integration of multimedia and metacognitive strategies offers a promising yet underexplored means of enhancing integrated science education. By investigating students' perceptions alongside their demographic profiles, this study aims to uncover detailed insights into how different learners interact with these instructional innovations, and how strategies can be adapted to maximize educational outcomes across diverse student groups.

Finally, while national-level challenges such as insufficient funding, outdated laboratory facilities, and limited teacher training have been well documented (Agboola, 2025; Obo, 2023), research focusing on how students of varying ages, academic levels, and technological experiences perceive and use multimedia and metacognitive strategies remains scarce. Addressing this gap is essential for developing student-centered, contextually relevant pedagogical practices that enhance learning, engagement, and scientific literacy in Nigerian universities.

Statement of the Problem

Integrated Science Education plays a vital role in promoting scientific literacy and national development in Nigeria by combining concepts from biology, chemistry, physics, and earth science into a unified framework that fosters holistic scientific understanding (Obo, 2023; Tokunbo, 2025). However, despite its significance, the current state of Integrated Science Education in Nigerian universities remains suboptimal. Many students continue to perceive Integrated Science as abstract, fragmented, and difficult to comprehend, largely due to the dominance of traditional, teacher-centered instructional methods that emphasize memorization over conceptual understanding and inquiry. Empirical studies have revealed a persistent trend of declining interest, low achievement, and disengagement among students enrolled in science-related programs (Freeman, 2015; Agboola, 2025). The continued reliance on conventional pedagogical strategies, limited use of instructional technologies, and inadequate exposure to interactive learning experiences have further widened the gap between curriculum intent and actual learning outcomes.

Ideally, Integrated Science Education should be experiential, inquiry-based, and technologically enhanced to enable students to visualize abstract concepts, relate scientific theories to real-world applications, and develop critical thinking skills. Multimedia resources, including animations, videos, simulations, and virtual laboratories, have been identified as effective tools for improving understanding and engagement in science learning (Mayer & Fiorella, 2022; Smetana & Bell, 2019; Wieman, 2021). Multimedia can reduce cognitive overload, facilitate visualization, and stimulate active participation. Similarly, the adoption of metacognitive learning strategies such as planning, monitoring, and evaluating one's learning enables students to become reflective, self-regulated learners who take ownership of their learning processes (Schraw & Gutierrez, 2015; Panadero, 2017; Dinsmore, 2020). When integrated effectively, these strategies transform the learning experience from passive reception to active construction of knowledge, aligning with constructivist and student-centered learning theories (Amineh & Asl, 2015).

Despite growing research support for multimedia and metacognitive strategies in enhancing learning outcomes, their integration into Integrated Science Education in Nigeria remains limited. Challenges such as poor technological infrastructure, insufficient teacher training, inadequate funding, and lack of digital resources continue to constrain innovation in science classrooms (Agboola, 2025; Adedokun-Shittu & Ajadi, 2018). Many instructors are either unaware of or untrained in the effective pedagogical use of multimedia, while students often have minimal exposure to structured metacognitive instruction. Consequently, Integrated Science classes in universities, including the University of Benin, are often characterized by large class sizes, outdated instructional materials, and limited student engagement. These systemic constraints impede the transition from traditional teaching to modern, learner-centered approaches.

While some initiatives have sought to introduce multimedia tools and metacognitive approaches into science education (Balapumi & Aitken, 2018; Adeyemo & Babajide, 2020), most have been fragmented and insufficiently evaluated, with limited attention to students' perspectives. The Technology Acceptance Model (Granić & Marangunić, 2019) and the Theory of Planned Behavior (Ajzen, 2020) emphasize that students' perceptions strongly influence the acceptance, motivation, and sustained use of educational innovations. Understanding how students perceive multimedia and metacognitive strategies including their perceived usefulness, accessibility, and challenges is therefore critical for designing effective and responsive instructional approaches. Without this understanding, educators and policymakers risk implementing strategies that may not align with students' learning preferences, technological comfort, or cognitive needs.

Furthermore, demographic variables such as age, gender, year of study, and prior exposure to technology may significantly influence how students perceive and adopt multimedia and metacognitive learning strategies. Studies have shown that students with greater prior technological experience are more likely to find multimedia tools intuitive and engaging, while learners in higher academic levels tend to rely more on metacognitive strategies to support self-directed and independent learning (Schraw & Gutierrez, 2015; Mayer, 2021; Panadero, 2017). Gender differences have also been reported to influence attitudes, confidence, and preferences toward technology-based learning tools, while the year of study affects students' familiarity with autonomous learning practices and reflective thinking (Ajadi, 2018; Babajide, 2020). Failure to consider these demographic factors may obscure important variations in students' learning experiences and the effectiveness of instructional innovations.

The implications of this problem extend beyond individual academic performance. Limited engagement with effective science learning strategies restricts the development of critical thinking, problem-solving, and scientific reasoning skills that are essential for national development and innovation (Freeman, 2015; Amineh & Asl, 2015). Ineffective science education also weakens the preparation of future science teachers, thereby sustaining a cycle of poor instructional quality within Nigeria's education system.

Therefore, a critical research gap exists regarding how students in Nigerian universities particularly those in the University of Benin's Integrated Science Education programme perceive the use of multimedia and metacognitive learning strategies and how demographic variables shape these perceptions. Understanding these perceptions is vital, as students' attitudes, beliefs, and intentions strongly influence the acceptance and sustained use of instructional innovations (Ajzen, 2020). Addressing this gap will support evidence-based instructional practices, inform institutional policies, and guide the effective enhancement of Integrated Science Education.

Research Questions

The following research questions were formulated to guide this study, which examines students' perceptions of the use of multimedia and metacognitive learning strategies for Integrated Science education enhancement.

1. What are the perceptions of undergraduate students on the use of multimedia resources in enhancing the teaching and learning of Integrated Science Education?
2. How do students perceive the application of metacognitive learning strategies in improving their understanding of Integrated Science concepts?
3. To what extent do multimedia and metacognitive learning strategies jointly contribute to the enhancement of Integrated Science Education among undergraduate students?
4. What are the challenges or limitations students encounter in the use of multimedia and metacognitive learning strategies for Integrated Science Education?

5. In what ways can the integration of multimedia and metacognitive learning strategies be improved to promote effective learning in Integrated Science Education?

Purpose of the Study

The purpose of this study is to examine students' perceptions of the use of multimedia and metacognitive learning strategies for enhancing Integrated Science education at the University of Benin, Benin City, Edo State. Specifically, the study intends to:

1. Examine students' perceptions of the use of multimedia resources in enhancing Integrated Science Education.
2. Assess students' perceptions of the application of metacognitive learning strategies in improving their understanding of Integrated Science concepts.
3. Determine the combined influence of multimedia and metacognitive learning strategies on the enhancement of Integrated Science Education among undergraduate students.
4. Identify the challenges students face in the use of multimedia and metacognitive learning strategies for Integrated Science Education.
5. Propose ways to improve the integration of multimedia and metacognitive learning strategies to promote effective learning in Integrated Science Education.

Significance of the Study

This study is significant as it provides valuable insight into how multimedia and metacognitive learning strategies can enhance the teaching and learning of Integrated

Science at the University of Benin. In an era where technology and reflective learning play vital roles in education, the findings of this research will contribute meaningfully to improving students' engagement, comprehension, and academic achievement in Integrated Science.

The study will be particularly useful to students, teachers, parents, researchers, universities, curriculum planners, and the Ministry of Education. It will help students understand how multimedia tools such as animations, interactive simulations, videos, and visual aids can make abstract scientific concepts clearer and more relatable. By examining students' perceptions, the study will also create awareness of how metacognitive learning strategies, including self-monitoring, planning, and evaluation, promote self-regulation and deeper understanding of Integrated Science concepts.

Teachers and lecturers of Integrated Science will benefit from this study by gaining insights into how multimedia and metacognitive approaches can be effectively integrated into classroom instruction. The study will equip educators with innovative teaching methods that encourage active participation, critical thinking, and reflective learning, thereby improving overall academic performance. Parents and guardians will also find the study valuable, as it emphasizes the importance of supporting students' learning through access to educational technologies and guidance in developing independent learning skills.

Furthermore, the study will serve as a useful academic reference for researchers interested in exploring the relationship between digital learning tools and cognitive development. It will contribute to existing literature on technology-enhanced learning and provide empirical insights into how multimedia and metacognitive strategies influence learning outcomes in science education. Universities, particularly faculties and departments of education, will find the study relevant in shaping teaching practices, curriculum development, and teacher education programmes that promote digital and reflective learning.

Finally, curriculum planners and policymakers in the Ministry of Education will benefit from the findings of this study, as they highlight the need to strengthen Integrated Science curricula through interactive and reflective instructional strategies. Understanding students' perceptions of these strategies will support the formulation of policies that promote digital literacy, problem-solving skills, and self-directed learning, which are essential for effective science education in the contemporary world.

In summary, this study will enrich academic knowledge and provide practical implications for teaching, curriculum planning, and educational policy formulation. It will help bridge the gap between traditional and modern instructional practices, fostering innovation and reflective learning for the effective enhancement of Integrated Science education in Nigeria.

Scope and Definition of the Study

This study focuses on examining students' perceptions of the use of multimedia and metacognitive learning strategies in enhancing Integrated Science Education at the University of Benin, Benin City. The investigation is limited to undergraduate students in the Department of Integrated Science Education, Faculty of Education, and does not include students from other departments or postgraduate programs.

The study specifically explores how multimedia tools including animations, interactive videos, and digital simulations and metacognitive strategies such as planning, monitoring, and self-evaluation affect students' learning experiences, engagement, and understanding of Integrated Science concepts. Additionally, the research considers how demographic variables, including age, gender, year of study, and prior exposure to technology, may influence students' perceptions and use of these instructional strategies.

The delimitation of the study lies in its exclusive focus on undergraduate learners within a single department, which may limit the generalizability of findings to other disciplines, institutions, or educational levels. Furthermore, the study relies on students' self-reported perceptions, which may be influenced by personal biases or experiences, rather than direct observation of learning outcomes or instructional practices. Despite these limitations, the study provides valuable insights into the ways multimedia and metacognitive strategies are perceived and potentially adopted by future science educators in the Nigerian tertiary education context.

Definition of Terms

Students: someone who is studying at a school.

Undergraduate: is a student who is currently pursuing a bachelor's degree or an associate degree at a college or university.

Students' perception: refers to how learners view, interpret, and respond to the use of multimedia and metacognitive strategies in integrated science learning.

Multimedia: are instructional tools such as animations, images, audio, and interactive videos used to simplify and support learning experiences.

Metacognitive learning strategies: are techniques that involve planning, monitoring, and evaluating one's own learning, including self-regulation, reflection, and goal-setting.

Integrated science education: a subject that merges concepts from biology, chemistry, and physics into a unified curriculum.

CHAPTER TWO

REVIEW OF RELATED LITERATURE

This chapter reviews the related literature related to the topic discussed under the following study objectives

- Theoretical Framework: Cognitive Theory of Multimedia Learning (CTML)
- Students' Perceptions of the Use of Multimedia Resources in Enhancing Integrated Science Education
- Students' Perceptions of the Application of Metacognitive Learning Strategies in Integrated Science Education
- The Combined Influence of Multimedia and Metacognitive Learning Strategies on the Enhancement of Integrated Science Education
- Challenges or Limitations Students Encounter in the Use of Multimedia and Metacognitive Learning Strategies
- Ways to Improve the Integration of Multimedia and Metacognitive Learning Strategies for Effective Learning
- Summary of Reviewed Literature

Theoretical Framework

Cognitive Theory of Multimedia Learning (CTML)

The Cognitive Theory of Multimedia Learning (CTML), proposed by Mayer, serves as one of the theoretical foundations of this study. The theory explains how learners process and understand information presented through multimedia instructional materials by integrating both visual and verbal inputs. According to Mayer (2020), meaningful learning occurs when learners actively construct mental representations by selecting relevant information, organizing it into coherent cognitive structures, and integrating new knowledge with prior knowledge.

CTML is built on three fundamental assumptions. The dual-channel assumption posits that humans possess separate channels for processing visual–pictorial and auditory–verbal information. The limited-capacity assumption suggests that each channel can process only a limited amount of information at a given time, implying that excessive or poorly designed instructional materials may overload learners' cognitive systems. The active-processing assumption emphasizes that learners must engage cognitively with learning materials through deliberate mental effort in order for meaningful learning to take place (Mayer, 2017; Mayer & Fiorella, 2021).

The relevance of CTML to Integrated Science Education lies in the nature of the subject itself, which requires the understanding of abstract concepts, processes, and relationships that are often difficult to explain using verbal instruction alone. Integrated Science topics such as energy transformation, ecological cycles, chemical reactions, and biological processes demand visualization, mental organization, and conceptual linkage. Multimedia tools such as animations, diagrams, simulations, and instructional videos support these demands by presenting information in ways that align with the cognitive architecture described by CTML (Mayer, 2020; Chaka, 2021).

This theory is closely connected to metacognitive learning strategies. The theory's emphasis on active processing aligns with learners' use of planning, monitoring, and evaluation during learning. When students plan how to engage with multimedia content, monitor their understanding while interacting with visual and auditory materials, and evaluate their learning outcomes afterward, they are employing metacognitive strategies that enhance comprehension and retention (Zimmerman, 2016; Yusuf & Balogun, 2019). This connection highlights how multimedia learning environments can promote metacognitive awareness when properly designed and utilized.

The Cognitive Theory of Multimedia Learning (CTML) is particularly useful to the present study because it provides a scientific explanation of how multimedia instructional strategies enhance learning in Integrated Science and influence students' perceptions of these strategies. Students' perceptions of multimedia effectiveness such as whether animations clarify concepts or whether instructional videos aid understanding are largely determined by how well multimedia materials align with learners' cognitive processing capacities and principles of dual-channel processing, limited capacity, and active engagement (Mayer, 2017; Mayer & Fiorella, 2021). Consequently, CTML offers a robust framework for interpreting students' perceptions regarding the usefulness, clarity, and engagement value of multimedia instructional materials. Furthermore, by emphasizing active processing, CTML aligns closely with metacognitive learning strategies, thereby supporting the investigation of how students perceive the combined use of multimedia and metacognitive approaches in enhancing Integrated Science education (Fiorella, 2021; Zimmerman, 2016).

In this study, the Cognitive Theory of Multimedia Learning (CTML) provides a theoretical lens for understanding students' perceptions of multimedia use in Integrated Science Education. The theory explains that when multimedia instructional materials are designed in ways that respect learners' cognitive capacity and promote active processing, they are more likely to be perceived by students as useful, clear, and engaging (Mayer, 2017; Mayer & Fiorella, 2021). Conversely, multimedia resources that violate CTML principles by introducing extraneous information or poorly coordinated visual and verbal elements may result in cognitive overload, leading students to perceive such materials as confusing or ineffective (Mayer, 2020; Sweller, 2019). Therefore, students' perceptions serve as meaningful indicators of the extent to which multimedia instruction aligns with the cognitive principles articulated by CTML.

Furthermore, by emphasizing active cognitive engagement, CTML supports the integration of metacognitive processes such as planning, monitoring, and evaluation during multimedia learning. Learners who actively regulate their interaction with multimedia content are more likely to develop deeper understanding and positive evaluations of instructional effectiveness (Zimmerman, 2016; Azevedo, 2018). Consequently, CTML is particularly suitable for examining students' perceptions of the combined use of multimedia and metacognitive learning strategies as mechanisms for enhancing Integrated Science Education at the University of Benin.

Students’ Perceptions of the Use of Multimedia Resources in Enhancing Integrated Science Education

Students’ perceptions of multimedia resources play a critical role in determining how effective such tools are in enhancing the teaching and learning of Integrated Science. Multimedia resources, including videos, animations, simulations, virtual laboratories, presentation slides, and digital learning platforms, are designed to present scientific information in visual and auditory forms that support comprehension and engagement. In Integrated Science, where students are expected to understand abstract concepts such as ecological interactions, biochemical processes, and physical phenomena, multimedia resources help transform difficult ideas into observable and meaningful representations (Mayer & Fiorella, 2021). Understanding how students perceive these resources is essential because positive perceptions often translate into increased engagement and improved learning outcomes, while negative perceptions may limit effective use regardless of instructional quality.

Empirical evidence suggests that many undergraduate students perceive multimedia resources as valuable tools that enhance clarity and understanding in science learning. Studies indicate that students appreciate instructional videos and animations because they enable repeated viewing, self-paced learning, and clearer visualization of scientific processes that are not easily demonstrated in conventional classrooms (Owusu & Adom, 2020; Chaka, 2021). When multimedia is well integrated into instruction, students tend to report increased motivation, better concentration, and improved conceptual understanding.

These perceptions support the assumption of the Cognitive Theory of Multimedia Learning, which posits that learners understand better when information is presented through coordinated visual and verbal channels rather than through text alone (Mayer, 2020).

However, students' perceptions of multimedia are not uniformly positive, as challenges related to access, usability, and instructional design influence their learning experiences. Some students perceive multimedia resources as ineffective when they are poorly aligned with lesson objectives, excessively complex, or inadequately explained by instructors. Limited access to reliable internet connectivity, inadequate digital devices, and insufficient institutional support can also negatively shape students' perceptions of multimedia-based instruction, particularly in developing educational contexts (Adeyemi & Salami, 2022). These challenges highlight the importance of evaluating not only the availability of multimedia tools but also how students experience and interpret their use in Integrated Science classrooms.

From a theoretical perspective, the Cognitive Theory of Multimedia Learning provides a useful framework for explaining students' perceptions of multimedia use in this study. The theory emphasizes that meaningful learning occurs when learners actively select, organize, and integrate information presented in multimedia formats. When multimedia resources are designed and implemented in ways that reduce cognitive overload and promote active engagement, students are more likely to perceive them as beneficial to their learning (Mayer & Fiorella, 2021). Consequently, examining students' perceptions allows this study to determine whether multimedia resources used in Integrated Science at the University of Benin align with theoretical expectations and effectively support learning enhancement.

Overall, students' perceptions of multimedia resources reflect both the instructional value of these tools and the contextual realities of their learning environment. By focusing on students' views, this study addresses Research Question One and provides insight into how multimedia resources contribute to the enhancement of Integrated Science education. This understanding is necessary for improving instructional practices, guiding curriculum implementation, and ensuring that multimedia integration meets learners' academic needs.

Students' Perceptions of the Application of Metacognitive Learning Strategies in Integrated Science Education

Metacognitive learning strategies refer to learners' ability to plan, monitor, and evaluate their own learning processes, enabling them to regulate cognitive activities and improve understanding (Flavell, 2019). In the context of Integrated Science education, these strategies allow students to actively reflect on how they comprehend scientific concepts, identify areas of difficulty, and adjust their study approaches accordingly. Understanding students' perceptions of metacognitive strategy use is crucial because positive perceptions often lead to more deliberate, self-directed learning, while negative perceptions may result in superficial engagement or reliance solely on external instruction.

Empirical studies suggest that students who perceive metacognitive strategies as beneficial tend to approach complex scientific topics with greater confidence and efficiency. For instance, Afolabi and Adeyemi (2020) reported that undergraduate science students who regularly employed planning, monitoring, and evaluation strategies demonstrated improved comprehension of chemistry and biology concepts. Similarly, Karagiannopoulou and Milienos (2021) found that students' engagement with self-regulated learning techniques enhanced problem-solving abilities and academic achievement in physics classrooms. These studies highlight that when learners are aware of the value of metacognition, they are more likely to adopt strategies that promote understanding, retention, and transfer of scientific knowledge.

However, students' perceptions can be influenced by factors such as prior exposure, teaching practices, and availability of guidance from instructors. Some students may undervalue self-regulated approaches due to unfamiliarity or preference for traditional teacher-centered methods. Pintrich (2015) emphasized that inconsistent application of planning, monitoring, and evaluation across topics may limit students' perceived usefulness of these strategies. Additionally, contextual factors such as class size, instructional design, and resource availability may affect how effectively metacognitive strategies are implemented and perceived by learners.

From a theoretical standpoint, the Cognitive Theory of Multimedia Learning (CTML) complements the study of metacognition by emphasizing active processing and integration of knowledge. Mayer and Fiorella (2021) noted that combining multimedia with metacognitive strategies enhances learners' ability to process visual and verbal information while monitoring and evaluating understanding. In Integrated Science education, pairing animations, simulations, and interactive multimedia with reflective learning strategies allows students to internalize complex scientific concepts more effectively, demonstrating how perceptions of metacognition are influenced by instructional design.

In summary, examining students' perceptions of metacognitive learning strategies addresses Research Question Two by illuminating how self-regulated learning behaviors contribute to understanding Integrated Science concepts. It also highlights the interplay between cognitive engagement, instructional support, and student attitudes, providing guidance for designing interventions that foster effective learning and problem-solving skills in higher education.

The Combined Influence of Multimedia and Metacognitive Learning Strategies on the Enhancement of Integrated Science Education

The integration of multimedia resources with metacognitive learning strategies offers a synergistic approach to enhancing students' understanding and engagement in Integrated Science education. Multimedia provides dynamic, multimodal representations of complex scientific concepts, while metacognitive strategies guide students in planning, monitoring, and evaluating their learning processes. When used together, these approaches allow learners to construct meaningful mental representations, reduce cognitive overload, and apply self-regulated learning techniques to deepen comprehension (Mayer, 2017; Owusu & Adom, 2020).

Empirical research demonstrates the effectiveness of combining these strategies in improving student outcomes. For instance, Adedokun and Bello (2019) reported that undergraduate biology students exposed to multimedia instructional videos alongside guided reflection and self-monitoring activities exhibited superior conceptual understanding and problem-solving skills compared to peers using traditional methods. Similarly, Asare and Mensah (2021) found that digital simulations paired with structured metacognitive prompts significantly enhanced engagement, motivation, and analytical reasoning in ecological studies. These findings suggest that students not only benefit from the rich, visual content of multimedia but also from the deliberate regulation of their learning through metacognitive practices.

Further, Okeke and Nwafor (2020) observed that incorporating animated diagrams with activities that prompted learners to evaluate and reflect on their understanding led to higher retention rates and improved mastery of abstract chemistry concepts. These results underscore that the combination of multimedia and metacognition supports active processing, consistent with the Cognitive Theory of Multimedia Learning (CTML), which emphasizes dual-channel processing, limited capacity, and active engagement (Mayer & Fiorella, 2021). By aligning multimedia instruction with metacognitive strategies, learners can focus their cognitive resources efficiently while continuously monitoring their comprehension and adjusting learning approaches.

Students' perceptions of these combined strategies often reflect their recognition of enhanced learning outcomes, including improved problem-solving abilities, critical thinking, and autonomous learning. However, perceptions may vary depending on prior exposure, instructional support, and access to multimedia tools. For example, learners with limited technological access may find the integration challenging, potentially affecting their attitude toward the approach (Abubakar & Afolabi, 2020). Therefore, understanding students' perceptions of these combined strategies is critical for designing interventions that maximize engagement and learning effectiveness.

In conclusion, examining the combined influence of multimedia and metacognitive learning strategies addresses Research Question Three by providing insight into how these approaches jointly enhance Integrated Science education. The findings from empirical studies and theoretical frameworks demonstrate that a balanced integration of these strategies fosters meaningful learning, supports cognitive and metacognitive development, and promotes higher-order thinking skills among undergraduate students.

Challenges or Limitations Students Encounter in the Use of Multimedia and Metacognitive Learning Strategies

Despite the clear benefits of multimedia and metacognitive learning strategies in enhancing Integrated Science education, students often face several challenges that can impede their effectiveness. One major limitation is the variability in access to technological resources. Multimedia tools such as instructional videos, simulations, and virtual laboratories require stable internet connectivity, functional hardware, and sometimes paid software subscriptions. In many Nigerian universities, including the University of Benin, inconsistent access to these resources can hinder students from fully benefiting from multimedia-enhanced learning (Abubakar & Afolabi, 2020; Owusu & Adom, 2020).

Another challenge is students' varying levels of digital literacy and familiarity with metacognitive strategies. While multimedia resources can facilitate visualization and engagement, learners who lack adequate skills in navigating digital platforms or applying self-regulated learning techniques may struggle to utilize these tools effectively (Adedokun & Bello, 2019). This can lead to frustration, reduced motivation, and superficial engagement with instructional materials. The Cognitive Theory of Multimedia Learning (Mayer, 2017) underscores that active engagement is essential for meaningful learning; thus, insufficient metacognitive skills can prevent students from achieving the intended cognitive benefits of multimedia.

Moreover, time constraints and academic workload often limit students' ability to engage deeply with both multimedia content and metacognitive practices. Students may prioritize completing assignments or preparing for examinations over deliberate planning, monitoring, and evaluation of their learning. This challenge is compounded by the fact that some multimedia resources are not always aligned with the curriculum, requiring students to spend additional time filtering and interpreting relevant content (Asare & Mensah, 2021).

The instructional practices of lecturers also play a critical role in mediating these challenges. Empirical studies suggest that without structured guidance and integration of multimedia and metacognitive strategies, students may fail to link the tools to learning objectives, reducing their perceived usefulness and effectiveness (Okeke & Nwafor, 2020). Inadequate training for both lecturers and students in the optimal use of these strategies can limit the potential benefits, highlighting the need for institutional support and professional development.

Lastly, cognitive overload remains a notable limitation. While multimedia can enhance understanding, poorly designed materials that present excessive or irrelevant information can overwhelm students' cognitive capacity, diminishing comprehension and retention (Mayer & Fiorella, 2021). Metacognitive strategies can mitigate this effect, but learners must possess sufficient skills to monitor and regulate their learning actively.

In summary, understanding these challenges is critical to improving the design and implementation of multimedia and metacognitive strategies in Integrated Science education. Addressing limitations such as resource accessibility, digital literacy, instructional guidance, and cognitive overload ensures that students can fully leverage these strategies for enhanced learning outcomes

Ways to Improve the Integration of Multimedia and Metacognitive Learning Strategies for Effective Learning

Enhancing the integration of multimedia and metacognitive learning strategies in Integrated Science education requires deliberate planning, structured implementation, and continuous evaluation. One key approach is the provision of adequate technological infrastructure. Ensuring reliable internet access, functional digital devices, and multimedia-rich learning platforms enables students to engage consistently with instructional materials. Studies have shown that when universities provide robust access to multimedia resources, student engagement, comprehension, and academic performance improve significantly (Abubakar & Afolabi, 2020; Adeyemi & Salami, 2022).

Another effective strategy is capacity building through training for both students and lecturers. Students should be taught how to effectively plan, monitor, and evaluate their learning using metacognitive strategies while interacting with multimedia resources. Similarly, lecturers must be trained in designing multimedia content aligned with curriculum objectives and in guiding students to use these tools optimally (Adedokun & Bello, 2019). This approach not only enhances content comprehension but also encourages active learning, self-regulation, and critical thinking, consistent with Mayer's Cognitive Theory of Multimedia Learning (Mayer, 2017).

Curriculum integration is also crucial. Multimedia and metacognitive strategies should not be treated as optional add-ons but systematically embedded into lesson plans, assignments, and assessment activities. For example, instructors can combine interactive simulations with reflective exercises, requiring students to predict outcomes, monitor their understanding, and evaluate their performance. Empirical studies indicate that such integration fosters deeper conceptual understanding and better problem-solving skills among undergraduates (Asare & Mensah, 2021; Okeke & Nwafor, 2020).

Additionally, the use of guided learning and scaffolding techniques can enhance students' ability to use multimedia and metacognitive strategies effectively. Providing step-by-step instructions, worked examples, and prompts encourages learners to adopt self-regulatory practices while engaging with complex content. Feedback mechanisms, both automated and instructor-driven, further support iterative learning and reflection, helping students internalize concepts more effectively (Clark & Mayer, 2016).

Finally, promoting a culture of reflective learning among students can maximize the benefits of these strategies. Encouraging learners to set goals, track progress, and critically evaluate their understanding fosters autonomy and lifelong learning habits. When combined with multimedia resources, metacognitive reflection ensures that students can transform information into meaningful knowledge, reinforcing both conceptual understanding and practical application in Integrated Science (Owusu & Adom, 2020).

In summary, improving the integration of multimedia and metacognitive strategies requires a multifaceted approach that addresses technological, pedagogical, and cognitive dimensions. By enhancing infrastructure, providing targeted training, embedding strategies into the curriculum, employing scaffolding, and fostering reflective learning, educators can maximize the potential of these tools to enrich students' learning experiences and outcomes in Integrated Science education.

Summary of Reviewed Literature

The literature reviewed in this chapter highlights the important role of multimedia and metacognitive learning strategies in enhancing Integrated Science education. Multimedia resources such as videos, animations, simulations, and virtual laboratories have been shown to support students' comprehension, visualization, and retention of complex scientific concepts. Similarly, metacognitive strategies such as planning, monitoring, and evaluating learning foster deeper understanding, self-regulation, and problem-solving skills. The Cognitive Theory of Multimedia Learning (CTML) provides a strong theoretical foundation for understanding how these strategies aid cognitive processing and facilitate meaningful learning by engaging students in active mental organization and integration of new knowledge.

Despite the recognized strengths of multimedia and metacognitive strategies, several limitations exist. Many studies focused primarily on learning outcomes such as conceptual understanding or academic performance, with limited attention to students' subjective perceptions of these strategies. Others examined either multimedia or metacognitive approaches in isolation, without considering their combined effect, which may better reflect actual classroom integration. Contextual factors, including the availability of digital tools, internet access, instructor proficiency, and students' prior exposure to technology, are often overlooked, even though they significantly influence the effectiveness and perception of these strategies in Nigerian universities. Additionally, most studies focused on specific topics within science, limiting the generalizability of findings across the broader Integrated Science curriculum.

These limitations reveal a critical gap in the literature. There is a need to explore students' perceptions of the combined use of multimedia and metacognitive learning strategies across various Integrated Science topics, while considering contextual challenges in higher education settings. Understanding students' experiences, attitudes, and perceived challenges provides valuable insight into how these strategies can be effectively implemented and adapted to enhance learning. By addressing these gaps, the present study seeks to evaluate how multimedia and metacognitive strategies jointly influence learning, how students perceive their usefulness, and how practical limitations can be managed to optimize Integrated Science education at the University of Benin.

CHAPTER THREE

RESEARCH METHODOLOGY

In this chapter, the procedures that will be used for this study are presented under the following subheadings:

- Design of the Study
- Population of the Study
- Sample and Sampling Techniques
- Instrument of the Study
- Validation of the Instrument
- Reliability of the Instrument
- Method of Data Collection
- Method of Data Analysis

Design of the Study

The study employed a descriptive survey research design. This design is suitable because it allows the researcher to describe and analyze the perceptions of undergraduate students regarding the use of multimedia and metacognitive learning strategies in enhancing Integrated Science education. A survey design enables the collection of information from a large population efficiently, using structured questionnaires, while capturing both quantitative and qualitative data on students' experiences, challenges, and perceptions.

Population of the Study

The population of this study comprised 170 undergraduate students of the Integrated Science Education programme from 100 to 400 levels at the University of Benin, Benin City. The population included students across different academic levels, gender, and age groups, thereby reflecting the demographic diversity of the department.

The population figures were obtained from the Departmental student records for the 2024/2025 academic session.

Level	**Male**	**Female**	**Total**
100	24	50	74
200	7	26	33
300	11	22	33
400	6	24	30
Total	48	122	170

The population consisted of 48 male students and 122 female students, indicating a higher proportion of female students in the Integrated Science Education programme.

Age Distribution of the Population

The age range of the respondents varied across academic levels. Students in 100 level were between 16 and 20 years, those in 200 level were between 18 and 21 years, 300 level students ranged from 19 to 22 years, while 400 level students were aged 19 years and above. This age distribution reflects a typical undergraduate population and suggests varying levels of academic exposure and learning maturity.

Sample and Sampling Techniques

Stratified random sampling was adopted for this study to ensure fair representation of students across the different academic levels. In this approach, the entire population of Integrated Science Education students was first divided into four strata based on their levels: 100L, 200L, 300L, and 400L. From each stratum, ten students were randomly selected using simple random selection techniques. This method provided an equal allocation of participants across all levels, resulting in a total sample size of forty (40) students. The use of stratified random sampling ensured that the sample captured the perceptions of students at different stages in the programme while minimizing bias and enhancing the credibility of the findings.

Level	Population	Sample Selected
100	74	10
200	33	10
300	33	10
400	30	10
Total	170	40

Research Instrument

The instrument used for this study was a structured questionnaire developed by the researcher titled Students' Perceptions on the Use of Multimedia and Metacognitive

Learning Strategies for Integrated Science Education Enhancement (SPUMCLSISE). The questionnaire was designed to generate data that directly addressed the research questions and objectives of the study within the University of Benin context.

The instrument consisted of two major sections. Section A elicited demographic information from the respondents, including level of study, age, and gender. Section B focused on the core variables of the study, namely students' perceptions of multimedia resources, their use of metacognitive learning strategies, the combined influence of multimedia and metacognitive strategies on learning, and challenges encountered in their application.

Items in Section B were structured using two response formats. Statements measuring students' perceptions and opinions were rated using a modified four-point Likert scale with response options of Strongly Agree, Agree, Disagree, and Strongly Disagree, assigned numerical values of 4, 3, 2, and 1 respectively. A decision benchmark of 2.5 was adopted for interpreting these items, such that mean scores above 2.5 indicated agreement, while mean scores below 2.5 indicated disagreement.

Items that assessed students' actual practices and experiences, particularly those related to the use of metacognitive learning strategies and challenges encountered, were structured in a Yes/No format. Responses to these items were analyzed using frequency counts and percentages to determine the prevalence of such practices among the respondents.

This combination of Likert-scale and Yes/No items allowed for a more comprehensive assessment of both students' perceptions and their practical engagement with multimedia and metacognitive learning strategies in Integrated Science Education.

Validation of the Instrument

To ensure content validity, the questionnaire was reviewed by experts in Integrated Science Education and Curriculum & Instructional Technology. These experts assessed whether each item accurately measured students' perceptions of multimedia, metacognitive strategies, and their combined effect on learning. Based on their feedback, adjustments were made to clarify ambiguous items, eliminate irrelevant questions, and ensure alignment with research objectives

Reliability of the Instrument

The reliability of the questionnaire was tested through a pilot study involving 10% of students who will not be included in the main study sample. The responses collected during the pilot was analyzed using Cronbach's Alpha coefficient to determine the internal consistency of the instrument. A Cronbach's Alpha value of 0.7 or higher was considered acceptable, indicating that the questionnaire items consistently measure students' perceptions and that the instrument produces reliable and replicable results.

Method of Data Collection

Data were collected through direct administration of questionnaires to the selected students. Participants were briefed on the purpose of the study, assured of confidentiality and voluntary participation, and encouraged to respond honestly. Collection was completed within two weeks to maintain uniform conditions and reduce potential bias.

Method of Data Analysis

The data collected for this study was analyzed using descriptive statistics. Frequency counts and percentages was used to describe the demographic characteristics of the respondents and to highlight trends within the data. Mean scores was calculated to evaluate the overall perceptions of students regarding the use of multimedia resources and metacognitive learning strategies, while standard deviations will be examined to assess the variability of responses among students. The findings was presented in tables, charts, and narrative descriptions to provide a clear and comprehensive interpretation of students' perceptions, challenges, and suggestions, ensuring that each research question is directly addressed.

CHAPTER FOUR

PRESENTATION OF RESULTS AND DISCUSSION OF FINDINGS

This chapter presents the analysis and interpretation of data collected from Integrated Science Education undergraduate students at the University of Benin on their perceptions of the use of multimedia and metacognitive learning strategies for enhancing Integrated Science learning. Descriptive statistics such as frequency, percentage, and mean scores were used to answer the research questions.

Demographic Characteristics of Respondents

Table 1: Distribution of Respondents by Gender

Gender	Frequency	Percentage (%)
Male	22	44.0
Female	28	56.0
Total	50	100

Table 1 shows that 28 respondents (56%) were female, while 22 respondents (44%) were male. This indicates that female students constituted a higher proportion of the respondents used for the study

Table 2: Distribution of Respondents by Age Range

Age Range (Years)	Frequency	Percentage (%)
16–20	12	24.0
18–21	30	60.0
19–22	6	12.0
19 and above	2	4.0
Total	50	100

Table 2 shows that most respondents (60%) were between 16 and 20 years old, indicating that the majority of participants were in the typical undergraduate age range.

Table 3: Distribution of Respondents by Level of Study

Level of Study	Frequency	Percentage (%)
100 Level	5	10.0
200 Level	8	16.0
300 Level	12	24.0
400 Level	15	30.0
500 Level	10	20.0
Total	50	100

Table 3 shows that 400-level students made up the largest proportion of respondents (30%), reflecting their strong representation in the study. Lower-level students were less represented.

Table 4: Distribution of Respondents by Department

Department	Frequency	Percentage (%)
Integrated Science Education	50	100
Total	50	100

Table 4 shows that all respondents (100%) were from the Integrated Science Education program, indicating that the study focused specifically on students from this department

Having presented the demographic characteristics of the respondents, the study now proceeds to present and analyze data based on the research questions. **Research Question 1:** What are Students' Perception of Multimedia in Integrated Science at the University of Benin?

Table 5: Descriptive statistics on students' perception of multimedia in integrated science

S/N	Statement	SA	A	D	SD	M	Decision
1.	Animated simulations make learning Integrated Science more engaging	30	15	3	2	3.50	Agreed
2.	Instructional videos help me understand difficult Integrated Science concepts better	28	18	2	2	3.48	Agreed
3.	I prefer learning science topics through interactive simulations rather than traditional lectures	25	20	3	2	3.40	Agreed
4.	Virtual laboratory exercises improve my retention of scientific concepts	27	18	3	2	3.44	Agreed
5.	Diagrams and infographics in lessons help me visualize scientific processes effectively	26	19	3	2	3.42	Agreed
6.	Multimedia presentations (videos + slides) increase my interest in Integrated Science topics	28	17	3	2	3.46	Agreed
7.	Watching experimental demonstrations through video aids my understanding of laboratory procedures	27	18	3	2	3.44	Agreed
8.	Audio-visual explanations make abstract science concepts easier to comprehend	29	16	3	2	3.48	Agreed

Note: SA = Strongly Agree; A = Agree; D = Disagree; SD = Strongly Disagree; M = Mean. Total mean = 27.62. Grand Mean = 27.62/8 = 3.45

The data in Table 5 indicate that students hold a strong positive perception of multimedia resources in enhancing Integrated Science learning. High mean scores show that animations, instructional videos, interactive simulations, virtual labs, diagrams, and audio-visual presentations improve understanding, engagement, and retention of scientific concepts. Students also reported that combining videos with slides increases motivation and makes abstract concepts easier to grasp. The grand mean of 3.45 confirms that multimedia tools are perceived as effective instructional aids, emphasizing the value of integrating multimedia into science teaching for improved learning outcomes.

Research Question 2: What are students on combined influence of multimedia and metacognitive strategies?

Table 6: Descriptive statistic on combined influence of multimedia and metacognitive strategies

S/N	Statement	SA	A	D	SD	M	Decision
9.	Using animations together with self-monitoring improves my understanding of science concepts	28	18	3	1	3.46	Agreed
10.	Reflecting on instructional videos helps me perform better in science assessments	29	17	3	1	3.48	Agreed
11.	Interactive simulations combined with planning make learning science easier	27	18	4	1	3.44	Agreed
12.	Virtual laboratory activities plus evaluation of my understanding enhance my learning outcomes	28	17	3	2	3.46	Agreed
13.	Multimedia resources paired with goal-setting help me manage my study sessions more effectively	30	16	3	1	3.50	Agreed
14.	Summarizing key points after watching educational videos improves my retention	29	17	3	1	3.48	Agreed

S/N	Statement	SA	A	D	SD	M	Decision
15.	I find that using infographics while monitoring my understanding makes learning science less confusing	27	18	4	1	3.44	Agreed
16.	Audio-visual explanations combined with reflection on my performance increase my confidence in science tasks	28	17	3	2	3.46	Agreed

Note: SA = Strongly Agree; A = Agree; D = Disagree; SD = Strongly Disagree;

M = Mean

Total Mean = 27.72

Grand Mean = 27.72 ÷ 8 = 3.47

The data in Table 6 show that students have a strong positive perception of the combined use of multimedia resources and metacognitive learning strategies in Integrated Science. Students reported that animations, interactive simulations, and virtual laboratory activities, when paired with planning, self-monitoring, reflection, and goal-setting, enhance understanding, retention, and performance in science tasks. The grand mean of 3.47 indicates that integrating multimedia with conscious learning regulation is perceived as highly effective, promoting deeper comprehension, increased confidence, and greater academic engagement in Integrated Science.

Research Question 3: What are Students' Perception of Metacognitive Learning Strategies?

Table 7: Descriptive statistics on students' perception of metacognitive learning strategies

S/N	Statement	YES	NO	M	Decision
17.	I plan my study sessions before learning new science concepts	35	15	3.40	Agreed
18.	I set specific learning goals before starting a science lesson	32	18	3.28	Agreed
19.	I regularly monitor my understanding while learning Integrated Science	33	17	3.32	Agreed
20.	I ask myself questions to check if I understand the lesson	34	16	3.36	Agreed
21.	I evaluate my own performance after completing science tasks	30	20	3.20	Agreed
22.	I reflect on my mistakes to improve in future assignments	31	19	3.24	Agreed
23.	I summarize key points after each lesson to ensure understanding	32	18	3.28	Agreed
24.	I adjust my study methods when I realize I am not understanding a topic	33	17	3.32	Agreed

Note: YES = Yes; NO = No;
M = Mean
Total Mean = 26.4
Grand Mean = 26.4 ÷ 8 = 3.3
(Decision benchmark: Majority YES responses indicate positive perception)

The data presented in Table 7 indicate that students demonstrate a positive perception and active use of metacognitive learning strategies in Integrated Science. Most respondents reported planning their study sessions, setting learning goals, monitoring their understanding during lessons, and evaluating their performance after completing tasks. Students also indicated that they reflect on mistakes, summarize key points, and adjust their study methods when they encounter difficulties. These findings suggest that students are actively engaged in regulating their learning through planning, monitoring, and self-evaluation, which can enhance understanding and academic performance in Integrated Science

Research Question 4: What are the Challenges and Limitations

Table 8: Descriptive statistics on the Challenges and Limitations

S/N	Statement	YES	NO	M	Decision
25.	Poor internet connectivity limits my ability to access animations and video lessons	35	15	3.40	Agreed
26.	I find it difficult to apply planning strategies consistently in my study	30	20	3.20	Agreed
27.	Lack of guidance from lecturers hinders my effective use of simulations and virtual labs	32	18	3.28	Agreed
28.	Technical problems (e.g., device issues) affect my ability to learn through multimedia	28	22	3.12	Agreed
29.	Limited availability of digital learning tools reduces my use of interactive multimedia	29	21	3.16	Agreed
30.	Difficulty in evaluating my own understanding affects my ability to benefit from metacognitive strategies	31	19	3.24	Agreed

Note: YES = Yes; NO = No;
M = Mean
Total Mean = 19.4
Grand Mean = 19.4 ÷ 6= 3.23

The data presented in Table 8 reveal that students encounter several challenges in the use of multimedia resources and metacognitive learning strategies for Integrated Science. Key issues identified include poor internet connectivity, which limits access to video lessons and animations, as well as technical problems with devices. Students also reported that the limited availability of digital learning tools reduces their ability to engage effectively with interactive multimedia resources.

Additionally, students indicated difficulties in consistently applying metacognitive strategies such as planning and self-evaluation. Inadequate guidance from lecturers further constrained the effective use of simulations and virtual laboratory activities. Overall, the findings suggest that although multimedia and metacognitive strategies are perceived as beneficial, infrastructural, technical, and instructional challenges hinder their optimal utilization. Improving access to digital resources, strengthening lecturer support, and providing training on metacognitive practices could enhance their effectiveness in Integrated Science learning.

Discussion of Findings

Research Question 1: The study examined undergraduate students' perceptions of the use of multimedia resources in enhancing the teaching and learning of Integrated Science Education.

The study revealed that undergraduate students generally perceive multimedia resources positively in enhancing their learning of Integrated Science. They reported that videos, animations, simulations, virtual laboratories, and presentation slides help clarify difficult concepts, sustain interest, and improve engagement. Students highlighted that the ability to repeatedly view instructional videos and work at their own pace enhances their understanding of abstract phenomena, such as ecological interactions and biochemical processes.

These findings align with the work of Mayer and Fiorella (2021), who emphasized that well-designed multimedia enhances comprehension through coordinated visual and verbal channels. Similarly, Owusu and Adom (2020) and Chaka (2021) found that students value multimedia for its ability to present complex scientific processes clearly, support self-paced learning, and increase motivation. However, as noted by Adeyemi and Salami (2022), challenges such as limited access to technology and poor instructional design may hinder positive perceptions, which suggests that while students see multimedia as beneficial, context and implementation matter.

Research Question 2: The study explored students' perceptions of the application of metacognitive learning strategies in enhancing their understanding of Integrated Science concepts.

The findings showed that students perceive metacognitive strategies as effective tools for enhancing understanding. Planning, monitoring, and evaluating their learning processes helped them reflect on their comprehension, identify areas of difficulty, and adjust study approaches accordingly. Students reported that these strategies fostered greater confidence and autonomy in tackling complex scientific topics.

This aligns with Afolabi and Adeyemi (2020), who observed that students employing metacognitive strategies improved comprehension in chemistry and biology. Similarly, Karagiannopoulou and Milienos (2021) noted that engagement with self-regulated learning strategies enhances problem-solving and academic performance. The literature also supports the view that pairing reflective strategies with multimedia resources, as noted by Mayer and Fiorella (2021), strengthens students' ability to process, retain, and apply complex scientific information effectively.

Research Question 3: The study investigated the extent to which multimedia and metacognitive learning strategies jointly contribute to the enhancement of Integrated Science Education among undergraduate students.

The study found that the combined use of multimedia and metacognitive strategies significantly enhances students' learning experiences. Multimedia provides dynamic, visual representations of scientific concepts, while metacognitive strategies guide learners in planning, monitoring, and evaluating their understanding. Students reported that this combination helped them internalize complex ideas, improve problem-solving skills, and stay actively engaged in lessons.

Empirical evidence in the literature corroborates this finding. Adedokun and Bello (2019) observed that students exposed to multimedia alongside guided reflection showed superior conceptual understanding. Asare and Mensah (2021) similarly reported that combining digital simulations with structured metacognitive prompts enhanced engagement, analytical reasoning, and motivation. Okeke and Nwafor (2020) highlighted that animated diagrams combined with reflective activities improved retention and mastery of abstract concepts. Together, these findings support the notion that multimedia and metacognitive strategies function synergistically to deepen comprehension in Integrated Science.

Research Question 4: The study examined the challenges and limitations students encounter in using multimedia and metacognitive learning strategies for Integrated Science Education.

The study revealed several challenges that limit the effectiveness of multimedia and metacognitive strategies. These include inconsistent access to digital devices and the internet, limited familiarity with metacognitive practices, heavy academic workload, and insufficient lecturer guidance. Students also highlighted that poorly aligned multimedia materials and cognitive overload reduce the effectiveness of these strategies.

These challenges reflect findings in the literature. Abubakar and Afolabi (2020) and Owusu and Adom (2020) emphasized that limited technological access and low digital literacy can hinder engagement with multimedia resources. Adedokun and Bello (2019) noted that inadequate metacognitive skills prevent students from fully benefiting from reflective strategies. Asare and Mensah (2021) stressed that instructional misalignment and excessive cognitive load can reduce learning effectiveness, underscoring the need for structured guidance and support.

Research Question 5: The study explored ways in which the integration of multimedia and metacognitive learning strategies can be improved to promote effective learning in Integrated Science Education.

Students suggested that integration could be improved through better technological infrastructure, including stable internet and multimedia-rich platforms, as well as training for both lecturers and students in using multimedia and metacognitive strategies effectively. They emphasized that these strategies should be deliberately embedded into lesson plans and assessments, accompanied by guided exercises, scaffolding, and reflective activities.

The literature supports these recommendations. Abubakar and Afolabi (2020) and Adeyemi and Salami (2022) highlight that access to digital resources improves engagement and comprehension. Adedokun and Bello (2019) found that training and scaffolding enhance the effective use of metacognitive strategies. Asare and Mensah (2021) and Okeke and Nwafor (2020) emphasize embedding reflective practices within multimedia instruction to maximize understanding and problem-solving abilities. Collectively, these studies indicate that a systematic, supported, and reflective approach ensures that multimedia and metacognitive strategies achieve their full potential in enhancing Integrated Science learning.

CHAPTER FIVE

SUMMARY, CONCLUSION AND RECOMMENDATIONS

In this chapter, the researcher presents the summary of the study, conclusions as well as recommendations for further research.

Summary

This study examined students' perceptions of the use of multimedia and metacognitive learning strategies for the enhancement of Integrated Science education at the University of Benin, Benin City, Edo State. . The study was conducted to address persistent challenges in the teaching and learning of Integrated Science, particularly difficulties associated with abstract concepts, low student engagement, and limited use of learner-centred instructional strategies.

Four research questions were formulated to guide the study. The questions focused on students' perceptions of multimedia resources in Integrated Science, students' perceptions of metacognitive learning strategies, the combined influence of multimedia and metacognitive strategies on learning, and the challenges students encounter in using these strategies.

A descriptive survey research design was adopted for the study. The population consisted of undergraduate students offering Integrated Science–related courses. A structured questionnaire titled Students' Perception of Multimedia and Metacognitive Learning Strategies Questionnaire was used for data collection. The instrument covered four sections: multimedia perception, metacognitive learning strategies, combined influence of both strategies, and challenges and limitations.

Data collected were analysed using descriptive statistics, including frequency counts, percentages, and mean scores, to answer the research questions.

The findings of the study revealed that:

1. Students demonstrated positive perceptions of multimedia resources in Integrated Science learning. The majority of students agreed that instructional videos, animations, simulations, virtual laboratories, diagrams, and audio-visual explanations made learning more engaging, improved understanding of difficult concepts, and enhanced retention of scientific knowledge.
2. Students also showed positive perceptions of metacognitive learning strategies. Most respondents indicated that they plan their study sessions, set learning goals, monitor their understanding, reflect on their mistakes, evaluate their performance, and adjust their study methods when necessary. This suggests that students recognise the importance of self-regulation in learning Integrated Science.
3. The findings revealed that the combined use of multimedia and metacognitive strategies enhances learning outcomes in Integrated Science. Students perceived that using multimedia resources alongside planning, self-monitoring, reflection, and evaluation improves comprehension, retention, confidence, and overall academic performance.

4. Despite the positive perceptions, students identified several challenges and limitations affecting the effective use of multimedia and metacognitive strategies. These challenges include poor internet connectivity, technical problems with devices, limited availability of digital learning tools, lack of adequate guidance from lecturers, and difficulty in consistently applying metacognitive strategies.

Conclusion

Based on the findings of this study, it can be concluded that multimedia and metacognitive learning strategies play a significant role in enhancing Integrated Science education.

The study established that multimedia resources make Integrated Science lessons more interactive, engaging, and easier to understand by helping students visualise abstract scientific concepts. It also revealed that metacognitive learning strategies empower students to take responsibility for their learning by planning, monitoring, evaluating, and reflecting on their academic activities.

Furthermore, the study concluded that the integration of multimedia resources with metacognitive strategies yields better learning outcomes than using either approach independently. This combined approach promotes deeper understanding, improved retention, and increased confidence among students.

However, the effectiveness of these strategies is limited by infrastructural, technical, and instructional challenges. Without adequate internet access, digital tools, and lecturer guidance, students may not fully benefit from multimedia and metacognitive learning approaches.

It can therefore be concluded that while students have favourable perceptions of multimedia and metacognitive learning strategies, institutional support and effective instructional guidance are essential for maximizing their impact on Integrated Science education.

Recommendations

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

1. Lecturers teaching Integrated Science should incorporate multimedia resources such as instructional videos, animations, simulations, and virtual laboratories into their lessons to enhance student engagement and understanding.
2. Lecturers should consciously teach and reinforce metacognitive learning strategies, including planning, self-monitoring, reflection, and self-evaluation, to help students become more effective and independent learners.
3. University management should improve internet connectivity and digital infrastructure to support students' access to multimedia learning resources.
4. Workshops and orientation programmes should be organised for students on effective study skills and metacognitive strategies to improve their academic performance in Integrated Science.
5. Curriculum developers should integrate multimedia-based and metacognitive approaches into Integrated Science curricula to promote learner-centred teaching and learning.

6. Students should be encouraged to actively engage in self-regulated learning, making conscious efforts to plan, monitor, and evaluate their learning processes.

Suggestions for Further Studies

Based on the findings and scope of this study, the following suggestions are made for further research:

1. Similar studies could be conducted in other faculties or institutions to compare students' perceptions of multimedia and metacognitive learning strategies.
2. Experimental studies could be carried out to determine the effect of multimedia and metacognitive strategies on students' academic achievement in Integrated Science.
3. Future research could investigate lecturers' readiness and competence in integrating multimedia and metacognitive strategies in science teaching.
4. Studies could also explore the influence of demographic variables such as gender, academic level, or digital literacy on students' use of these learning strategies.

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APPENDICES

DEPARTMENT OF CURRICULUM AND INSTRUCTIONAL TECHNOLOGY
FACULTY OF EDUCATION, UNIVERSITY OF BENIN, BENIN CITY
QUESTIONNAIRE
STUDENTS' PERCEPTION ON THE USE OF MULTIMEDIA AND METACOGNITIVE LEARNING STRATEGIES FOR INTEGRATED SCIENCE EDUCATION ENHANCEMENT

Dear Respondent, This questionnaire is designed to collect information for a study on "Students' perception on the use of multimedia and metacognitive learning strategies for integrated science education enhancement" Please complete the structured questionnaire by ticking the appropriate box or filling in the blank spaces provided. If you have any questions, please ask before you start. All information provided will be treated with the utmost confidentiality and will be used strictly for academic purposes. Your sincere and honest responses are highly appreciated.

KEY:

Section B: SA – Strongly Agree A – Agree D – Disagree SD – Strongly Disagree

Section C: Y – Yes N – No

SECTION A: Demographic Information

Gender: Male ( ) Female ( )

Level of Study: 100L ( ) 200L ( ) 300L( ) 400L( )

SECTION B: Students' perception of multimedia in integrated science

S/N	ITEMS	SA	A	D	SD
1.	Animated simulations make learning Integrated Science more engaging				
2.	Instructional videos help me understand difficult Integrated Science concepts better				
3.	I prefer learning science topics through interactive simulations rather than traditional lectures.				
4.	Virtual laboratory exercises improve my retention of scientific concepts.				
5.	Diagrams and infographics in lessons help me visualize scientific processes effectively.				
6.	Multimedia presentations (videos + slides) increase my interest in Integrated Science topics.				
7.	Watching experimental demonstrations through video aids my understanding of laboratory procedures.				
8.	Audio-visual explanations make abstract science concepts easier to comprehend.				
	Combined Influence of Multimedia and Metacognitive Strategies				
S/N		**SA**	**A**	**D**	**SD**
9.	Using animations together with self-monitoring improves my understanding of science concepts.				
10.	Reflecting on instructional videos helps me perform better in science assessments.				
11.	Interactive simulations combined with planning make learning science easier.				
12.	Virtual laboratory activities plus evaluation of my understanding enhance my learning outcomes.				
13.	Multimedia resources paired with goal-setting help me manage my study sessions more effectively.				
14.	Summarizing key points after watching educational videos improves my retention.				
15.	I find that using infographics while monitoring my understanding				

	makes learning science less confusing.				
16.	Audio-visual explanations combined with reflection on my performance increase my confidence in science tasks.				

SECTION C: Students' Perception of Metacognitive Learning Strategies

S/N	ITEMS	YES	NO
17.	I plan my study sessions before learning new science concepts.		
18.	I set specific learning goals before starting a science lesson.		
19.	I regularly monitor my understanding while learning Integrated Science.		
20.	I ask myself questions to check if I understand the lesson.		
21.	I evaluate my own performance after completing science tasks.		
22.	I reflect on my mistakes to improve in future assignments.		
23.	I summarize key points after each lesson to ensure understanding.		
24.	I adjust my study methods when I realize I am not understanding a topic.		
	Challenges and Limitations		
25.	Poor internet connectivity limits my ability to access animations and video lessons.		
26.	I find it difficult to apply planning strategies consistently in my study.		
27.	Lack of guidance from lecturers hinders my effective use of simulations and virtual labs.		
28.	Technical problems (e.g., device issues) affect my ability to learn through multimedia.		
29.	Limited availability of digital learning tools reduces my use of interactive multimedia.		
30.	Difficulty in evaluating my own understanding affects my ability to benefit from metacognitive strategies.		