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Effect of Explicit and Concrete-Representational-Abstract Strategies on Students' Learning Outcomes in Basic Science

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Abstract-** Basic Science serves as a foundational discipline that introduces core scientific concepts and principles, preparing students for advanced studies in Biology, Chemistry, and Physics. Despite its importance, student performance in Basic Science across Nigeria is poor, particularly in Ibarapa, This is largely attributed to teachers' methods of teaching the subject, which resulted in students' perceived difficult learning outcomes (achievement in and attitude of the students). Previous studies largely looked into student and teacher factors, with less attention paid to active learning strategies such as explicit and concrete-representational-abstract. This study, therefore, was designed to determine to compare the effects of Explicit Strategy (ES) and Concrete-representational-abstract Strategy (CraS) on students' learning outcomes of some perceived difficult concepts in Basic Science in Ibarapa, Nigeria. It also examined the moderating effects of Self-efficacy and teachers' Area of Specialisation (Basic, Core Science, and Non-science) The study adopted a pretest-posttest control group quasi-experimental design with a 3x2x3 factorial matrix. Three Local Government Areas in Ibarapa were adopted, and nine Junior School II were randomly selected (three per LGA). The schools were randomly assigned to ES (272), CraS (293), and the control (223) groups. The instruments used were Students' Achievement Test in BS (r=0.77); Students' Attitude to BS (r=0.72), Students' Self-efficacy (r=0.70) questionnaires and guides. The data were analysed using ANCOVA and Bonferoni post-hoc, while the hypotheses were tested at a p ≤ 0.05 level of significance. The study revealed that The findings affirm that the concrete-representational-abstract strategy is superior in promoting deep learning and retention in both achievement and attitude to Basic Science. However, there was a significant main effect of treatment on students' attitude (F(2; 787)=7.51; ŋ2=0.02). The participants exposed to the Concrete-representational-abstract-strategy had the highest post-mean score (83.95), followed by those in the explicit strategy (82.16) and the conventional (79.78) groups. There was a significant main effect of Students' Self-efficacy on attitude (F(2; 787)=13.35; ŋ2=0.02) but not on achievement. There were also significant main effects of teachers' area of specialisation on achievement (F(2; 787)=202.64; ŋ2=0.35) and attitude (F(2; 787)=62.64; ŋ2=0.14). Consequently, its effectiveness is amplified when delivered by teachers with a strong background in basic science education. Explicit instruction, while structured and clear, may not foster the same level of engagement or conceptual mastery, particularly when used by educators outside the basic science domain, like core science subjects (Biology, Chemistry, and Physics) or non-science. The study, therefore, will help teachers and learners if the strategies are adopted by basic science teachers to teach any concepts in basic science in the classroom.

***Keywords:** Explicit Strategy, Concrete-Representational-Abstract Strategy, Students' Learning Outcomes, Ibarapa In Nigeria*

I. INTRODUCTION

Science is a pursuit of knowledge that seeks to understand fundamental laws and general truths, ultimately transforming our environment to enhance human life. Science plays a vital role in society. Teaching science aims to foster positive changes in students, including intellectual skills, critical thinking, problem-solving abilities, attitudes, behaviors, and the capacity to evaluate information and make informed decisions. It increases students' interest in STEM by encouraging curiosity and enthusiasm for science, technology, and mathematics, and students' ability to tackle challenges effectively.

Science is an intellectual and practical activity incorporating the methodical learning of the structure and behaviour of the physical and natural world through observation and experimentation leading to the discoveries of principles, laws and theories by researchers. Scientific literacy learnt through science - education improves the production of people who can efficiently partake in and contribute to the life of the society. While objectivity, open - mindedness and honesty are some of the values which are cultivated by those who learn science, the better appreciation and understanding of the environment developed desire and ability to adapt.

The changes are essential for students' academic and personal growth, as highlighted by Cebrian and Junyent (2015). Secondary school education is intended to be learner-centered, aiming to foster maximum self-development and independence. The National Policy on Education (2013) stated that secondary schools should offer every primary school graduate, regardless of gender, socio-economic status, religion, or ethnicity, access to higher-level learning opportunities (FRN, 2013). Sharing scientific concepts and procedures with people who aren't often thought of as belonging to the scientific community was involved in the discipline. The person or people in question could be the target in the community. It is certain that some science contents make up topics of science education (Bauer and Kinchiner, 2020).

Science education goals in Nigeria are the development of scientific attitudes as well as preparing students to observe or investigate their surroundings to explain basic natural phenomena (Stela *et al*, 2020). Additionally, using the acquired skills to solve problems that arise daily. Developing scientifically literate people who can engage in logical thought and behavior is the main objective. Nigeria science education goals are giving students' knowledge and abilities they need to observe and investigate their surroundings, critically and objectively explain basic natural phenomena, and then apply what they have learned to everyday situations and societal issues. The world is more scientific oriented where there has been a new fervor to advance technologically and scientifically, particularly in emerging nations like Nigeria. Meanwhile, students are taught fundamental subjects, including Basic Science, to acquire knowledge about the physical world and develop skills to tackle everyday challenges. This foundational education equips students for future growth.

Integrated Science is a foundational subject in Junior secondary school that prepares students for advanced science courses at the senior school level. It adopts a unified approach to science by presenting concepts and principles in a way that emphasizes the interconnectedness of scientific ideas, minimizing early emphasis on the differences between scientific disciplines (Ogonnaya, 2016). The primary goals of Basic Science include helping students: observe and investigate their surroundings using their senses and hands, develop a curiosity to gain essential knowledge and skills in these areas, and use what they've learned to real-life situations, address community challenges, explore career paths in science and technology, and get ready for further education. These aims are outlined in the Basic Science curriculum (FRN, 2013).

The curriculum is structured around a spiral model, meaning that topics are introduced in a progressively complex manner throughout the 9 years of basic education, from primary 1 to 6 through junior school 1 to 3, following the national education policy (FME, 2014). Basic Science curriculum adopts an integrated approach, combining content from various scientific disciplines to present a cohesive perspective to introduce it as a whole, rather than as separate subjects like Physics, Chemistry, or Biology (FRN, 2013). According to Ajayi (2019), the Basic Science curriculum serves 2 primary purposes: i. offer a solid science foundation to students. ii. establish a strong foundation for those intended to pursue it.

Despite various efforts aimed at realizing the objectives of Basic Science, researchers like Ferdinand (2007) and Ogunnike (2018) have observed poor performance of students in the subject across Nigeria, and in need of substantial enhancement. Also, Adeyemi (2010), Ajagun (2013), and Oshodi *et al* (2017) findings have shown that students' learning outcomes remain not so encouraging.

Based on the researcher's findings from the result analysis from the ministry of education in Oyo state, it can be inferred that the rates of failure and basic passes are relatively low when compared to the higher percentages of students achieving credit passes and distinctions. Given these performance levels, around 90% of students would progress to studying science, which is a key foundation. Junior School students only require a basic science subject that must be passed in the BECE to qualify for entry into science classes in Senior Secondary School.

However, the reality is quite different. Only about 20 to 25% enroll in science streams in Senior school. In Oyo State, not only is student enrollment in core science classes low, but many of those who do pursue science subjects are compelled to attend extramural classes or hire private tutors to keep up with the curriculum. Those who lack access to such support often struggle and ultimately perform below expectations, with poor achievement scores in core science subjects during their Senior Secondary education.

Considering the data contrast to the general view of poor student achievement in Basic Science across Nigeria, the researcher aims to focus on maintaining and improving the relatively positive outcomes recorded in Oyo State. Therefore, it is crucial to continue supporting students to sustain this academic momentum, to eventually achieve a 100% success rate in Basic Science. This would significantly contribute to advancing science and technology in the state.

To further understand the situation, the researcher conducted interviews with several teachers regarding students' achievement in the BECE. Most teachers commended the current government's efforts to enhance the learning environment in public schools. These efforts include the implementation of free education, provision of adequate teaching materials, distribution of exercise and notebooks to students, supply of science equipment to public secondary schools, recruitment of teachers through the Post Primary Teaching Service Commission (TESCOM), and improvements in classroom conditions to ensure more effective teaching and learning. The achievement of a teacher-to-student ratio of 1:30, as agreed, as well as the provision and renovation of science laboratories, were also highlighted (NPE, 2013). From the teachers interviewed, these initiatives have significantly contributed to the improvement in BECE, Oyo State.

Despite the critical role Basic Science plays in youth development and national progress, as well as its function as a foundational subject for core science disciplines in Senior Secondary School, many students develop a different idea of science once they advance to the senior level. A preliminary survey conducted in various schools across Oyo State revealed that the number of Junior Secondary School students transitioning into science classes at the Senior Secondary level is quite low. Fewer than 25% of those who took the BECE, even those with strong grades in Basic Science, went on to register for other subjects. Instead, the majority of students chose to pursue Arts or Commercial subjects, despite having the qualifications to study science.

This low enrollment in science streams may be attributed to several factors, including inadequate teaching skills among educators, low teacher commitment, assigning non-science teachers to handle Basic Science, indifference toward science teaching and learning, ineffective teaching methods, lack of instructional materials, and students' weak foundational knowledge in both science and mathematics. Insufficient funding of the education sector by relevant authorities and students' negative attitudes toward Basic Science have also been identified as contributing factors (Ibe and Aboniyi, 2014). Agwu and Samuel (2019) assert that the way educators explain difficult concepts in Basic Science contributes to students' limited understanding and declining interest in continuing with science subjects. The researcher interviewed several students in the Arts and Commercial classes to understand why they chose those streams despite achieving good results in Basic Science in their Junior Secondary School BECE, where they were once expected to pursue careers as scientists in the state. Most of the students explained that they believe core science subjects, Physics, Chemistry, and Biology, are meant only for exceptionally bright students due to their perceived difficulty, which they had already noticed in Basic Science. They also mentioned that science subjects often require a lot of time for practical experiments and are associated with high costs and limited career opportunities.

Additionally, some students cited a lack of adequate science equipment in their schools and found science textbooks difficult to comprehend. They described Physics as too abstract, Biology as overly extensive, and Chemistry as particularly challenging. Many concluded that science subjects are too heavily based on mathematics. Several students also admitted to having a weak foundation in Basic Science from their primary and junior secondary education. Furthermore, they reported receiving little to no encouragement from parents or peers to pursue science in Senior Secondary School. The researcher also noted a general lack of motivation among these students.

When students perceive a concept within a subject as difficult, their performance in that subject tends to decline. If this perception persists, it can influence their peers as well, potentially discouraging even those who might otherwise perform well. Changing such negative perceptions requires significant effort from the teacher, who must invest time and skill in making the concepts more understandable. Students need to be motivated to learn, as they are eager.

Mastering Basic Science greatly impacts students' overall achievement in the subject, and this underscores the need for qualified and specialized teachers in each scientific area (Abella and De Jesus, 2021). The findings from this study, particularly the high number of students who drop science subjects, suggest that students struggle with specific concepts in Basic Science. These challenges are often linked to the way certain topics are taught. The study also reveals that some poor teaching approaches may be a key factor contributing to the learning difficulties students face. These difficulties, in turn, influence their willingness and ability to pursue core science subjects in Senior Secondary School.

The basic content experience as difficult by students in basic science is physical content as well as the chemical content (Johnston, 2021). These difficulties may be caused by to complexity of the concepts existing as micro, macro, and symbolic, which are more common in basic science concepts, especially at the micro and symbolic levels. And teachers who are not specialized in it may find it difficult to provide concrete experiences for the students to facilitate more effective learning.

The students interviewed perceived some difficulties in basic science than other science-related concepts that they encounter in other core science subjects. These difficult concepts need a qualified teacher in that field of specialisation who will give meaning to the concept.

Science tends to lose its appeal and excitement when students are passive learners. This lack of active participation may lead students to view some concepts as difficult (Behar and Polat, 2007). However, with adequate training and consistent use of appropriate instructional strategies by teachers, these perceived difficulties in Basic Science can be minimized. Students' attitudes toward Basic Science are essential to their learning process, making it the second dependent variable examined in this study.

Educators are concerned with students' cognitive development as well as the affective domain, particularly their attitudes. According to Joda (2019), attitude is commonly defined as a "response tendency" or a state of being prepared to respond, indicating a student's predisposition to react in certain ways. Students' attitudes toward Basic Science can be reflected in their level of interest and how they engage with the subject, especially about topics they find challenging, as the key Basic education among core science subjects (Joseph, 2020). A positive attitude supports learning by encouraging enjoyment and engagement with the subject matter, while a negative attitude hinders learning and motivation (Apara, 2015).

Attitude reflects students' responses or reactions to learning experiences. It is typically expressed through preferences, such as liking, disliking, or rejecting a particular subject or concept. The way a student approaches Basic Science can greatly influence their performance in school. Pamungkas, Subali, and Lunuwih (2017) described science education as a process aimed at imparting an understanding of the nature of science to learners. Students' attitudes to Basic science are evident in how they engage with the subject during lessons. Attitudes can generally be categorized as positive or negative, or favorable or unfavorable. A positive attitude toward learning is shown through increased diligence and better academic outcomes, whereas a negative attitude tends to hinder effective learning (Rijal and Bachtiar, 2015). Nursa'adah *et al*. (2023) identified that students' negative attitudes could be caused by the monotonous traditional method used by the science teacher to teach basic science. In this case, learning occurs in a passive manner, with students hesitant to engage mentally or accept the material presented. Based on the BECE analysis results from Oyo State, students showed a positive attitude toward learning Basic Science. However, their core subjects in Senior secondary school were negatively large due to their knowledge of these subjects as being more difficult.

Studies conducted by Gambari and Yusuf (2017), Fatokun and Sotayo (2018), and Ajayi (2019) revealed that the instructional approaches used by Basic Science educators have considerably influenced students' unfavorable attitude toward both Basic and core science subjects in Senior Secondary School. Similarly, Umeh (2017) pointed out that students' indifferent attitudes in Junior Secondary School, particularly toward challenging topics in biological and physical sciences, contribute to their low performance. Recent observations highlight increasing concern over students' attitudes toward Basic Science at the junior level. A considerable number of learners exhibit passivity during lessons, and even those who participate frequently struggle with grasping the subject matter, an issue often linked to the teaching methods employed.

Basic Science and Technology is an integrated subject that combines various disciplines, including Biology, Chemistry, Physics, and Basic Technology (FRN, 2013). This combination is intended to equip students with the foundational knowledge necessary for studying science. For effective delivery, ideal qualified Integrated Science teacher with Bashelor Degree certificate should handle the subject. However, with the inclusion of Physical and Health Education and ICT, it has become challenging to teach the subject in its original integrated format (FRN, 2013).

As a result, teachers specializing in Biology, Chemistry, or Physics are often assigned to teach. Presently, the subject is treated as if it were a set of separate disciplines, with different teachers handling each component. This fragmented approach stems from the lack of professionals trained to teach the subject as a unified whole. Consequently, the subject is not being taught effectively, some topics are neglected entirely due to the absence of qualified instructors, while students who have completed the Basic Science component should be effectively introduced to the broader world of science, enabling them to grasp subjects that are interconnected rather than viewing them as isolated disciplines (FRN, 2004). To meet the goals outlined by the NPE, it is essential that well-trained teachers, who are capable of both integrating scientific concepts and addressing the specific content of each science subject should teach the subject.

Studies have indicated that students often find biological and physical sciences, particularly Physics and Chemistry, to be the most challenging areas in the Basic Science and Technology curriculum (Babayemi, Akpan, and Emah, 2018). Olagunju and Akpan (2019) assert that students' performance is closely tied to the various components of Basic Science, which in turn influences their ability to succeed in individual science subject.

The researcher is particularly concerned with the perceived difficult concepts in Basic Science, as students have identified these as key barriers to their academic success in the subject. Ensuring strong student performance in Basic Science is crucial, as it lays the foundation for understanding science-related subjects at the senior secondary level. However, studies have shown that students often view certain topics in Basic Science, especially those related to biology, chemistry, and physics, as challenging. For this study, only selected concepts within these three areas will be examined (Babayemi, Akpan, and Emah, 2018).

According to Akogun *et al*. (2020), examples of these difficult concepts include topics such as the uniqueness of humans (reasoning, problem-solving, observation, measurement, inference), chemical substances, kinetic theory, first aid, heat transfer, growth and development, crude oil, habitats and adaptations of living organisms, changes and development, evaporation, boiling, petrochemicals, temperature, security and rescue operations, as well as heat transfer methods—conduction, convection, and radiation. These topics are all rooted in the physical, biological, and chemical sciences, and students often struggle with them in both internal and external examinations at the senior secondary level (Babayemi, Akpan, and Emah, 2018).

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Various researchers have linked poor student performance in these areas to several to include method use for teaching complex topics (Olagunju and Babayemi, 2014), a shortage of qualified Basic Science and Technology teachers (Ebeh, 2014), and students' negative attitudes toward science subjects (Olarewaju, 1988), among others. To address these challenges, such difficult concepts must be taught using student-centered instructional approaches (Aloovi, 2016).

However, to further understand and give direction to this study, various studies were examined to determine the extent to which difficult concepts have been studied in the past. The study by Babayemi, Akpan, and Emah (2018) carried out a general survey to determine the difficult concepts in basic Science. Their result indicated that most biological, physical, and chemical science topics were perceived as difficult. Similarly, Olagunju and Babayemi (2014) carried out a survey on instructional strategies used for teaching Basic Science, result showed that teachers usually use inadequate strategies. The observed inadequacy of the teaching strategy is due mainly to the fact that students have limited opportunities to actively explore and think. The use of a student-centred approach would enable the learners' difficulties to be simplified and probably improve the attitude of learners toward the subject (Aloovi, 2016).

Invariably, the lecture method is still viewed as a model for teaching, even in this period of technological advancement among educators. In addition, the method is still in use in colleges and universities as a means of instruction in these higher institutions (Zare-ee and Kuar, 2011). According to Ogundiwin and Ahmed (2015), the traditional method (Lecture method) used to teach science is extremely ineffective at all levels. Olashehinde and Olatoye's (2014) research findings showed that when the lecture method is employed, it is ineffective in the instruction of science. Aloovi (2016) suggested hands-on activities, as it improve interest, which translates to an improvement in their performance. Amongst these are student-centered strategies such as explicit strategy, concrete-representational-abstract strategy, interactive invention strategy, think-pair-share strategy, interactive engagement strategy, concept mapping strategy, and so on. These instructional strategies allow students to construct their experiences by making them active participants in the teaching procedure rather than inactive learners. In light of this, There has been a persistent trend of poor student performance and negative attitudes toward perceived difficult concepts particularly in school. This issue is a major for researcher during field observations. Other believed it is teaching strategies commonly used by Basic Science educators that have significantly contributed to students' low achievement and poor attitudes toward the subject.

As a result of delivering Basic Science content to junior secondary students to promote deeper, more meaningful learning. This highlights the importance of adopting learner-centered instructional approaches, such as the Explicit Strategy (ES) and the Concrete-Representational-Abstract Strategy (CRAS). Therefore, seeks these two for improving students' learning outcomes of perceived difficult concepts in Basic Science in Ibarapa region of Nigeria.

Explicit strategy refers to a teaching approach where lessons are intentionally structured and delivered to help beginners build foundational knowledge on a specific subject. This method was first developed by Lorraine Hammond, drawing on educational research from the 1960s and 1970s. During that time, researchers observed classrooms to explore how certain teacher behaviors influenced student achievement. They discovered that highly effective teachers consistently reviewed prior knowledge, checked for student understanding, and addressed misconceptions throughout their lessons.

Explicit teaching involves demonstrating tasks and guiding students through each step, similar to following a detailed recipe when baking a cake, where missing a step or ingredient could lead to poor results. This approach blends direct instruction with opportunities for learners to practice and gradually construct understanding on their own. In this way, it aligns with aspects of constructivist learning, where students actively engage in building their knowledge based on guided instruction.

Research conducted by Flethcher, Lynn, Fuchs, and Barnes (2018) emphasized that explicit instruction involves teachers clearly guiding students through tasks by offering direct explanations, sharing relevant experiences, and demonstrating new concepts. Akinoso (2013) reported that applying explicit instructional methods in Mathematics significantly boosted students' academic achievements and improved their attitudes toward the subject.

Similarly, Ogunleye (2019) investigated the impact of explicit instruction on senior secondary students' performance in Chemistry. The study found that students taught using explicit strategies outperformed peers who were exposed to traditional teaching methods. Further support comes from Amua and Kur (2019) and John (2023), who showed that learners receiving explicit instruction exhibited greater motivation than those taught with conventional strategies.

Overall, the explicit strategy has consistently proven effective in enhancing students' academic outcomes, particularly in tackling challenging topics within Basic Science. The second approach, which also promotes student-centered learning and involves the use of tangible materials to support teaching and enhance understanding, particularly of challenging concepts in Basic Science, is the concrete-representational-abstract strategy. This method is especially useful in junior school.

Concrete-Representational-Abstract Strategy (CRAS) is the second instructional method adopted by the researcher. This strategy boost students' academic achievement also, positively influence their attitudes toward learning key science subjects. In turn, this can lead to improved performance in the subjects. CRAS is three-phase instructional approach deepen at enhancing learners' grasp of core concepts and techniques. It begins with hands-on manipulation of concrete materials, progresses to pictorial or visual representations, and concludes with solving problems using abstract symbols or notations.

This structured learning process helps students transition from concrete experiences to abstract thinking. The CRAS approach offers a guided instructional sequence that prepares learners for success in science by building conceptual understanding step by step. According to Witzel (2015), the use of concrete materials enables students to encode and retrieve information through multiple sensory channels, ie, visual, auditory, tactile, and kinesthetic. When learning Basic Science, students greatly benefit from engaging with well-structured, concrete materials that reinforce their understanding of difficult concepts (Witzel, 2015).

Nugroho and Jailani (2019) demonstrated that the concrete-representational-abstract strategy (CRAS) significantly enhanced students' mathematical skills. The study outlined the strategy's three core stages: the concrete phase, the representational (or pictorial) phase, and the abstract phase. Students were required to progress through each stage sequentially, ensuring they fully understood each concept before advancing to the next.

Ogunleye (2019) also applied this approach in Chemistry, particularly with students who had difficulties with mathematical concepts. The findings showed that CRAS effectively improved their performance, especially in areas of Chemistry that involve mathematical reasoning.

The integration of these two strategies, Explicit Strategy and CRAS, into the teaching of perceived difficult concepts in Basic Science is therefore seen as beneficial. Additionally, Yusuf (2024) explored effects of self-efficacy, achievement motivation, and learning strategies on students' academic performance. Results revealed that learning environment and instructional methods significantly influence academic outcomes. Among these, self-efficacy is identified as a key moderating variable, playing a critical role in shaping students' learning outcomes.

Bryant (2017) emphasized self-efficacy on the crucial role it plays in encouraging students to achieve their academic goals to tackle learning challenges. He observed that learners with high self-efficacy are more inclined difficult tasks, manage time efficiently, persevere through setbacks, experience lower levels of anxiety, and demonstrate greater flexibility in applying different learning strategies and adapting to diverse teaching environments.

Consistently, self-efficacy is a powerful instrument that predict students' academic performance. Some

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researchers argue that it has stronger predictive value than other non-cognitive factors like motivation, emotional state, or personality traits (Ojo, 2022).

Bandura (1986) defines self-efficacy as individuals' ability to plan and execute the necessary steps to accomplish particular performance outcomes.

Ayoum and Al-Momani (2018) defined self-efficacy as a person's ability to pass or fail in completing given assignment. Similarly, Koseoglu (2015) also, define self-efficacy as confidence one has and abilities or strengths when working, studying, or striving toward academic success. In the academic context, self-efficacy is widely recognized as being positively linked to academic performance and is considered a crucial factor in achieving positive outcomes.

Students with low self-efficacy often lack the determination necessary for academic success and tend to shy away from challenges, perceiving them as threats, (Maulana, 2017). Similarly, Sadi and Dagyar (2015) noted that individuals with strong, difficult tasks increased effort, whereas weak abilities are prone to giving up when encountering difficulties, which negatively impacts their academic performance. This view is supported by Aldosari (2020), who identified a significant correlation. Meanwhile, scholars such as Achenreiner, Kleckner, Knight, and Lily (2019), along with Putri and Prabawanto (2019), emphasised the crucial factor that enables students to persist with completely challenging academic tasks. Ghezzi, Tramontano, and Babaranelli (2016) further affirmed that students with higher self-efficacy not only achieve better academic results but also handle academic pressures more effectively than their peers with lower self-efficacy.

Hassan (2020) argued that strong self-efficacy is vital for students who aim to take control of their academic progress, particularly when using innovative learning strategies that involve critical thinking, skill acquisition, and problem-solving in science classes. Supporting this, Bryant (2017) identified a powerful predictor of students' learning outcomes. Ojo (2022) further noted that low self-efficacy affects both the cognitive (achievement) and affective (attitude and perception) domains. He explained that students lacking confidence in their abilities tend to give up easily, while those who believe in themselves remain motivated and persistent, even when facing challenges.

On another note, Basic Science faces significant challenges, one of which is the shortage of qualified and specialized teachers. Often, individuals with backgrounds in Integrated Science, core science subjects, or even non-science disciplines are assigned to teach Basic Science at both lower and upper basic education levels. Abella and De Jesus (2021) pointed out that this lack of subject specialists has negatively impacted students' performance and attitudes toward the subject. Similarly, Usman (2003) argued about the shortage of qualified science teachers, which may be a major factor contributing to students' poor academic outcomes in science. Therefore, the area of teachers' specialization is considered the second moderator variable in this study.

Joseph (2020) emphasized that when teachers are trained in and specialize in the subjects they teach, it not only fosters greater interest in the subject for both the teacher and students but also leads to improved academic outcomes. Students benefit from the teacher's depth of knowledge, which helps them build strong conceptual foundations and gain mastery of the subject. Specialization refers to the specific field or subject area in which a teacher has received professional training and has the expertise to instruct (Joseph, 2020). He further asserted that effective teaching requires teachers who possess the pedagogical skills to deliver it.

De Jesus and De Jesus (2021) noted that teachers often lack confidence when teaching topics beyond their area of expertise. This lack of confidence can become evident in various aspects of teaching, such as lesson planning, selecting appropriate activities, conducting laboratory experiments, and applying scientific concepts to real-life contexts. These shortcomings can negatively affect students' interest and enthusiasm for learning Basic Science.

Similarly, Okah (2014) researched teacher effectiveness and student achievement in tertiary institutions. The findings showed that students who believed their teachers had strong subject knowledge performed better than those who did not. This supports the earlier conclusion by Isangedigbi (2007), who argued that for a teacher to be truly effective and positively impact student performance, they must have a solid grounding in their subject area.

Furthermore, Ademulegon's findings, as cited in Gbore (2010), reinforced this view by revealing that students taught by highly qualified and experienced teachers, especially those who majored in the subject, consistently outperformed those taught by less qualified educators. Joseph (2020), from his research findings, found a significant relationship between teacher-related factors, such as qualifications, experience, and subject specialization, and students' academic performance in science subjects.

Cohen (2018) noted that assigning teachers to subjects outside their area of specialization creates added challenges within the education system, impacting not only students but also fellow teachers, parents, school leadership, and governing bodies. This practice increases pressure on staffing logistics and compromises both the quality of instruction and student learning. Similarly, Blazer (2015) pointed out that teaching outside one's expertise reduces instructional quality and negatively influences students' academic outcomes.

Allen (2018) also found that teachers placed in such roles often experience feelings of incompetence, face cognitive stimulation, by struggle to make lessons engaging due to insufficient subject knowledge. These concerns have been echoed by researchers, who argue that to improve both academic performance and student attitudes to Basic Science, it is essential to employ well-qualified and specialized Basic Science teachers (Abe and Owoeye, 2017).

Basic Science educators have emphasized that when concepts in the subject are poorly taught and inadequately learned, students may struggle to grasp essential ideas, leading to low academic achievement and negative attitudes toward the subject. Drawing from the Examination results of Oyo state over eight years (2015–2022), the researcher believes that for schools in the state to maintain and build upon this performance, deliberate efforts must be made to sustain the progress.

To achieve this, it is necessary to adopt diverse instructional strategies, such as the Explicit Strategy and the Concrete-Representational-Abstract (CRA) Strategy, that can help students to develop critical thinking skills, apply knowledge effectively and to gain a deeper understanding of challenging concepts. These approaches, supported by existing literature, which foster positive attitudes to Basic Science at the junior school.

Thus, research aims at examining effects of Explicit strategy and CRA strategy on students' learning outcomes, specifically their achievement and attitude toward perceived difficult concepts in Basic Science. Additionally, the research will explore the moderating roles of students' self-efficacy and teachers' areas of specialization in Basic Science within the Ibarapa, Oyo state, Nigeria.

II. STATEMENT OF THE PROBLEM

Basic Science, now taught as Basic Science and Technology, in Junior Schools across Nigeria. It is designed to equip the upper basic education level with scientific literacy for everyday life and to prepare them for post-basic science education. The subject combines elements of core science disciplines, Biology, Chemistry, and Physics, into an integrated curriculum. Ideally, students who complete Basic Science should transition smoothly into science subjects at the senior secondary level.

However, literature shows that students' performance across the different components of Basic Science varies significantly. There is a consistent pattern of underperformance in areas related to physical science (Physics and Chemistry), as well as abstract biological topics such as family traits.

Previous attempts to address these learning difficulties have relied heavily on computer-based instructional methods, which many teachers lack the training or resources to implement effectively. To address the abstract nature of these concepts, it is essential to explore teaching strategies that are more practical and accessible, such as the Explicit Strategy and the Concrete-Representational-Abstract (CRA) Strategy. These methods do not require advanced technology and are more adaptable to typical classroom settings.

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Given these concerns, this study seeks to evaluate the effects of the Explicit and CRA strategies on students' learning outcomes in Basic Science, particularly regarding perceived difficult concepts. Beyond teaching methods, other factors also influence student achievement. One key factor is the teacher's area of specialization, whether they were specifically trained to teach Basic Science or were trained in other science subjects intended for senior secondary education.

Therefore, the study tends to examine the effects of Explicit strategy and CRA strategy on students' achievement in and attitude to challenging Basic Science concepts, while also assessing the moderating roles of students' self-efficacy and teachers' area of specialization in content delivery.

III. HYPOTHESES

Ho1: There is no significant main effect of treatment on students' Achievement in and Attitude to Basic Science

Ho2: There is no significant main effect of students' self-efficacy in basic science Achievement in and Attitude to Basic Science

Ho3: There is no significant main effect of teachers' area of specialization on students' Achievement and Attitude to Basic Science

Ho4: There is no significant interaction effect of students' self-efficacy and teachers' area of specialization on students' Achievement in and Attitude to Basic Science

IV. METHODOLOGY

The study employed a quasi-experimental design involving a pretest-posttest control group structured using 3x2x3 factorial. The population of the study comprised 9 junior secondary schools ll basic science students in Ibarapa meje having three Local Government Area of Oyo State. a simple random technique was used to select three junior secondary schools each from the three Local Government Area present in Ibarapa Meje Metropolis. They were randomly assigned to experimental and control groups in which intact classes of a sample of 204 students were used. Three instruments were used to collect data they were Students' Achievement Test in Basic Science (SATBS): Students' Attitude to Basic Science questionnaire (SABSQ); Student's Self-Efficacy questionnaires and guides (SSEQ). The SATBS contained 30 multiple – choice questions adopted from past questions from Junior School Certificate Examination. And ea h items had one key response. The SABSQ adopted from Ojo (2022). It has two section; the participants biography data; and the 32 statements on attitude to basic science. The statement was on a modified Likert scale ranging from Strongly Agree (SA) to Strongly Disagree (SD). Participants indicate their degree of agreement with each item by selecting one of the four options. For positively worded items, responses are scored as follows: SA = 4, A = 3, D = 2, and SD = 1. For negatively worded items, the scoring is reversed to maintain consistency in attitude measurement. The validity of the research instrument was by content and face validity, and the reliability and internal consistency were evaluated using the Cronbach Alpha formula. Also, the SSEQ was adopted from Ojo (2022), it has 26 statements of student's self-efficacy in basic science. The questionnaire was modified to a four-point Likert scale with the options: Strongly Agree (SA), Agree (A), Strongly Disagree (SD), and Disagree (D). Some items were revised to align with the focus on difficult Basic Science concepts and to match the learners' proficiency levels. Scoring was applied as follows: SA = 4, A = 3, SD = 2, and D = 1 for positively worded statements, while negatively phrased items were scored in reverse. The validity of the instrument was based on content and face validity and the instrument assesses three main areas: students' interest, anxiety levels, and perceived usefulness of difficult science topics. The internal consistency reliability of the tool yielded a Cronbach's alpha coefficient of 0.88. The Three Local Government Areas (LGAs) in Ibarapa were adopted and nine Junior School II was randomly selected (three per LGA). The schools were randomly assigned to explicit strategy (71), Concrete-representational-abstract strategy (68) and the control (65) groups. The instruments used were Students' Achievement Test in BS (r=0.77); Students' Attitude to BS (r=0.72), Students' Se (r=0.70) questionnaires and guides. The treatment lasted 12 weeks. The data were analysed using ANCOVA and Bonferoni post-hoc test at $p \leq 0.05$ level of significance.

Procedure for the strategies used;

The following steps were followed in the explicit strategy

Step 1a; The teacher introduces the lesson to the students and write the topic of the lesson on the chalkboard as well as the stated behavioral objectives.

b. He divides the students into groups of 5 which is heterogeneous in terms of gender and academic ability.

Step 2: The Teacher breaks the information into simpler forms for the students to understand and to enable them generate ideas based on the concept of the lesson.

Step 3: The Teacher uses model and other instructional materials (charts) in clear and simple languages.

Step 4: The students interact with models and other teaching aids to better understand the content and how it might be used and compare them with real-life objects

Step 5: The students verbalize their thought processes based on their understanding of what they have learnt in the class and in their group.

Step 6: The students were guided to study and gain a better understanding of the concept using the model shared by the teacher and write out the important points from their findings for presentation.

Step 7: The students' merge their understanding of the lesson with their findings in group.

Step 8: The students summarise their findings from different objects given to them and the teacher corrects their errors and gives assignment.

Procedure for Concrete-Representational-Abstract Strategy

The following steps were followed in the concrete-representational-abstract strategy;

Step 1a: The teacher introduces the lesson to the students and write the topic of the lesson on the chalkboard as well as the stated behavioral objectives.

b. He divides the students into groups of 5 which is heterogeneous in terms of gender and academic ability.

PHASE 1: CONCRETE

Step 2: The teacher hangs the instructional charts on the wall in front of the class and distribute the cardboard containing diagrams of the content of the lesson to each group and also display the model on group table.

Step 3: The students examine the diagram on the chart hang on the wall and the materials for the lesson in groups and were motivated by various questions:

Step 4: The students' verberlise their thought on the material given to them for the lesson among themselves in groups.

Step 5: The students interact with the concrete materials given to them for the lesson by comparing the real-life object with the diagram representation.

PHASE 2: REPRESENTATIONAL

Step 6: The students were given a plain sheet of paper to draw their mental representation of what they have seen and to compare their diagram with the teacher's diagram and figure out the picture in their mind.

Step 7: The students represent the concrete materials in a pictorial form assisted by the teacher. Afterward, bringing out their impression of the diagram from their mind.

PHASE 3: ABSTRACT

Step 8: The teacher asks questions from the students' based on the content of the lesson.

Step 9: The students answer questions based on their understanding gotten from the lesson.

Step 10a:. Each group prepares a summary of their group findings from the different materials given to them by the teacher

b. Each group summarises their findings to the general group leader for presentation.

c. Teacher corrects any misconception in each group summary presented

d. Students were given general assignment by the teacher

Procedure for Conventional Strategy (Control Method)

The following steps were followed in the conventional strategy;

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Step 1: The teacher writes the content of the lesson on the chalkboard for the students

Step 2: The teacher presents instructional aids and discusses the concepts of the lesson

Step 3: The teacher demonstrates the processes involved to the students

Step4: The teacher asks the students to write the note on the board in their notebooks

Step 5: The teacher evaluates the lesson by asking students some questions based on the content of the lesson taught

Step 6: The teacher gives home/work/ assignment

V. RESULTS

Ho1: there is no significant main effect of treatment on students' achievement in basic science.

To test Hypothesis 1, an ANCOVA analysis was carried out to examine whether there was no significant main effect of the treatment, self-efficacy and teachers' area of specialisation on students' achievement in Basic Science. The outcome of this analysis is shown in Table1:

Table 1: Main and Interaction Effects of Treatment, Self-Efficacy, and Area of Specialisation on Students' Post-Achievement in Basic Science.

Source	Type III Sum of Squares	df	Mean Square	F	Sig.	Partial Eta Squared
Corrected Model	9065.474	18	503.637	53.984	0.000	0.558
Intercept	10781.967	1	10781.967	1155.705	0.000	0.600
PreAchievement	206.487	1	206.487	22.133	0.000	0.028
Treatment	307.992	2	153.996	16.507	0.000*	0.041
Self-efficacy	23.735	1	23.735	2.544	0.111	0.003
Area of specialization	3780.998	2	1890.499	202.640	0.000*	0.345
Treatment x Self-efficacy	35.007	2	17.504	1.876	0.154	0.005
Treatment x Area of specialization	385.548	4	96.387	10.332	0.000*	0.051
Self-efficacy x Area of specialization	4.307	2	2.153	.231	0.794	0.001
Treatment x Self-efficacy x Area of specialization	35.673	4	8.918	.956	0.431	0.005
Error	7183.594	770	9.329			
Total	138495.000	789				
Corrected Total	16249.067	788				

R Squared = 0.56 (Adjusted R Squared = 0.55) * denotes significant p<0.05

Table1 indicated that there was a significant main effect of treatment on students' achievement in perceived difficult concept in basic science ($F_{(2;\ 787)} = 16.51$; $p<0.05$, partial $\eta^2 = 0.04$). Since the p value (Sig.) of 0.000 was significantly lesser than 0.05 level of significance, thus the null hypothesis 1a was rejected at the 5% level of significance. This means when students are taught with distinct treatment groups, their post-achievement mean scores in perceived difficult concept in basic science differed significantly. Table 4.1 further revealed an effect size of 4.0%, which implies that independent variable (treatment groups) alone accounted for 4.0% of the variance in observed in pupils' adjusted post-achievement scores, The degree of differences of students' post-achievement mean scores across the treatment groups are established by the Estimated marginal means analysis and presented in Table 2.

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Table2: Mean Performance by Treatment and Control groups

Treatment	Mean	Std. Error	95% Confidence Interval Lower Bound	Upper Bound
Explicit Strategy (ES)	13.02	0.27	12.49	13.55
Concrete-Representational-Abstract Strategy (CRAS)	11.31	0.21	10.90	11.73
Conventional Strategy (CS)	11.14	0.23	10.70	11.59

Table 2 revealed that students taught with Explicit Strategy (ES) had the highest adjusted post-achievement mean score (13.02) in perceived difficult concept in basic science, followed by participants in Concrete-Representational-Abstract (CRAS) (11.31) and the conventional (11.14) strategies, respectively. This order is presented as ES > CRAS > CS. The Bonferroni post hoc test of multiple comparisons was carried out to determine the source of the significant main effect observed and the result is presented in Table 3.

Table 3: Bonferroni comparison of Treatment and Control Groups Means by Post-Achievement in perceived difficult concept in basic science

(I) Treatment	(J) Treatment	Mean Difference (I-J)	Sig.
Explicit Strategy (ES)	Concrete-Representational-Abstract Strategy (CRAS)	1.704*	.000
	Conventional Strategy (CS)	1.875*	.000
Concrete-Representational-Abstract Strategy (CRAS)	Explicit Strategy (ES)	-1.704*	.000
	Conventional Strategy (CS)	.171	1.000
Conventional Strategy (CS)	Explicit Strategy (ES)	-1.875*	.000
	Concrete-Representational-Abstract Strategy (CRAS)	-.171	1.000

* denotes significant $p<0.05$

Table 3 showed that the difference in the post-achievement mean score of students in perceived difficult concept in basic science exposed to Explicit Strategy (ES) and Concrete-Representational-Abstract Strategy (CRAS) was statistically significant. Also, the difference between Explicit Strategy and the conventional strategy was significant. However, the mean difference in students' post-achievement in perceived difficult concept in basic science between those in concrete-representational-abstract and conventional strategies was not statistically significant. This indicated that the difference between the treatment groups (Explicit and Concrete-Representational-Abstract Strategies), the difference between the Explicit and conventional strategies were the sources of significant main effect of treatment observed on students' post-achievement in perceived difficult concept in basic science.

Ho2: There is no significant main effect of treatment, self-efficacy and teachers' area of specialisation on students' attitude to basic science

ANCOVA was used to test null hypothesis 2, which stated that there will be no significant main effect of treatment self-efficacy and teachers; area of

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specialisation on students' attitude to Basic Science. Table 4 shows the results.

Table 2: Main and Interaction Effects of Treatment, Self-efficacy and Teachers' Area of specialisation on Post-Attitude of Students to Basic Science

Source	Type III Sum of Squares	df	Mean Square	F	Sig.	Partial Eta Squared
Corrected Model	56545.103	18	3141.395	25.573	0.000	0.374
Intercept	274129.996	1	274129.996	2231.637	0.000	0.743
PreAttitude	522.789	1	522.789	4.256	0.039	0.005
Treatment	1844.883	2	922.442	7.509	0.001*	0.019
Self-efficacy	1639.836	1	1639.836	13.350	0.000*	0.017
Area of specialization	15389.106	2	7694.553	62.640	0.000*	0.140
Treatment x Self-efficacy	797.359	2	398.680	3.246	0.039*	0.008
Treatment x Area of specialization	4892.568	4	1223.142	9.957	0.000*	0.049
Self-efficacy x Area of specialization	1659.976	2	829.988	6.757	0.001*	0.017
Treatment x Self-efficacy x Area of specialization	351.803	4	87.951	0.716	0.581	0.004
Error	94708.168	771	122.838			
Total	5854924.000	790				
Corrected Total	151253.271	789				

R Squared = 0.37 (Adjusted R Squared = 0.36) * denotes significant p<0.05

Table 2.1 revealed that the main effect of treatment on students' attitude to perceived difficult concept in Basic Science was significant ($F_{(2; 787)} = 7.51$; $p<0.05$, partial $\eta^2 = 0.02$). Hence the null hypothesis 2 was rejected at the 0.05 level of significance, implying that when students are taught with distinct interventions, their post-attitude mean scores to perceived difficult concept in Basic Science differed significantly. It was observed that the effect size was 2.0%, implies that the independent variable (treatment groups) alone accounted for 2.0% of the variation observed in pupils adjusted post-attitude scores, The magnitude of difference of students' post-attitude mean scores across treatment groups are analysed by the Estimated marginal means and it is results presented in Table2.2

Table2.2: Post-Attitude Mean by Treatment and Control groups

Treatment	Mean	Std. Error	95% Confidence Interval Lower Bound	Upper Bound
Explicit Strategy (ES)	82.16	0.99	80.22	84.10
Concrete-Representational-Abstract Strategy (CRAS)	83.95	0.77	82.45	85.46
Conventional Strategy (CS)	79.78	0.76	78.30	81.27

Table 2.2 revealed that students taught with Concrete-Representational-Abstract Strategy (CRAS) had the highest adjusted post-attitude mean score (83.95) in perceived difficult concept in Basic Science, followed by participants in Explicit Strategy (ES) (82.16) and the conventional (79.78) strategies, respectively. This order is presented as CRAS > ES > CS. The Bonferroni post hoc test of multiple comparisons was carried out to determine the source of the significant

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main effect observed and the result is presented in Table 2.3.

Table 2.3: Bonferroni comparison of Treatment and Control Groups Post-Attitude mean to perceived difficult concept in Basic Science

(I) Treatment	(J) Treatment	Mean Difference (I-J)	Sig.
Explicit Strategy (ES)	Concrete-Representational-Abstract Strategy (CRAS)	-1.789	0.458
	Conventional Strategy (CS)	2.379	0.172
Concrete-Representational-Abstract Strategy (CRAS)	Explicit Strategy (ES)	1.789	0.458
	Conventional Strategy (CS)	4.169*	0.000
Conventional Strategy (CS)	Explicit Strategy (ES)	-2.379	0.172
	Concrete-Representational-Abstract Strategy (CRAS)	-4.169*	0.000*

* denotes significant p<0.05

Table 2.3 revealed that the difference in the post-attitude mean score of students in basic science taught by Concrete-Representational-Abstract Strategy (CRAS) and Explicit Strategy (ES) was not statistically significant. However, the difference between the Concrete-Representational-Abstract Strategy and the Conventional Strategy was significant. The mean difference in students' post-attitude to Basic Science between those in Explicit and Conventional Strategies was not statistically significant. This indicated that the sources of the significant main effect of treatment observed on students' post-attitude to Basic Science were not due to the difference between the treatment groups (Explicit and Concrete-Representational-Abstract Strategies), but between the Concrete-Representational-Abstract and Conventional Strategies.

VI. DISCUSSION

Interaction Effect of Treatment, Self-Efficacy, and Teachers' Area of Specialisation on Students' Achievement in Basic Science

The null hypothesis sought to find out whether the interaction of treatment, self-efficacy, and area of specialization significantly affects students' achievement in basic science. To test this hypothesis ANCOVA analysis was employed at p0.05 level of significant and treatment x self-efficacy x area of specialization is interpreted and the result indicated that there was no significant interaction effect of treatment, self-efficacy, and area of specialisation on students' achievement in basic science ($F_{(4, 785)} = 0.96$; $p>0.05$). Thus, the hypothesis was not rejected, meaning that treatment, self-efficacy, and teachers' area of specialisation did not affect students' achievement in basic science.

The finding that there was no significant interaction effect of treatment, self-efficacy, and area of specialization on students' achievement in basic science ($F(4, 785) = 0.96$; $p>0.05$) suggests that these variables do not interact with each other to influence students' achievement in basic science. But in a research conducted on the effect of treatment and teachers' area of specialisation on students' achievement in basic science, it was found that the treatment (i.e., explicit, and concrete-representational-abstract strategies) and area of specialization (i.e., basic science, core science, and non-science) interacted to influence students' achievement in basic science. According to Cohen (2011), an effect size of 0.05 is considered moderate, indicating that the interaction effect of treatment and area of specialization had a noticeable impact on students' achievement. The line graph presented in Figure 4.2 provides a visual representation of the post-achievement mean scores of the students across explicit, concrete-representational-abstract, and conventional strategies and areas of specialization. The findings on the graph show a consistency having explicit strategy (15.65) has the highest significant difference from those taught by teachers with basic science in concrete-representational-abstract strategy (15.24) and basic science in conventional strategy (15.23). Also, in core science teachers in explicit (13.77) show a higher significance in the teaching of the students than those in conventional strategy (10.77) and concrete-representational-abstract strategy (8.95). from the findings, on non-science teachers' concrete-representational-abstract strategy (9.76) was higher than the experimental group's explicit strategy (9.64) and the conventional strategy of (7.43). The graph shows consistency, and this is caused by the interaction effect of the treatment and area of specialisation. From the research conducted by the researcher on the interaction effect of treatment and teachers' area of specialisation on students' attitude to Basic Science that there was a statistically significant difference in students' post-attitude mean score to perceived difficult concepts in basic science based on teachers' area of specialisation. Moreover, the finding suggests that teachers should be aware of the potential interaction effects between treatment and area of specialization when evaluating the effectiveness of instructional strategies. This may involve using more nuanced evaluation methods that take into account the complex interactions between different factors.

The non-rejection of the hypothesis implies that the null hypothesis that treatment, self-efficacy, and area of specialization do not affect students' achievement in basic science cannot be rejected. This finding suggests that other factors may be more influential in shaping students' achievement in basic science. Recent research has highlighted the importance of considering multiple factors that influence students' achievement in Science, Technology, Engineering, and Mathematics (STEM) subjects (Wang and Degol, 2017). For example, a study by Ozden (2017) found that students' motivation, self-efficacy, and interest in science were significant predictors of their achievement in science.

However, the present study's finding suggests that treatment, self-efficacy, and area of specialization may not be as influential in shaping students' achievement in perceived difficult concepts in basic science. This highlights the need for further research to identify the factors that influence students' achievement in basic science.

A study by Singh et al. (2020) found that teacher support, parental involvement, and student engagement were significant predictors of students' achievement in science. Another study by Khan et al. (2019) found that students' prior knowledge, learning strategies, and self-regulation skills were significant predictors of their achievement in science.

Interaction Effect of Treatment, Self-Efficacy, and Area of Specialisation on Students' Attitude to Basic Science

The null hypothesis was tested using ANCOVA analysis and the result is presented as follows;

The table revealed that the interaction effect of treatment, self-efficacy, and area of specialisation on students' attitude to perceived difficult concepts in basic science was not significant ($F_{(4,\ 785)} = 0.96$; $p>0.05$). Hence, the hypothesis was not rejected. This implies that treatment, self-efficacy, and area of specialisation did not affect students' attitude to perceived difficult concepts in basic science.

The finding that the interaction effect of treatment, self-efficacy, and area of specialization on students' attitude to perceived difficult concepts in basic science was not significant ($F(4, 785) = 0.96$; $p>0.05$) suggests that these variables do not interact with each other to influence students' attitudes towards perceived difficult concepts in basic science.

The non-rejection of hypothesis implies that the null hypothesis that treatment, self-efficacy, and area of specialization do not affect students' attitude to basic science cannot be rejected. This finding suggests that other factors may be more influential in shaping students' attitudes towards perceived difficult concepts in basic science. From the research conducted by the researcher on the interaction effect of treatment and teachers' area of specialisation on students' attitude to Basic Science that there was a statistically significant difference in students' post-attitude mean score to perceived difficult concepts in basic science based on teachers' area of specialisation. Moreover, the finding suggests that teachers should be aware of the potential interaction effects between treatment and area of specialization when evaluating the effectiveness of instructional strategies. This may involve using more nuanced evaluation methods that take into account the complex interactions between different factors.

Recent research has highlighted the importance of considering multiple factors that influence students' attitudes towards Science, Technology, Engineering, and Mathematics (STEM) subjects (Wang and Degol, 2017). For example, a study by Ozden (2017) found that students' motivation, self-efficacy, and interest in science were significant predictors of their attitudes towards science.

However, the present study's finding suggests that treatment, self-efficacy, and area of specialization may not be as influential in shaping students' attitudes towards in basic science. This highlights the need for further research to identify the factors that influence students' attitudes towards basic science concepts.

In conclusion, the finding that the interaction effect of treatment, self-efficacy, and area of specialization on students' attitude to basic science was not significant suggests that other factors may be more influential in shaping students' attitudes. Further research is needed to identify these factors and to develop effective strategies for promoting positive attitudes towards basic science concepts.

VII. CONCLUSION

The finding suggests that teachers should consider the area of specialization of their students when designing instructional strategies for teaching basic science concepts.

Furthermore, the finding implies that teachers should be aware of the potential interaction effects between treatment and area of specialization when evaluating the effectiveness of instructional strategies. This may involve using more nuanced evaluation methods that take into account the complex interactions between different factors.

As noted by Shulman (1986), teachers' pedagogical content knowledge plays a crucial role in determining students' learning outcomes. The finding suggests that teachers should develop pedagogical content knowledge that takes into account the area of specialization of their students.

Moreover, the Concrete-Representational-Abstract strategy significantly improves student achievement in Basic Science, especially when implemented by basic science specialised teachers. The study highlights the need for targeted professional development and strategic teacher deployment to maximise instructional impact.

VIII. RECOMMENDATIONS

- Schools should prioritise assigning science-specialised teachers to Basic Science classes.
- Teacher training programs should include Explicit and Concrete-Representational-Abstract strategies methodology as a core component.
- Further research should explore the long-term effects of strategy-teacher alignment on student performance.

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