**Strategies and Challenges in Strengthening Science Education Through Resource Improvisation in Secondary Schools: A Review**

**Abstract**

The use of improvised instructional materials (IIM) in teaching natural and physical sciences in African schools has gained significance due to the challenges faced by science education, such as student disinterest and financial constraints. To evaluate the effectiveness of IIM in science education, a review of ten studies conducted between 2015 and 2023 was undertaken using Google Scholar and the ERIC database. The review found that IIM can be an effective and affordable alternative to traditional instructional materials, leading to improved student engagement, motivation, and learning outcomes in science subjects. However, the quality and reliability of IIM can vary, and further research is needed to determine the best practices for their use in science education. Inadequate classroom space, a lack of energy, and infrastructure have been identified as effective use factors that influence the successful use of instructional materials in education. This review highlights some of the difficulties encountered in obtaining educational resources in Africa, including inadequate infrastructure, limited access to technology, a lack of cultural relevancy, high expenses for educational materials, and a scarcity of educational resources. To address these challenges, modernizing instructional materials is crucial. Creating and using current instructional materials can significantly improve learning outcomes and student engagement. This includes incorporating multimedia lectures, engaging simulations, and virtual laboratories that provide students with practical experience. Enhancing science education through resource improvisation and the effective use of instructional materials is crucial for improving the quality of education in African schools.

**Key words:** Improvised instructional**,** instructional materials, inadequate infrastructure, Financial constraints, Student disinterest

## 

## Introduction

## Science education is an essential part of modern education, and it plays a vital role in developing critical thinking skills, problem-solving abilities, and preparing students for careers in science, technology, engineering, and mathematics (STEM). However, many schools face challenges in providing quality science education due to limited resources and outdated instructional materials. In this article, we will discuss strategies and challenges in enhancing science education through resource improvement and instructional material development.

## Background a Review

* + 1. **Importance of using Improvised Instructional Materials**

“The use of locally produced instructional materials in teaching and learning has many advantages” (1). “the use of improvisation in teaching makes the concept more practical and subsequently reduces abstractions. Again, they are cost effective, because they could be obtained from the local environment. They are generally very safe to use during demonstrations and experiments; it might not be capable of inflicting injuries, which means it could be hazard free. In addition, they serve as a motivation to learners as much as they participate in the activities during the production of the materials and also arouse learners’ interest. Moreover, the use of these materials minimizes concerns about breakage, repair and loss since they are readily available in the environment. It informs both students and teachers that alternatives for some of the conventional science teaching materials are possible. It also shows that people can do scientific experiments with the materials around them” (Mensah, 2015).

Furthermore (2) indicated that “the use of indigenous local materials is definitely safer, cheaper and cultural-sensitive alternative to the use of commercial and factory produced chemicals. When teachers and students use improvised instructional materials, it could lead to the discovery of new knowledge, and students’ talents may be discovered”.

“Using improvised instructional materials assist teachers economically and may make students more interactive. Beyond these, it makes students make use of their intellectual ability in the process of teaching and learning” (3). “A very important opportunity of using improvised materials for experiments is that, it enables learners to participate fully in the actual construction of the apparatus and gives them more ideas about how such materials work. Again, improvised instructional materials bring home to the classroom, and clarify unfamiliar principles and concept of science to learners. More so, when teachers improvise instructional materials for teaching, teachers’ develop their potentials” (Mensah, 2015)..

**Challenges in Instructional Material Implementation**

Cultural and regional factors play a significant role in the implementation of instructional materials. These factors encompass a wide range of elements, including language, beliefs, values, customs, traditions, and educational systems specific to a particular culture or region. Understanding and considering these factors are crucial for effective instructional material implementation as they can greatly influence the reception, understanding, and engagement of learners.

Language is one of the most prominent cultural factors that impact instructional material implementation. The language used in instructional materials should align with the language proficiency of the target audience. In multilingual regions or culturally diverse classrooms, it is essential to provide materials in multiple languages to ensure inclusivity and accessibility. Additionally, cultural nuances and idiomatic expressions should be taken into account when translating or adapting instructional materials to different languages.

Beliefs and values prevalent in a culture or region also shape the implementation of instructional materials. Different cultures have varying perspectives on education, learning styles, and the role of teachers and students. For example, some cultures prioritize rote memorization and direct instruction, while others emphasize critical thinking and student-centered approaches. Instructional materials need to align with these beliefs and values to be effective. They should reflect cultural relevance, incorporate local examples and contexts, and respect cultural sensitivities.

Customs and traditions influence instructional material implementation by shaping the learning environment and practices. For instance, some cultures have specific rituals or protocols related to teaching and learning that need to be considered when designing instructional materials. Cultural customs may also impact the timing and scheduling of lessons or the use of certain teaching methods. Adapting instructional materials to accommodate these customs can enhance engagement and create a more inclusive learning experience.

The educational system within a particular culture or region also has a significant impact on

Instructional material implementation. Each educational system has its own curriculum frameworks, standards, assessment practices, and pedagogical approaches. Instructional materials must align with these requirements to ensure they meet the educational goals and objectives set by the system. Additionally, the availability and accessibility of resources, such as technology or textbooks, may vary across different regions, which can affect the implementation of instructional materials.

Furthermore, cultural and regional factors influence the learning preferences of students. Some cultures value collaborative learning, while others prioritize individual work. Instructional materials should consider these preferences to promote engagement and maximize learning outcomes. Moreover, cultural factors can influence students' prior knowledge and experiences, which should be acknowledged and integrated into instructional materials to facilitate meaningful connections and enhance comprehension.

* + 1. Types of Instructional Materials for Science Education

In science education, instructional materials play a crucial role in facilitating effective teaching and learning experiences. These materials are designed to support teachers in delivering content and engaging students in hands-on activities, experiments, and investigations. There are various types of instructional materials used in science education, each serving a specific purpose and catering to different learning styles. Here are some common types of instructional materials used in science education, along with examples and their respective authors:

1. Textbooks: Textbooks are one of the most widely used instructional materials in science education. They provide a comprehensive overview of scientific concepts, theories, and principles. Textbooks often include illustrations, diagrams, charts, and graphs to enhance understanding (4) .

2. Laboratory Manuals: Laboratory manuals provide step-by-step instructions for conducting experiments and investigations in the science laboratory. They often include safety guidelines,

Equipment lists, procedures, data collection sheets, and analysis questions. (5).

3. Visual Aids: Visual aids are instructional materials that use visual elements such as images, diagrams, charts, and videos to enhance understanding and retention of scientific concepts. They can be used in the form of posters, charts, slideshows, or online multimedia resources.

NASA: The National Aeronautics and Space Administration provides a wide range of visual aids,

4. Models and Manipulative: Models and manipulative are physical objects or representations used to illustrate abstract scientific concepts. They provide a hands-on approach to learning and help students visualize complex ideas.

5. Online Resources: With the advancement of technology, online resources have become increasingly popular in science education. These resources include websites, virtual labs, simulations, interactive games, and multimedia presentations. PhET Interactive Simulations: Developed by the University of Colorado Boulder.

* + 1. **Factors Influencing Effective Use of Instructional Materials**

For the purpose of encouraging meaningful learning experiences and raising student accomplishment, the proper use of instructional materials is essential. Any tools, resources, or assistance used to promote teaching and learning in the classroom are referred to as instructional materials. Textbooks, workbooks, worksheets, multimedia resources, manipulative resources, technology-based resources, and other supplemental materials are examples of these items (6).

The efficient utilization of instructional materials in educational contexts is influenced by a number of factors. These variables may be divided into three primary categories: factors linked to teachers, factors related to students, and factors related to materials (7) .

1. Teacher-related factors

In order to properly use educational materials, teachers are essential. The way in which educational resources are used in the classroom is greatly influenced by their knowledge, abilities, attitudes, and beliefs. Some significant aspects of teaching include:

a) Pedagogical content knowledge: Teachers must have a thorough comprehension of the information they are instructing and know how to use the materials to effectively communicate it to the pupils. This entails being able to choose the proper resources, modify them to fit the requirements of various students, and incorporate them into lesson plans.

b) Familiarity with instructional materials: Teachers should be familiar with the instructional materials they are using to ensure they align with curriculum standards and learning objectives. They need to understand how to navigate and utilize these materials effectively to engage students in meaningful learning experiences.

c) Professional development opportunities: For instructors to improve their knowledge and abilities in using instructional materials successfully, ongoing professional development is crucial. Teachers might learn fresh methods for integrating instructional resources into their lesson plans via conferences, seminars, training sessions, and cooperation with peers.

d) Attitudes and beliefs: Teachers' attitudes and convictions on the worth and potency of teaching resources might affect their readiness to employ them in the classroom. Positive attitudes towards educational resources might boost motivation and effort in efficiently utilizing them.

**2. Student-related factors**

The characteristics and needs of students also impact the effective use of instructional materials. Teachers must consider the following student-related factors:

a) Learning styles and preferences: There are several learning preferences and types among students, including visual, auditory, and kinesthetic learning. To promote the greatest possible level of engagement and understanding, instructional materials should address these various learning demands.

b) Prior knowledge and background: Students bring varying levels of prior knowledge and background experiences to the classroom. Instructional materials should be designed in a way that builds upon students' existing knowledge and connects new information to their prior understanding.

c) Motivation and interest: Engagement with educational materials may be influenced by a student's drive and enthusiasm in the subject. To keep students' interest and encourage active engagement, teachers should use materials that are pertinent, interesting, and engaging.

d) Special educational needs: When accessing instructional materials, special education students need more assistance and adjustments. To guarantee inclusivity and equitable learning opportunities for all students, educators should take accessible features, adjustments, or alternate resources into consideration.

**3. Material-related factors**

Some material-related issues include (8).the qualities of instructional materials themselves, which have an impact on how well they are used in the classroom.

a) Alignment with curriculum standards: The curricular standards and learning objectives should be reflected in the teaching materials. They should provide a logical and sequential overview of the necessary knowledge, abilities, and concepts.

b) Appropriateness for diverse learners: The inclusiveness and diversity of instructional resources should be prioritized in order to meet the requirements of all learners, including those with varying linguistic, cultural, and cognitive backgrounds. They must to provide different levels of difficulty and give a variety of access points for comprehension.

c) Technological compatibility: Instructional materials must be compatible with a range of technical platforms and devices due to the growing use of technology in education. This Guarantees that digital materials are seamlessly included into the teaching and learning processes

* 1. **Conceptual Framework**
     1. **Resource Improvisation**

Finding innovative ways to get around resource constraints in scientific teaching is known as resource improvisation. This may entail using low-cost resources, repurposing already-existing materials, or using technology to improve educational experiences. This review seeks to equip teachers to maximize the use of available resources by presenting techniques for resource improvisation.

* + 1. **Instructional Materials**

Instructional material refers to any resources or tools that are used to support teaching and learning activities (9). These materials are designed to facilitate the acquisition of knowledge, skills, and understanding in a specific subject or topic. They can take various forms, including textbooks, workbooks, worksheets, multimedia presentations, videos, audio recordings, simulations, manipulative, and online resources.

The use of instructional materials is crucial for efficient teaching and learning. The significance of modern teaching resources that are in line with current scientific understanding and pedagogical techniques will be covered in this review. It will investigate methods for creating and implementing educational resources that motivate students and encourage active learning.

* 1. **Benefits and Limitations of Resource Improvisation**

Resource improvisation in science education refers to the ability of educators to adapt and make use of available resources in order to enhance the learning experience for students. This approach recognizes that not all schools or classrooms have access to the same level of resources, and therefore encourages teachers to be creative and innovative in their teaching methods. While resource improvisation can offer several benefits, it also has its limitations. In this comprehensive response, we will explore both the benefits and limitations of resource improvisation in science education (10).

* + 1. **Benefits of Resource Improvisation in Science Education**

In this category, some educators face preparation-phase teaching Benefits relating to motivation and skills as well as an implementation-phase Benefits linked to their pedagogical knowledge.

**Intrinsic Benefits of Resource Improvisation in Science Education**

Resource improvisation in science education refers to the creative and flexible use of available resources to teach science concepts and skills. This approach has several intrinsic benefits for both students and teachers (11) .

1. Develops Critical Thinking Skills: Resource improvisation encourages students to think critically and creatively, as they learn to use available resources to solve problems and answer questions. This skill is essential in science, as it enables students to analyze data, evaluate evidence, and draw conclusions.

2. Enhances Scientific Literacy: By using real-world resources to teach science concepts, resource improvisation helps students develop a deeper understanding of scientific principles and their practical applications. This can lead to a more scientifically literate population, better equipped to make informed decisions about the world around them.

3. Fosters Collaboration and Communication: Resource improvisation often requires students to work in teams to find and use resources, which helps develop their collaboration and communication skills (12).These skills are essential for success in many areas of life, including science.

4. Promotes Active Learning: Resource improvisation encourages active learning, as students are engaged in hands-on activities and experiments that require them to think, experiment, and solve problems. This approach can help students retain information better and develop a deeper understanding of scientific concepts.

5. Increases Engagement and Motivation: By using real-world resources to teach science, resource improvisation can increase student engagement and motivation. Students are more likely to be interested in learning about science when they can see its practical applications and relevance to their lives. (13) and Many science educators have been motivated for the willingness to improvise science education equipment for their lessons 14-15.

6. Cultivates Creativity: Resource improvisation nurtures creativity in both educators and students. Teachers who are skilled at improvising with resources can inspire their students to think creatively and find innovative solutions to problems. By encouraging students to explore different ways of using materials, resource improvisation helps develop their creative thinking skills, which are valuable in scientific inquiry and problem-solving (16) .

**Extrinsic Benefits of Resource Improvisation in Science Education**

In addition to the intrinsic benefits, resource improvisation in science education has several extrinsic benefits for students, teachers, and society as a whole (17).

1. Cost-Effective: Resource improvisation is a cost-effective way to teach science, as it uses available resources rather than expensive equipment or materials. This can be especially beneficial for schools with limited budgets.

2. Access to Real-World Resources: Resource improvisation provides students with access to real-world resources, such as local ecosystems, community organizations, and industry partners. This can help students gain a more accurate understanding of scientific principles and their practical applications.

3. Community Engagement: Resource improvisation can engage the community in science education, as local organizations and industry partners can provide resources and expertise to support student learning. This can help build a more scientifically literate community and promote the value of science education.

4. Prepares Students for the Workforce: Resource improvisation can prepare students for the workforce by teaching them to think creatively, solve problems, and work collaboratively. These skills are essential for success in many careers, including science, technology, engineering, and mathematics (STEM).

5. Promotes Social Responsibility: By using real-world resources to teach science, resource improvisation can promote social responsibility and environmental sustainability. Students can learn about the impact of human activities on the environment and develop the skills and knowledge needed to address these challenges.

6. Equitable Access to Learning: One of the key advantages of resource improvisation is that it allows educators to provide quality science education even in resource-constrained settings. By making use of readily available and affordable materials, teachers can ensure that all students

have access to engaging and meaningful learning experiences. This approach promotes equity in education by reducing the dependence on expensive resources or technologies (18) .

7. Enhanced Engagement: Resource improvisation allows educators to create a more engaging learning environment by utilizing a variety of materials and tools. This can include using everyday objects as teaching aids or incorporating technology such as smartphones or tablets into lessons. By making use of diverse resources, students are more likely to be actively involved in their learning process, leading to increased engagement and motivation (19) .

**Limitations of Resource Improvisation in Science Education:**

Resource improvisation in science education refers to the ability of teachers to adapt and make use of available resources in order to enhance the learning experience for students. While resource improvisation can be a valuable approach, it is important to recognize that there are both intrinsic and extrinsic limitations associated with this practice.

Intrinsic Limitations

1. Lack of Standardization: Resource improvisation can lead to variations in teaching methods and materials across different classrooms or schools. While this flexibility can be beneficial, it may also result in inconsistencies in the quality and depth of learning experiences for students.

Standardized resources often provide a common foundation for instruction, ensuring that all students receive a similar level of education (20) .

2. Limited availability of Resources: In some cases, educators may face challenges in finding suitable resources for improvisation. This can be particularly true for schools located in economically disadvantaged areas or regions with limited access to educational materials. The lack of necessary resources may hinder the effectiveness of resource improvisation as teachers struggle to find appropriate alternatives (21)

3. Time Constraints: Resource improvisation requires additional time and effort from educators to identify, adapt, and incorporate materials into their lessons. This can be a significant challenge for teachers who already have heavy workloads or limited preparation time. The need for extensive planning and preparation may limit the extent to which resource improvisation can be effectively implemented in practice (21) .

4. Teacher Competence and Training: Resource improvisation relies heavily on the skills and creativity of educators. Teachers need to possess a deep understanding of scientific concepts and pedagogical strategies to effectively improvise with resources. However, not all teachers may have the necessary training or experience to engage in resource improvisation, which can limit its potential impact on student learning (18).

5. Assessment Challenges: Resource improvisation can pose challenges when it comes to assessing student learning outcomes. Since improvised resources may vary across classrooms, it can be difficult to establish consistent assessment criteria or compare student performance. This can make it challenging for educators to evaluate the effectiveness of their teaching methods or provide meaningful feedback to students (22) .

Extrinsic Limitations:

1. Curriculum Constraints: Extrinsic limitations of resource improvisation in science education can arise from curriculum constraints imposed by educational authorities or standardized testing requirements. These constraints may prioritize content coverage over hands-on learning experiences, limiting the opportunities for teachers to improvise with resources. The pressure to adhere strictly to a predetermined curriculum can restrict creativity and innovation in teaching practices.

2. Administrative Support: The level of administrative support provided to teachers can significantly impact their ability to engage in resource improvisation. Lack of support from school administrators, such as limited funding for resources or insufficient time allocated for professional development, can hinder teachers' capacity to effectively improvise and enhance science education. Adequate administrative support is crucial for creating an environment that encourages resource improvisation.

3. Infrastructure Limitations: Extrinsic limitations can also stem from infrastructure constraints within educational institutions. Insufficient laboratory facilities, limited access to technology, or overcrowded classrooms can impede teachers' ability to implement resource improvisation strategies effectively. Without the necessary infrastructure, teachers may struggle to provide students with hands-on experiences and hinder their ability to fully engage in scientific inquiry.

* 1. **Theoretical Foundations of Resource Improvisation**

Theoretical foundations for analyzing instructional materials' impact refer to the underlying principles, theories, and frameworks that guide the examination and evaluation of educational resources and materials in terms of their effectiveness and influence on student learning outcomes. These foundations provide a conceptual framework for researchers, educators, and policymakers to understand and assess the impact of instructional materials on teaching and learning processes.

* + 1. **The cognitive theory of multimedia learning**

The cognitive theory of multimedia learning is a theoretical framework that seeks to explain how individuals process and learn information presented in multimedia formats. Developed by Richard Mayer. According to the cognitive theory of multimedia learning, individuals have limited cognitive resources, and learning is most effective when these resources are allocated efficiently. The theory proposes several principles that guide the design and presentation of multimedia materials to optimize learning outcomes.

One of the key principles is the multimedia principle, which suggests that people learn better from words and pictures than from words alone. This is because presenting information in multiple modalities (e.g., text, images, audio) allows learners to process information through both visual and auditory channels, leading to deeper encoding and better retention. Research has shown that multimedia presentations that combine relevant visuals with spoken or written explanations can improve comprehension and recall compared to text-only presentations.

Another important principle is the coherence principle, which emphasizes the importance of minimizing extraneous or irrelevant information in multimedia materials. According to this principle, learners can become overloaded with unnecessary cognitive processing if they are presented with extraneous visuals or text that does not contribute to the main message. By removing irrelevant elements and focusing on essential content, instructional designers can reduce cognitive load and enhance learning.

The modality principle is another key aspect of the cognitive theory of multimedia learning. This principle suggests that information should be presented in the modality that best matches its nature. For example, complex visual information may be better understood when presented as animations or diagrams rather than as written text. Similarly, verbal explanations may be more effective when presented as spoken narration rather than as on-screen text. By aligning the modality of presentation with the nature of the information being conveyed, learners can process and integrate the information more effectively.

This theory suggests that individuals learn more effectively when information is presented in both visual and auditory formats rather than through a single modality. According to this theory, instructional materials that integrate text, images, audio, and video elements can enhance learning by engaging multiple sensory channels and facilitating the construction of mental representations (23).

* + 1. **The socio-cultural theory of learning**

The socio-cultural theory of learning, also known as social constructivism is a theoretical framework that emphasizes the role of social interaction and cultural context in the process of learning and development. This theory was developed by the renowned psychologist Lev Vygotsky in the early 20th century.

Learning is a social activity that takes place through interactions with others. He believed that individuals acquire knowledge and skills by engaging in meaningful activities within their cultural and social environment. In this theory, learning is seen as a collaborative process where learners actively participate in constructing their understanding of the world (24) .

One of the key concepts in socio-cultural theory is the zone of proximal development (ZPD). The ZPD refers to the gap between what a learner can do independently and what they can achieve with guidance and support from more knowledgeable others. Vygotsky argued that learning occurs most effectively when learners are challenged to reach just beyond their current level of competence, with the assistance of a more knowledgeable peer or adult.

Another important concept in socio-cultural theory is scaffolding. Scaffolding refers to the support provided by a more knowledgeable person to help learners bridge the gap between their current abilities and their potential abilities. This support can take various forms, such as modeling, questioning, providing feedback, or breaking down complex tasks into smaller steps. Through scaffolding, learners gradually internalize and master new skills and knowledge.

Vygotsky also emphasized the role of language in learning and development. He believed that language plays a crucial role in mediating cognitive processes. Language allows individuals to communicate with others, express their thoughts and ideas, and internalize knowledge. According to Vygotsky, language serves as a tool for thinking and enables learners to regulate their own cognitive processes.

Furthermore, socio-cultural theory highlights the importance of cultural tools and artifacts in learning. Cultural tools refer to the physical and symbolic resources that are available within a particular culture, such as writing systems, calculators, or computers. These tools shape the way individuals think and learn, and they are passed on from one generation to another through social interactions.

* + 1. **Constructivist theory of learning**

Constructivist theory of learning is an educational philosophy that emphasizes the active role of learners in constructing their own understanding and knowledge. It suggests that learning is a process of actively building meaning and making sense of new information based on prior knowledge and experiences.

At its core, constructivism views learning as a social and interactive process where learners actively engage with their environment to construct their own understanding. This theory rejects the notion that knowledge is simply transmitted from teacher to student, but rather emphasizes the importance of learners' active involvement in the learning process.

According to constructivist theory, learners are not passive recipients of information but rather active participants in constructing their own knowledge. They do this by connecting new information to their existing knowledge and experiences, organizing and restructuring their mental representations, and reflecting on their learning experiences.

One key concept in constructivism is the idea of scaffolding. Scaffolding refers to the support provided by teachers or more knowledgeable peers to help learners build their understanding. This support can take various forms, such as modeling, questioning, providing feedback, or breaking down complex tasks into smaller steps. The goal of scaffolding is to gradually transfer responsibility for learning from the teacher to the learner, allowing them to become independent thinkers and problem solvers.

Another important aspect of constructivist theory is the idea of authentic learning experiences. Constructivists argue that learning should be situated in real-world contexts that are meaningful and relevant to learners. This can involve engaging students in hands-on activities, problem-solving tasks, inquiry-based or collaborative projects that mirror real-life situations. By doing so, learners are able to make connections between what they are learning and how it can be applied in practical settings. Teachers can design instructive materials and meaningful learning experiences that adhere to constructivist principles by improvising with resources designing lessons (25).

Constructivism also highlights the role of reflection in the learning process. Learners are encouraged to reflect on their own thinking and learning strategies, as well as on the social and cultural contexts in which they are situated. Reflection allows learners to make sense of their experiences, identify misconceptions, and develop metacognitive skills that enable them to monitor and regulate their own learning.

It is important to note that constructivist theory does not advocate for a completely student-centered approach where teachers have no role. Instead, it recognizes the importance of guidance and supports from knowledgeable others. Teachers play a crucial role in creating a supportive learning environment, designing meaningful learning tasks, and facilitating students' construction of knowledge.

## Statement of Problem

The issue of students' low performance in science on internal and external examinations has not been resolved despite all the efforts taken to promote good teaching and learning of the subject at the secondary school level in Africa (26). Numerous reasons, including the absence and underutilization of instructional tools for the teaching and learning of science courses in secondary schools in Africa, have been identified as contributing to this high failure rate. How much do science instructors have access to and use instructional materials and improvised material when teaching and studying science? This is the study's problem.

The researcher is therefore prepared to look at the Strategies and Challenge usage instructional materials and improvised material for Science instruction in a secondary schools in Africa.

* 1. **Research Aim and Objectives**

The research aims to explore various strategies and challenges associated with improving science education by utilizing resource improvisation and instructional materials.

**Objective**

* To investigate the knowledge and perceptions teachers and students on the use of

Improvised instructional materials.

* To examine the challenges in accessing instructional materials.
* To determine the factors Influencing Effective Use of Instructional Materials

## Scope and Significance of a Review

This review's focus covers a broad variety of subjects relating to teaching science, resource innovation, and instructional materials. It goes in-depth on the methods used to improve scientific education, such as making use of the resources at hand and creating useful teaching tools. The analysis looks at the difficulties instructors have using these tactics and offers some potential answers.

The scope also includes diverse educational environments, including the Secondary schools in the continent, as well as educational levels ranging from secondary school to higher education. It looks at how instructional materials and resource improvisation might be modified to match the unique demands of various educational situations.

## Significance

Enhancing scientific education is crucial for a number of reasons. Understanding the natural world, developing critical thinking abilities, advancing scientific literacy, and preparing students for professions in STEM (Science, Technology, Engineering, and Mathematics) disciplines are all made possible by science.

In this review, resource improvisation is a crucial topic that is covered. Numerous educational institutions struggle with a lack of finance and access to cutting-edge resources. In order to have the most possible influence on students' learning experiences, instructors should experiment with different improve techniques. The importance of resource improvisation as a way to get around resource limitations and improve scientific teaching is highlighted in this paper.

In science education, instructional tools are also quite important. The use of well-designed materials may engage students, increase conceptual comprehension, allow for hands-on learning experiences, and offer possibilities for inquiry-based learning. This evaluation emphasizes the need of creating instructional materials of the highest caliber that adhere to curricular requirements and take different learning styles and abilities into account.

## Methods

I intend to compile and categories findings that address resource improvisation and instructional materials at the secondary school level in the first section of this article. The reviewer examines earlier study findings from other researchers to increase their significance. in order to accomplish this. Research on strategies and challenge for enhancing science education through resource improvisation and instructional materials in secondary schools is conducted through online study of the Google Scholar and ERIC databases. When results were reviewed, inclusion and exclusion methods were utilized to weed out studies that didn't meet the research inclusion requirements for secondary school. Results were first filtered for Resource Improvisation and Instructional Materials.

A total of forty (40) studies were looked into and examined. Studies that did not suit the title were excluded from the database, totally 7 (seven). Additionally, 6(six) research were deleted for being outdated (out of scope) and 17(seventeen) studies conducted on college and elementary school pupils were rejected. As a result.10 (ten) studies were approved to be analyzed in this review because they comprised some of the factors that affect students toward science.

## FINDINGS

The first objective is to investigate the knowledge and perceptions of teachers and students on the use of Improvised instructional materials. To understand the knowledge and perceptions of teachers and students on the use of improvised instructional materials, a study was conducted in Africa. This review was obtained from ten journals and reviews.

The results of the studies showed that most teachers and students had positive perceptions of the use of improvised instructional materials. Most teachers said these materials helped to increase student engagement and motivation, and provided opportunities for students to develop creative and critical thinking skills (27). Students reported that they enjoyed using the improvised materials and found them to be more interesting and engaging than convectional materials.

Teachers used creativity in the creation and adaptation of instructional materials to meet the requirements of their particular teaching goals. Learning became more relevant and contextualized as a result of their continuous integration of these materials into their sessions (28).

However, from few teachers and students the study also identified some challenges associated with the use of improvised instructional materials. It is time consuming and effort to prepare and integrate these materials into their teaching and learning, and that they sometimes struggled to find suitable materials and they are not effective as the standardized one. Students reported that they sometimes found it difficult to understand how to use the improvised materials effectively.

Despite these challenges, the study found that the use of improvised instructional materials was generally perceived as a valuable and effective practice by both teachers and students. Generally these materials have the potential to provide a more inclusive and engaging learning environment, particularly for students who may struggle with traditional teaching methods.

The second objective challenges to access instructional materials is a critical factor in the education sector, it has direct impacts on the quality of learning and the achievement of students. However, in many African countries, accessing instructional materials remains a major challenge. This review highlights some of the challenges faced in accessing instructional materials in Africa from most respondents was ,Inadequate infrastructure, human resource, Limited access to technology, Lack of relevance and cultural appropriateness, High costs of instructional materials, Limited availability of instructional materials. (29) .

The lack of readily available educational resources in Africa is one of the major obstacles to access instructional material is Due to a lack of budget, infrastructure, and human resources, in many schools especially those in rural regions, do not have access to textbooks, a computer, teaching aids and other teaching –learning materials (30).

Most respondents said High costs of instructional materials are another factor to access instructional materials even it is available, the material is too expensive for many students and institutions to afford. Particularly in low-income family, the cost of textbooks, workbooks, and other resources can be a considerable hardship for families and schools, and according to (29) (20%) of family's annual income account for the cost of textbooks and other educational material is Almost all respondents put the third and basic factor is limited access to technology.

Educational resources in Africa are restricted access to technology. Lack of access to computers, tablets, and digital technology in many secondary schools and communities might restrict the availability of digital teaching resources. Only one in ten African children have access to a computer (31).

Most school managers and teachers responded that inadequate infrastructure and human resources are other factor. Many secondary schools lack the equipment needed to enable the use of educational resources, including libraries, pedagogical center, computer laboratories, and internet connectivity. In addition, most teachers lack skill or experience needed to use and manage educational resources efficiently.

The third objective is to determine the factors Influencing effective Use of Instructional Materials. According to most respondents effective utilization of instructional materials influenced by factors the design and quality of the materials, accessibility and adaptability, teacher knowledge and pedagogical approach, student engagement and interactivity, technological integration. By considering these factors, educators can select and utilize instructional materials that optimize student learning outcomes.. Additionally, for successful teaching and learning, there must be access to textbooks, instructional aids, technological resources, and other learning materials. Although many African schools struggle with inadequate or out-of-date resources, this can have a detrimental influence on how well instructional materials are used (32) .

The effectiveness of using instructional materials is significantly influenced by the knowledge and skills of teachers. Therefore most teachers respond they do not have knowledge and skills to effectively integrate the instructional resources into teaching and learning practices.so teachers must take proper training. Teachers who had been trained in the proper use of instructional resources had more successful teaching methods than those who hadn’t. (33).

Most educational leaders and teachers respond effective teaching and learning depend on the curriculum's congruence with the instructional resources. The aims, content, and pedagogical strategies of the curriculum should all be reflected in the design of the instructional materials. Teachers may successfully employ instructional resources to assist student learning and achieve the targeted learning outcomes when they are in line with the curriculum. In addition to this the instructional materials should be relevance to the student’s cultural context and everyday life experience. Curriculum alignment is crucial for optimizing the usage of instructional resources (34) **.**

According to the views of the reviewer there is a lack of awareness: among teachers on the effective use of improvised instructional materials, and the potential benefits they offer.

Limited financial resources: many schools in Africa lack the financial resources to purchase traditional instructional materials, leaving teachers with no option but to rely on improvised materials.

Technology integration: The use of technology can enhance the effectiveness of improvised instructional materials, particularly in rural areas with limited infrastructure.

Teacher training and support: Teachers need to be trained on the effective use of improvised instructional materials to enhance teaching and learning.

* 1. **Strategies for Enhancing Science Education**:

1. Modernizing Instructional Materials: Creating and using current instructional materials can improve learning results and student engagement. This includes multimedia lectures, engaging simulations, and virtual laboratories that provide students practical experience.

2. Professional Development for Teachers: Providing teachers with continuing professional development opportunities will help them keep up to date on new technology and pedagogical approaches that they can use in their science classrooms.

3. Business Partner Collaboration: Working with business partners may provide schools access to tools, knowledge, and resources that they might not otherwise have. Internships, mentoring initiatives, and guest lectures by experts in the industry might all fall under this category.

4. Project-Based Learning: Promoting project-based learning can help students improve their ability to collaborate, think critically, and solve problems.This method entails giving students actual challenges to work on in small groups so they may understand scientific principles while resolving a real-world problem.

5. Incorporating Technology: Using technology in scientific lectures can improve learning results and student engagement. This might involve utilizing computer programs, internet tools, and instructional games to impart scientific ideas.

## Conclusion

Enhancing science education through resource improvisation and the effective use of instructional materials is crucial for improving the quality of education in African schools. This review presents several key findings related to the knowledge and perceptions of teachers and students, challenges in accessing instructional materials, and factors influencing their effective use.

**Knowledge and Perceptions**

Most teachers and students in Africa have positive perceptions of improvised instructional materials. These materials have the potential to increase student engagement, motivation, and critical thinking skills. However, challenges, including the time and effort required for preparation and difficulties in finding suitable materials, were also identified.

Challenges in Accessing Instructional Materials:

Challenges in accessing instructional materials remain a significant issue in many African countries. Insufficient infrastructure, limited access to technology, high costs, and a lack of relevance and cultural appropriateness were identified as major obstacles.

**Factors Influencing Effective Use**

Effective utilization of instructional materials is influenced by several factors, including the design and quality of materials, accessibility, teacher knowledge, student engagement, and technological integration. Teacher knowledge and skills are crucial for the successful integration of instructional resources. Teacher training is essential to enhance their ability to use these resources effectively.

**Acknowledgements:**

The authors gratefully acknowledge the Ministry of Education, Federal Democratic Republic of Ethiopia, and Mekelle University, Ethiopia, for their steadfast support and encouragement, which were instrumental in the successful completion of this systematic review.

**Disclaimer (Artificial intelligence)**

Option 1:

Author(s) hereby declare that NO generative AI technologies such as Large Language Models (ChatGPT, COPILOT, etc.) and text-to-image generators have been used during the writing or editing of this manuscript.

Option 2:

Author(s) hereby declare that generative AI technologies such as Large Language Models, etc. have been used during the writing or editing of manuscripts. This explanation will include the name, version, model, and source of the generative AI technology and as well as all input prompts provided to the generative AI technology

Details of the AI usage are given below:

1.

2.

3.

**Reference**

1. Ahmed, A. M. (2008). Improvisation of instructional materials for the teaching of Biology, an important innovation in the Nigerian educational system. Pristine Journal, 50, 1–7.
2. Abdulazeez, I. B. (2021). Assessment of the Challenges in Primary Education Development: A Case Study of Ilorin West Local Government Area of Kwara State (2015–2020) (Master's thesis, Kwara State University (Nigeria).
3. Fredriksen, B,&Barr,S (2015) ,Getting textbooks to every child in Sub-Saharan Africa: Strategies for addressing the high cost and low availability problem. World Bank publication
4. Balogun, T. A. (1983, August). Interest in science and technology education in Nigeria. Paper presented at the 12th International Symposium on Interest in Science and Technology Education, Lagos-Nigeria.
5. Barron, A. E. (2013). Auditory instruction. In Handbook of research on educational communications and technology (pp. 937–966). Routledge.
6. Bencze, L., & Hodson, D. (1999). Changing practice by changing practice: Toward more authentic science and science curriculum development. Journal of Research in Science Teaching: The Official Journal of the National Association for Research in Science Teaching, 36(5), 521–539.
7. Doni, S.K.,Goiga,D.N.,& Sesay,A.S.(2022).Factors affecting production and utilization of instructional materials in secondary schools of east hararege zone oromia (doctoral dissertation)
8. Craft, A. (2005). Creativity in schools: Tensions and dilemmas. Psychology Press.
9. Doppelt, Y. (2003). Implementation and assessment of project-based learning in a flexible environment. International Journal of Technology and Design Education, 13, 255–272.
10. Ertmer, P. A., & Ottenbreit-Leftwich, A. T. (2010). Teacher technology change: How knowledge, confidence, beliefs, and culture intersect. Journal of Research on Technology in Education, 42(3), 255–284.
11. The Benefits of Improvised Materials in Education https://educorpus.com/benefits-of-improvised-materials-in-education/
12. Hodson, D. (2008). Towards scientific literacy: A teachers' guide to the history, philosophy and sociology of science. Brill.
13. Ikpegbu, E., Ezeasor, D. N., Nlebedum, U. C., Nwogu, C., Nnadozie, O., & Agbakwuru, I. O. (2012). Morphology of the oropharyngeal cavity and oesophagus of the farmed adult African catfish (Clarias gariepinus Burchell, 1822). Analecta Veterinaria, 32(2), 17–23.
14. Keeley, B., & Little, C. (2017). The state of the world’s children 2017: Children in a digital world. UNICEF.
15. Marín, V. I., de Benito, B., & Darder, A. (2020). Technology-enhanced learning for student agency in higher education: A systematic literature review. Interaction Design and Architecture (s) Journal-Ix D&A, 2020, num. 45, p. 15-49.
16. Mader, S. S. (2017). Laboratory manual for human biology texts. McGraw-H.
17. Musar, A. (1993). Equipment for science education constraints and opportunities. World Bank.
18. Kambuga, Y. M. (2024). Teacher Improvisation Skills in Enhancing Teaching and Learning Process in Pre-Primary Schools in Tanzania. Futurity Education, 4(1), 98-109.
19. Manjale, N. B., & Abel, C. (2017). Significance and adequacy of instructional media as perceived by primary school pupils and teachers in Kinondoni District, Tanzania. International Journal of Educational Policy Research and Review, 4(6), 151-157.
20. National Research Council, Center for Science, Mathematics, Engineering Education, & Committee on Development of an Addendum to the National Science Education Standards on Scientific Inquiry. (2000). Inquiry and the national science education standards: A guide for teaching and learning. National Academies Press.
21. National Research Council, Division of Behavioral and Social Sciences and Education, Board on Science Education, & Committee on a Conceptual Framework for New K-12 Science Education Standards. (2012). A framework for K-12 science education: Practices, crosscutting concepts, and core ideas. National Academies Press.
22. National Science Teachers Association. (n.d.). NSTA. Retrieved from [www.nsta.org](https://www.google.com/url?sa=E&q=http%3A%2F%2Fwww.nsta.org)
23. Onyango, M. A. (2013). School-based factors influencing instructional Performance of teachers in public primary schools in Kadibo Division, Kisumu County, Kenya (Doctoral dissertation).
24. Gabriel, p. (2023). The impact of improvised teaching materials on effective teaching and learning of agricultural science in some selected secondary schools in jama’a local government kafanchan, area of kaduna state. Science open preprints.
25. Olorundare, A. S. (2014). Theory into practice: Beyond surface curriculum in science education. The 147th inaugural lecture, University of Ilorin, Ilorin, Nigeria.
26. Onasanya, S. A., & Omosewo, E. O. (2011). Effect of improvised and standard instructional materials on secondary school students’ academic performance in physics in Ilorin, Nigeria. Singapore Journal of Scientific Research, 1(1), 68–76.
27. Papert, S. (1993). The children's machine: Rethinking school in the age of the computer. Basic Books.
28. Penuel, W. R., Roschelle, J., & Shechtman, N. (2007). Designing formative assessment software with teachers: An analysis of the co-design process. Research and Practice in Technology Enhanced Learning, 2(1), 51–74.
29. Phelan, J. (2011). What is life?: A guide to biology with physiology. W. H. Freeman and Company.
30. Ramelgalima, L. V., River, D. V., & Almanza, E. G. (2013). [The International Journal of Science in Society]. The International Journal of Science in Society, 79–89.
31. Wahyuni, E., Eko Tanuso, N. A., Waruwu, Y., Mata, Y., & Susanto, A. N. (2023). The Role of Educational Games in Increasing Student Motivation and Engagement. Al-Hijr: Journal of Adulearn World, 2(4).
32. Vygotsky, L. S., & Cole, M. (1978). Mind in society: Development of higher psychological processes. Harvard University Press.
33. Holdhus, K., Høisæter, S., Mæland, K., Vangsnes, V., Engelsen, K. S., Espeland, M., & Espeland, Å. (2016). Improvisation in teaching and education—roots and applications. Cogent Education, 3(1), 1204142.
34. World Bank. (2017). Overview: Learning to realize education’s promise.
35. Mensah, D. (2015). Using improvised instructional materials to teach chemical methods. Education and Psychology Department. <https://www.nmt.edu/academics/psych-ed/docs/chemistry.pdf>