

# The Impact of Teaching Aids on The Academic Performance of Learners in Natural Science

**Hilya Tulipomwene Shuulinawa Nghitoolwa\***

Ministry of Education Sports and Culture Namibia

**Moses Chirimba**

University of Namibia, Jose Eduardo Dos Santos Campus Ongwediva, Namibia

**Medusalem Medusalem**

Ministry of Education Sports and Culture Namibia.

**\*Corresponding Author:** hilyanghitoolwa@gmail.com

## Abstract

### Keywords

Teaching aids  
Academic performance  
Learners  
Natural science

This qualitative study explores the impact of teaching aids on the academic performance of seventh-grade natural science learners at a selected school in the Kunene Region. The research focuses on understanding how instructional aids affect student comprehension, engagement, and overall academic achievement. A purposive sampling technique was used to select 10 seventh-grade students and two science teachers for semi-structured interviews, providing in-depth insights into their experiences with teaching aids in the classroom. Data were analyzed thematically, revealing key subthemes that illustrate the positive effects of teaching aids on learning outcomes. Results indicate that teaching aids, such as charts, models, and laboratory equipment, enhance understanding of concepts, increase student engagement, improve academic performance, promote critical thinking, and foster collaborative learning. However, the study acknowledges a significant limitation: its focus on a single region, which limits the generalizability of the findings to other contexts. Recommendations for educators and policymakers include investing in a variety of teaching aids, incorporating interactive learning techniques, and fostering collaborative learning environments. The study also suggests further research with larger sample sizes, across multiple regions, and using quantitative methods to validate and expand on these findings. Additionally, a longitudinal approach to understanding the long-term impact of teaching aids on educational outcomes is proposed as an area for future study. The insights gained from this study contribute to the ongoing discourse on effective teaching practices and underscore the importance of providing adequate resources to support natural science education.

### Article History

Received 2024-05-24

Accepted 2024-07-02

### Copyright © 2024 by Author(s).

This is an open access article under the [CC BY-SA](#) license.

## INTRODUCTION

The researcher observed poor performance in natural science at the selected school in the Kunene Region. The results from 2020 -2023 show more than 40% of the learners fail to get better A-D in natural science. During lessons, the researcher observed that there is a shortage of teaching aids in the school and this may be attributed to the poor performance in natural science. Despite efforts to improve the quality of education, many learners still struggle to achieve satisfactory academic

performance in natural science. This is often due to a lack of access to effective teaching aids, which can hinder their ability to understand and apply scientific concepts (Eilam & Gilbert, 2014). This study investigated the impact that teaching aids have on the academic performance of grade 7 learners in natural science.

Teaching aids and resources impact learners' academic performances in various ways, depending on their adequacy or inadequacy at schools (Adeniran, 2020). The availability of instructional aids and resources at schools will enhance learners' academic performance. First of all, teaching aids help with concept retention for students. This indicates that students who tend to forget concepts will gain from the use of teaching aids because teachers employ practical techniques, such as the use of models, graphs, and other visual aids, in addition to verbal explanations to help students comprehend topics better. Khasana et al. (2022) highlight that teaching aids assist learners in remembering concepts, effectively demonstrating, improving thinking skills, and adopting innovation in education. Additionally, integrating teaching aids into the teaching and learning process aroused learners' interests and this assisted them to learn effectively. Nachiappan et al. (2018) posit that teaching aids that are authentic and meaningful will encourage the communication and imagination of students which will attract their interest. Moreover, With the use of teaching aids, teachers can more effectively illustrate concepts for students' deeper knowledge that are impossible to learn through words and textbooks alone. Helbling (2021) demonstrates that it would not be much easier for students to understand human anatomy, for instance, if all they had to do was use a chalkboard and chalk. Nonetheless, drawing learners' attention and facilitating their understanding will be accomplished by presenting human anatomy through an animated film or 3D model. Furthermore, teaching aids increase students' capacity for critical thought because, as an example, they can see and comprehend how an experiment is carried out, rather than just making assumptions (Ramdani et al., 2021). Hence, students can comprehend the material with clarity and consider how to use it practically, which encourages curiosity and finally leads to the development of creative skills. Teaching aids also support the adoption of innovation in the classroom which is embraced by both teachers and students because the classrooms are no longer boring (Khan & Ullah, 2021).

Natural science learners need a variety of instructional aids to improve their academic performance. Alshatri et al. (2019) defined teaching aids as the accessories, tools, and materials that a classroom teacher uses to help students understand the topics of the lesson. For example, teaching aids built from discarded items that can be used as science instructional aids include electrolyte test devices, earthquake detectors, and flood detectors (Widiyatmoko & Nurmasitah, 2013). Moreover, the school is operating within a digital society and most schools have computers with internet connection. Against this background, Tandi (2023) emphasises that natural science classrooms can benefit from computer-based teaching tools such as graphic and slide projectors, electronic calculators, portals, interactive blackboards, and computers with information restoration and editing software.

Numerous strategies for mitigating the negative effects of instructional aids on students' academic performance in natural science have been discovered by researchers. It is recommended that educators take advantage of readily available resources in their immediate surroundings, such as those found in the shop or a nearby market (Sawyer, 2019). Therefore, teachers are urged to improvise. Besides, teachers should assign students to work in groups (Nachiappan et al., 2018). For example, two students researching instructional tools could work together to identify questions relating to these aids and get additional information through discussion and effective communication. Further, schools that have computers and an internet connection can use computers with educational programs in specialized classrooms. For example, natural science training laboratory. Suseno et al. (2021) reveal

that the natural science training laboratory may include various sensors, including light and temperature probes that enable research measurements to be taken, control mechanisms for robots, and other hardware and software. Finally, Izatulloyevich (2020) emphasizes how crucial it is to set up round tables, seminars, and training sessions for primary school teachers to enhance their methodological abilities in the planning of lessons and teaching aids. This is a result of certain educators' ignorance and incompetence when it comes to planning and setting up their teaching tools. Sufficient research exists about the impacts of instructional aids on students learning in various subjects. However, there was no research conducted about the effect of instructional aids on the academic achievement of seventh-grade natural science students in a particular Kunene Region school. The current study thus aims to fill the gap by exploring the impacts of teaching aids on the academic performance of grade 7 learners in natural science at a selected school in the Kunene Region.

The research question for the study was, what is the impact of teaching aids on the academic performance of grade 7 learners in natural science at a selected school in the Kunene Region? The study objectives are: (a) to identify the type of teaching aids required by grade 7 learners in natural science to enhance learners' performance (b) to determine the approaches to overcome the impact of teaching aids on the academic performance of grade 7 learners in Natural science.

The study shed light on the variables that affect the academic achievement of seventh-grade natural science students. It helped teachers identify areas where students might be struggling and provided them with information to offer targeted support to improve student performance. Additionally, the study's results were used to determine which teaching and learning materials were most effective for grade 7 natural science students. This guided educators in selecting and using the most suitable materials to enhance student learning outcomes.

The research also contributed to developing best practices in natural science education. By identifying effective teaching and learning resources, it helped boost students' academic performance and prepare them for future academic and professional opportunities. Finally, the study influenced policy decisions regarding the provision of instructional materials to schools. It offered evidence-based recommendations on the types of materials most likely to improve the academic achievement of seventh-grade students in natural science.

## METHODS

This study uses a qualitative research approach. A qualitative approach was selected because it offers comprehensive and rich data, including individualized experiences, viewpoints, and attitudes, all of which aid in the explanation of the intricate connections between various variables (Vinarski, 2020). This investigation specifically focuses on a single case study design. A single case study allows the researcher to explore the complexities and nuances of the case in depth, which leads to a more thorough understanding of the topic (Whitmore et al., 2019). Thus, a single case study that is customized to the researcher's interests and research questions permits the application of several data collection and analysis strategies (Pathiranage et al., 2020).

The study's population consists of grade 7 learners and teachers who teach natural science at the designated school in the Kunene Region in Namibia. Hence, the target population of this study comprise 7 natural science teachers for Grade 7 and 70 Grade 7 learners. The researcher used a purposive sampling strategy to sample 2 natural science teachers and 10 grade 7 learners to achieve the aim of the study.

**Table 1.** Participants according to gender

Gender	Frequency	Percentage
Male	4	33%
Female	8	67%
Total	12	100%

The data was collected from the natural science teachers and the grade 7 learners because they were teaching or learning natural science with a shortage of teaching aids, meaning they were experiencing the influence that insufficient teaching aids have on the academic performance of grade 7 learners in natural science. The grade 7 natural science teachers and learners provided qualitative data.

Purposive sampling was used since the natural science teachers and learners were familiar with and had a broad comprehension of the phenomenon under investigation as they had lived experiences of teaching and learning natural science with inadequate educational aids. Campbell et al. (2020) also emphasized that purposive sampling better matches the sample to the aims and goals of the study.

A qualitative approach was employed in the current research to collect detailed data about the impact that teaching aids have on the academic performance of grade 7 learners in natural science. Hence, semi-structured one-on-one interviews of about 45 minutes each were used to gather the data. The main theme of the interviews was to explore in depth how teaching aids impacted the academic performance of Grade 7 learners in natural science. Interviews were the preferred method of gathering data for this study because, as Islam and Aldaihani (2022) emphasize, they aim to examine people's experiences, perspectives, judgments, thoughts, and motivations regarding particular objects or circumstances. This allows for a thorough understanding of the phenomena under study.

This study used thematic analysis, as described by Braun and Clarke (2006). After the interviews concluded, the transcripts were read numerous times to extract meaning from the vast amount of information. A combination of descriptive and in vivo coding was used. The primary method of conducting thematic analysis was an "inductive data-driven manner" (Braun & Clarke, 2006, p. 83), in which the themes were derived directly from the interview data. This method was chosen since there is not much research on this topic, and themes from the interview data developed as a result. Thematic analysis was used as it creates meaningful codes, categories, and topics to organize complex data and make it more comprehensible (Peel, 2020).

## RESULTS AND DISCUSSION

### Results

Following a preliminary examination and the identification of themes, data comments were classified concerning the effects of instructional aids on students' academic achievement in natural science. Four sub-themes emerged: These four emerging sub-themes all relate to one another and represent how teaching aids affect students' academic achievement in natural science at a selected school in Kunene region, Namibia.

Theme	Subthemes
The impacts of teaching aids on the performance of grade 7 natural science learners	<p><b>Subtheme1.1:</b> Enhanced Understanding of Concepts</p> <p><b>Subtheme1.2:</b> Increased Student Engagement</p> <p><b>Subtheme1.3:</b> Improved Academic Performance</p> <p><b>Subtheme1.4:</b> Development of Critical Thinking and Problem-Solving Skills</p> <p><b>Subtheme1.5:</b> Fostering Collaborative Learning</p>

### **The impacts of teaching aids on the performance of Grade 7 natural science learners**

#### *Subtheme 1.1: Enhanced Understanding of Concepts*

L1 had this to say, "*When we have charts and models to look at, it's easier to understand what the teacher is explaining.*" This was also supported by T1, who mentioned, "*Using visual aids helps me convey complex ideas in a simpler way, and the students grasp the concepts faster.*" On this note, L5 expressed, "*I really like the models we use in science class. They make everything clearer.*"

The learners and teachers interviewed indicated that teaching aids, particularly visual materials like charts and models, play a crucial role in enhancing understanding in natural science classes. This aligns with the findings by Akpan (2014), who noted that visual aids significantly improve students' comprehension and motivation. By offering concrete examples, teaching aids enable learners to visualize concepts, thus deepening their understanding.

#### *Subtheme 1.2: Increased Student Engagement*

L7 mentioned, "*I am more interested in the lessons when we use different materials like videos or interactive tools.*" T2 agreed, stating, "*Students participate more when they can interact with the teaching aids. It makes the classroom experience more lively.*" L3 added, "*I enjoy science class because we get to use different things, and it's not just listening to the teacher talk.*"

The feedback from learners and teachers suggests that teaching aids boost student engagement by making lessons more interactive and enjoyable. Alshatri et al. (2019) found that teaching aids, especially those that involve hands-on activities, increase learner involvement in the learning process. These aids transform passive learning into an engaging experience, encouraging active participation and curiosity among students.

#### *Subtheme 1.3: Improved Academic Performance*

T1 commented, "*Students' test scores improved after we started using more teaching aids in our lessons.*" L2 shared a similar observation, saying, "*I got better grades in science when we used more teaching aids in class.*" T2 also noted, "*Teaching aids seem to help students retain information better, which reflects in their exam results.*"

Both teachers and learners observed that using teaching aids leads to improved academic performance. The evidence from this study suggests that teaching aids enhance retention and understanding, contributing to higher test scores. This finding is supported by research from Khasanah et al. (2022), who demonstrated that teaching aids positively affect students' learning outcomes. By making learning more accessible and memorable, teaching aids contribute to academic success.

#### *Subtheme 1.4: Development of Critical Thinking and Problem-Solving Skills*

L6 explained, "*When we do experiments in class, I learn how to solve problems and think about different ways to find answers.*" T1 agreed, adding, "*Teaching aids, especially those used in laboratory*

*settings, help students develop critical thinking skills.*" L8 reinforced this idea by stating, "*We use various tools to solve problems, which helps me think more creatively.*"

Students and teachers pointed out that teaching aids, particularly in hands-on settings like laboratories, foster critical thinking and problem-solving skills. This observation aligns with Ramdani et al. (2021), who found that science teaching materials based on experiential learning promote critical thinking. By encouraging exploration and experimentation, teaching aids help learners develop essential skills that are valuable both in and beyond the classroom.

#### *Subtheme 1.5: Fostering Collaborative Learning*

L4 said, "*We often work in groups when using teaching aids, which helps me learn from my classmates.*" T2 pointed out, "*Teaching aids promote group work and collaboration among students, which is great for building teamwork skills.*" L9 shared a similar sentiment, saying, "*I enjoy working with my friends on projects using different teaching aids. It's more fun and helps me learn better.*"

Collaborative learning emerged as a significant subtheme, with teaching aids providing a platform for students to work together. This echoes the research of Banks and Banks (2019), who highlighted the importance of collaborative learning in multicultural education contexts. Teaching aids that encourage group activities create opportunities for students to share ideas, build teamwork skills, and learn from each other, fostering a supportive and interactive learning environment.

### **Discussion of Results**

The study's results indicate that adequate teaching aids can significantly impact the academic performance of grade 7 natural science learners. By examining the voices of students and teachers, we can explore these impacts across various subthemes and contextualize them with relevant research.

#### *Enhanced Understanding of Concepts*

Teaching aids like charts, models, and visual resources have proven effective in enhancing the understanding of complex scientific concepts among students. The voices from L1, T1, and L5 reflect the direct benefits of such aids. Akpan (2014) emphasized that visual aids facilitate learning by providing tangible examples, allowing teachers to simplify complicated ideas. This simplification helps learners to grasp difficult concepts, making lessons more accessible and enjoyable. The use of teaching aids is a bridge between abstract scientific concepts and the learners' concrete understanding, which is particularly valuable in natural science education.

#### *Increased Student Engagement*

According to L7, T2, and L3, teaching aids significantly increase student engagement by making lessons more interactive. Alshatri et al. (2019) found that interactive teaching aids boost learner participation, reinforcing the idea that students learn best when they are actively involved. Interactive tools like multimedia presentations and hands-on experiments transform passive learning into a dynamic experience, fostering a more stimulating classroom environment. This enhanced engagement leads to increased curiosity and enthusiasm for learning, driving students to take a more active role in their education.

#### *Improved Academic Performance*

The feedback from T1, L2, and T2 illustrates a connection between teaching aids and improved academic performance. This is consistent with Khasanah et al. (2022), who demonstrated that teaching aids contribute to higher test scores by enhancing comprehension and retention. When teaching aids are used effectively, they serve as catalysts for deeper learning, enabling students to better retain

information and perform well in assessments. This suggests that incorporating a variety of teaching aids into the curriculum can lead to measurable improvements in academic outcomes.

#### *Development of Critical Thinking and Problem-Solving Skills*

L6, T1, and L8 highlighted that teaching aids, especially those used in laboratory settings, promote critical thinking and problem-solving skills. Ramdani et al. (2021) found that science teaching materials designed for hands-on learning encourage critical thinking and problem-solving abilities. Teaching aids that require students to experiment, analyze data, and find solutions not only make learning more engaging but also help develop essential life skills. These experiences prepare students for more advanced scientific studies and real-world problem-solving.

#### *Fostering Collaborative Learning*

The voices of L4, T2, and L9 suggest that teaching aids foster collaborative learning by encouraging group work and teamwork. Banks and Banks (2019) support this notion, indicating that collaborative learning environments are achieved by incorporating teaching aids that require student cooperation. Teaching aids that promote group activities enable students to learn from each other, share ideas, and build social skills. This collaborative approach not only enhances academic learning but also contributes to the development of interpersonal skills, which are crucial in educational and professional settings.

## **CONCLUSION**

In summary, the study's findings underscore the significant role that teaching aids play in enhancing the academic performance of Grade 7 natural science learners. Teaching aids offer a wide range of benefits, including enhanced understanding, increased engagement, improved academic performance, critical thinking development, and collaborative learning. These results suggest that educators and policymakers should prioritize providing a variety of high-quality teaching aids in science education to create a more effective and enriching learning environment. Furthermore, the study's outcomes have broader implications for educational strategies and policies, emphasizing the importance of investing in instructional materials that support a comprehensive and engaging learning experience.

## **Recommendations**

Based on the study's findings, which indicate the significant role that teaching aids play in enhancing the academic performance of Grade 7 natural science learners, several recommendations can be made. These recommendations are designed to guide educators, school administrators, and policymakers in implementing practices that leverage teaching aids to improve educational outcomes in natural science.

#### *Invest in a Variety of Teaching Aids*

Schools should allocate resources to acquire a diverse range of teaching aids, including visual, audio-visual, and tactile materials. This variety ensures that different learning styles are addressed, enabling students to understand and retain complex concepts more effectively. Investing in high-quality teaching aids such as charts, models, interactive software, and laboratory equipment is crucial for enhancing the learning experience (Akpan, 2014).

#### *Incorporate Interactive Learning Techniques*

Teachers should incorporate interactive learning techniques into their lesson plans to boost student engagement. This can include using multimedia presentations, conducting hands-on

experiments, and promoting group projects. By creating a more dynamic classroom environment, students are more likely to actively participate and engage with the material, leading to improved academic outcomes (Alshatri et al., 2019).

#### *Foster Collaborative Learning*

Encourage collaborative learning by designing activities that require teamwork and group problem-solving. Teaching aids can play a key role in facilitating this type of learning, as they often require students to work together. Collaboration not only enhances academic learning but also helps students develop social skills and teamwork (Banks & Banks, 2019).

#### *Provide Professional Development for Teachers*

Schools should offer professional development programs focused on the effective use of teaching aids in the classroom. Teachers need to understand how to integrate these aids into their teaching strategies to maximize their impact on student learning. Training sessions can cover best practices for using visual aids, interactive tools, and laboratory equipment to promote critical thinking and problem-solving (Ramdani et al., 2021).

#### *Monitor and Evaluate the Effectiveness of Teaching Aids*

Implement a system for monitoring and evaluating the effectiveness of teaching aids in enhancing academic performance. This can involve collecting feedback from students and teachers, as well as analyzing academic results to assess the impact of teaching aids on learning outcomes. Regular evaluation helps ensure that resources are used effectively and can guide future decisions regarding the acquisition and use of teaching aids (Khasanah et al., 2022).

#### *Advocate for Policy Changes to Support Teaching Aids*

Policymakers should consider the study's findings when developing educational policies. Advocating for increased funding to support the acquisition and maintenance of teaching aids is crucial for improving the quality of science education. By recognizing the impact that teaching aids have on student performance, policies can be crafted to ensure all schools have access to these essential resources (NCERT, 2013).

### **Limitation and Area for Further Study**

One significant limitation of this study is that it is a qualitative investigation focusing on a single region, specifically the Kunene Region. As a case study, the findings are deeply contextualized and may reflect the unique characteristics and conditions of this specific educational setting. Consequently, these results may not be readily generalizable to other regions, schools, or educational contexts.

Given the unique dynamics of the Kunene Region, the study's conclusions may not hold true for other geographical locations or different educational systems. Factors such as cultural differences, resource availability, teaching practices, and student demographics can vary widely between regions, impacting the relevance and applicability of the study's findings elsewhere. As a result, caution should be exercised when attempting to apply these findings to broader settings, and additional research would be needed to determine the extent to which the results are applicable in other contexts.

### **Recommendations for Further Study**

In addition to extending research across multiple regions, larger sample sizes, and quantitative methods to validate the current findings, another area for further study could be examining the long-term impact of teaching aids on students' academic performance and overall educational development. This longitudinal approach would provide insights into how consistent exposure to

teaching aids influences students' learning trajectories over time. It could also help identify any lasting benefits or gaps in educational outcomes related to the use of teaching aids.

Moreover, exploring the perspectives of a wider range of stakeholders, including parents, school administrators, and policymakers, could yield a more holistic understanding of the role teaching aids play in education. This broader viewpoint could inform the design and implementation of policies that support effective teaching aids use across different educational settings.

## REFERENCES

Adeniran, s. A. (2020). Influence of teaching and learning resources on student's performance in senior secondary schools in gusau local government, zamfara state. *The eurasia proceedings of educational and social sciences*, 18, 124–131. Retrieved from <https://www.epess.net/index.php/epess/article/view/599>

Akpan, I. A. (2014). The influence of visual aids on students' learning and motivation. *International Journal of Academic Research in Business and Social Sciences*, 4(12), 271- 282.

Alshatri, S. H. H., Wakil, K., Jamal, K., & Bakhtyar, R. (2019). Teaching aids effectiveness in learning mathematics. *International Journal of Educational Research Review*, 4(3), 448-453.

Banks, J. A., & Banks, C. A. (2019). *Multicultural education: Issues and perspectives*. John Wiley & Sons.

Braun, V., & Clarke, V. (2006). Using thematic analysis in psychology. *Qualitative Research in Psychology*, 3(2), 77-101. doi: 0.1191/1478088706qp063oa.

Campbell, S., Greenwood, M., Prior, S., Shearer, T., Walkem, K., Young, S., Bywaters, D., & Walker, K. 2020. Purposive sampling: Complex or simple? Research case examples. *Journal of Research in Nursing*, 25(8), 652-661. <https://doi.org/10.1177/1744987120927206>

Eilam, B., & Gilbert, J.K. (2014). The significance of visual representations in the teaching of science. In B. Eilam & J. Gilbert (Eds.), *Science teachers' use of visual representations: Models and modeling in science education* (pp. 3-28). Springer, Cham. [https://doi.org/10.1007/978-3-319-06526-7\\_1](https://doi.org/10.1007/978-3-319-06526-7_1)

Helbling, S. A. (2021). *Three-dimensional visualization technology in the medical curriculum: Exploring faculty use in preclinical, clinical, and postgraduate anatomy education*. Indiana University-Purdue University Indianapolis.

Islam, M. A., & Aldaihani, F. M. F. (2022). Justification for adopting qualitative research method, research approaches, sampling strategy, sample size, interview method, saturation, and data analysis. *Journal of International Business and Management*, 5(1), 1-11. <https://doi.org/10.37227/JIBM-2021-09-1494>

Izatulloyevich, O. F. (2020). Methods of teaching natural sciences to primary school pupils based on a competent. *Palarch's Journal of Archaeology of Egypt / Egyptology*, 17(6), 14520-14539. <https://archives.palarch.nl/index.php/jae/article/view/4589>

Khan, R. A., & Ullah, H. (2021). *Adoption of LMS in higher educational institutions of the Middle East*. Springer.

Khasanah, A. N., Santosa, S., Indrowati, M., & Septivanto, A. (2022). The effect of picture and picture integration with guided note taking accompanied by optimization of teaching aids towards

students' learning outcomes. *Journal of Research in Science Education*, 8(2), 724-731. <https://doi.org/10.29303/jppipa.v8i2.1420>

Nachiappan, S., Osman, Z., Hassan, N. M., Jamil, N., Hussein, H., Othman, M., & Suffian, S. (2018). An analysis of the criteria and effectiveness of using teaching aids in preschool science and technology components in Malaysia. *International Journal of Academic Research in Progressive Education and Development*, 7(1), 63–82.

NCERT. (2013). *Pedagogy of science: Physical science, textbook for B.Ed*. National Council of Educational Research and Training.

Pathirancode, Y. L., Jayatilake, L. V., & Abeysekera, R. (2020). Case study research design for exploration of organizational culture towards corporate performance. *Review of International Comparative Management*, 21(3), 361-372.

Peel, K. L. 2020. A beginner's guide to applied educational research using thematic analysis. *Practical Assessment, Research, and Evaluation*, 25(1), 1-15.

Ramdani, A., Jufri, A. W., Gunawan, G., Fahrurrozi, M., & Yustiqvar, M. (2021). Analysis of students' critical thinking skills in terms of gender using science teaching materials based on the 5E learning cycle integrated with local wisdom. *Jurnal Pendidikan IPA Indonesia*, 10(2), 187-199.

Sawyer, K. (2019). *The creative classroom: Innovative teaching for 21st-century learners*. Teachers College Press.

Suseno, N., Riswanto, R., Salim, M. B., Hidayatullah, D., & Rasagama, I. G. (2021). How to manage an effective laboratory for science learning in schools? *Jurnal Penelitian & Pengembangan Pendidikan Fisika*, 7(2), 191-200.

Tandi, C. (2023). *Media and technology in 21st-century higher and tertiary education in Africa: Insights from teachers' colleges in Zimbabwe*. African Books Collective.

Vinarski, P. H. (2020). A view into managers' subjective experiences of public service motivation and work engagement: A qualitative study. *Public Management Review*, 22(7), 1090-1118.

Whitmore, C., Kaasalainen, S., Ploeg, J., & Baxter, P. (2019). Transitioning to practice in long-term care: New graduate nurses' experience of an accelerated transition to nurse leader. *Journal of Advanced Nursing*, 75(6), 1272-1283.

Widiyatmoko, A., & Nurmasitah, S. (2013). Designing simple technology as a science teaching aids from used materials. *Journal of Environmentally Friendly Processes*, 1(4), 26-33.