Business & Social Science
IJRBS

Research in Business & Social Science

IJRBS VOL 12 NO 2 (2023) ISSN: 2147-4478

Available online at www.ssbfnet.com
Journal homepage: https://www.ssbfnet.com/ojs/index.php/ijrbs

Exploring teacher improvisation and its influence on learner performance in an under-resourced Grade 11 Life Science class

Thasmai Dhurumraj [(a)*] *Zainul Moola* [(b)]

[(a)] *Ph.D., School of Science Education, University of Johannesburg, Kingsway & University Roads, Aukland Park, Johannesburg, 2092, South Africa.*
[(b)] *M.Ed. Student, School of Science Education, University of Johannesburg, Kingsway & University Roads, Aukland Park, Johannesburg, 2092, South Africa.*

ARTICLEINFO

Article history:

Received 13 January 2023
Received in rev. form 02 March 2023
Accepted 18 March 2023

Keywords:

Improvised Resources; Pedagogy, Instructional Materials

JEL Classification:
I23

ABSTRACT

The decline in learner performance in science education in South Africa is a perennial problem. Resource paucity in government schools is ubiquitous and reflects inherent challenges that pervade science classrooms. Scientific resources are imperative to the success of content delivery; however, South African government schools need help in procuring these standardised instruments and resources. Therefore, educators must innovate by employing improvised resources. This study illuminates the relationship between improvised resources and learner performance. A quasi-experimental design is adopted. A local school in Gauteng was used for this study, with 40 Grade 11 Life Science students and 1 Life Science educator participating in the project. A pre-test and post-test were administered to evaluate the effect of improvise resources comparatively. The ANOVA two-factor analysis tool demonstrated significant results of performance between the experimental and controlled groups as a statistical difference is seen in the mean scores, further accentuating the invaluable use of improvised resources.

Introduction

Adequate resources, instructional materials, and teacher expertise determine the success or failure of the curriculum (Ogunode *et al*., 2022). Most schools in rural areas still need adequate apparatus in science classrooms to conduct experiments. Therefore, the teacher is responsible for employing improvised materials as a substitute for the much-needed equipment. Under-resourced schools often employ behavioural pedagogical approaches because of resource deficits that juxtapose the constructivist paradigm, a preferential method that facilitates the scientific inquiry of learners. There needs to be more scientific resources in South African public schools, which engenders educators to use innovative methods often to conduct scientific investigations (Mamutse & Ramnarain, 2016). The result is improvised resources, a substitute for scientific apparatus with cost-effective materials for practical work since schools are not equipped with resources.

South African schools need more scientific resources, particularly those in agrestic areas. In addition, Life Science is a practical subject, and learners must actively participate in the process (Amos *et al*., 2022)—Mamutse and Ramnarain (2016) document gradational improvements in physical resources in under-resourced schools. However, transformation and reform are subdued by the dire need for resources imperative for practicality in science classrooms. Ultimately, the ramifications of a repressive system are now prominent presently as township schools have a dearth of instructional materials while schools in the suburb, previously reserved only for whites, have provisions for apparatus and equipment needed to conduct scientific investigations. Mamutse and Ramnarain (2016) controvert the assumptions that practical applications in science require laboratory equipment, and in so doing, the effective use of improvised resources has been promulgated as an alternative. Government schools cannot make provisions for the shortage of

* *Corresponding author. ORCID ID: 0000-0003-1792-2952*

https://doi.org/10.20525/ijrbs.v12i2.2341

apparatus required in science classrooms; however, teaching materials need to supplement and augment explanations for effective teaching and learning.

A myriad of secondary schools in South Africa encounters substantial paucity of resources that are paramount to the didactics of Life science. The concern arises when schools employ teacher-centred instruction since there are no alternatives, thus compromising the efficacy of student learning. Fundamentally, it impedes scientific inquiry as the scientific processing skills of the learners are neglected. Educators opt for traditional teaching paradigms because they need to possess the critical faculties necessary for the successful execution of the improvised resources. Socioeconomic deterrents have tasked educators with circumventing science resource scarcity by utilising unorthodox methods to conduct experiments in the classroom. These factors have a direct impact on learner performance. Measuring the effectiveness of improvised materials on learner performance may eliminate the dilemma of underperformance in Life sciences.

Ibrahim *et al.* (2019) concur that a teacher's competence, skill and ingenuity precipitate the viability of improvised classroom resources and affect student performance. Furthermore, competency in low-cost materials is required so that technicalities such as accuracy and precision are not jeopardised during application. Misapplication of instructional materials could potentially engender and perpetuate learner misconceptions (Ogbe & Omenka, 2017). Ibrahim *et al*. (2019) emphasise critical engagement through inquiry-based teaching and learner-oriented tasks as vital to teaching and learning via improvised resources. Conversely, Ibrahim *et al.* (2019) augment this sentiment by echoing the inaccessibility of laboratory equipment which perpetuates the use of lecture methods as opposed to guided inquiry. The real problem stems from financial constraints. However, Utibe-Abasi (2015) identifies teachers' lack of exposure to improvised resources as a pedagogical factor since the implementation is a skill they have yet to develop. Mahlatse and Ramaila (2020) conducted a study utilising semi-structured interviews to determine Life science teachers' inclination or proclivity to use improvised resources; the authors tabulated the data and found that a vast majority of participants employed improvised resources due to resource paucity, affordability, and accessibility of materials and educational value of integrating phenomena into real-life contexts.

There needs to be more professional development in in-service and pre-service teachers.

According to Mabasa and Singh (2020), some teachers possess basic training while others still need to. Furthermore, content knowledge and training are neglected in this field. Mabasa and Singh (2020) found that teachers performed investigations theoretically using textbooks; without considering the use of improvised resources. This could affect learner performance negatively. The insight that is gleaned from this study would benefit educators and policymakers. For learners to perform at optimum capacity, educators require training. The Department of Education could propagate a developmental program in which improvised resource workshops are presented for professional development. These efforts will improve learner performance in rural and under-resourced schools. The study will be guided by the following research question: What is the relationship between the Grade 11 Life Science teacher's use of improvised resources and learner performance?

Literature Review

Theoretical and Conceptual Background

Meaning of Improvisation

Instructional materials are indispensable to the fundamental nature of Life science teaching and learning and didactics in general. Ideally, science teaching efficacy could be supplemented by integrating apparatus needed to conduct investigations, however, socioeconomic constructs prevent the feasibility of this endeavour. Science resources facilitate knowledge acquisition and performance (Ogunode *et al*., 2022). The inaccessibility of resources has led to the declination of student achievement in science. Although resource paucity has been mitigated to some extent, it still remains an ubiquitous dilemma in most schools across South Africa. Improvised resources could be seen as a cost-effective substitute for the standardise apparatus required in science classrooms. Ezechi (2019) defines improvised resources as using alternative resources in place of the real equipment that is often unobtainable. Synonymously, Ibrahim *et al*. (2017) elucidate the term by stating that it is the use and adaptation of local resources when manufactured materials are in shortage or absent altogether. The resources reinforce the comprehension of complex scientific concepts (Ogunode *et al*., 2022). Mboto *et al*. (2011) and Asare *et al*. (2018) highlight the impact of the much-needed improvised resources in African countries such as Kenya and Ghana respectively. They report a similar circumstance to those experienced in South Africa such as the lack of instructional materials for teaching and learning in science and its effectiveness on academic achievement, therefore making the study contextually appropriate.

Improvised Resources and Paucity in Standardised Instructional Materials

Mboto *et al.* (2011) make a profound statement in conveying the idea that to successfully impart scientific knowledge, instructional materials must be supplemented by explanations and a positive learning experience. However, they also acknowledge that schools cannot always satisfy the financial viability needed to procure standardised apparatus for science classrooms. Similarly, Ezechi (2019) concurs that effective delivery of content cannot be executed if it is bereft of interaction between the teacher, learner and resource. Ezechi (2019) is cognisant of resource paucity and accentuates the lack of funding for equipment that is often sophisticated but exorbitant. Contextually, South African government and rural schools are at the epicentre of the challenges regarding resource deficiency as they suffer immense setbacks either because the institution has scant resources, or the educator remains accountable for purchasing the materials. Since a large number of schools in South Africa are under resourced, teachers have to employ their pedagogical ingenuity to invoke educational change (Ramaila & Ramothwala, 2020).

Improvised resources are critical to Life science learning as a congruency must exist between abstract concepts that are taught and pragmatic experience (Saminu & Usman, 2017). However, Azumah (2020) accents the contextualisation of these materials thus implying that there must be a relevance to everyday life experiences. Improvisation can be sub categorised into substitution and construction; substitution alluding to using cost-effective materials in place of standardised lab equipment and construction which is involves constructing new materials from scratch (Achimungu & Muftawu, 2019). Ndayambaje *et al*. (2019) conducted a compelling study in Rwanda to evaluate the use of improvised resources versus standardised laboratory equipment in teaching thermal expansion in Physical science, in which both variables explored performed equally well. Although the study was conducted in the discipline of Physical science, the skills could be extrapolated and applied to Life science. This is a feasible solution that could be deployed in South Africa, as the study has contextual merit which highlights the plight of resources shortages in third world countries. Ogunode *et al*. (2022) refers to improvisation as the alternative as three dimensional models are used to teach the excretory system the use of these instructional models assists with a learner's assimilation of knowledge thus creating understanding of concept (Ogunode *et al*., 2022). Saminu and Usman (2017) explicate the teacher-oriented use of improvised resources as an effective strategy conversely, Hauwa and Hauwa (2018) report learners' active participation in the process of improvisation to have been met with higher achievement. On the same note, Ramaila (2022) states that the purpose of using improvised resources is to optimise academic performance. A learner centred approach that hinges on guided inquiry-based learning with an emphasis on facilitation rather than exposition is desired.

The Effect of Improvised Resources on Academic Performance

Teachers need to ensure that learners employ scientific processing skills that concretise their learning experience to augment their academic performance. Ndayambaje *et al*. (2019) posit that learners experience difficulty in grasping abstract concepts in science and identifies experiential learning as a suggestion in consolidating theoretical ideas which are often abstract and practical application of those ideas. This is a keen observation as learning in science favours a constructivism view as opposed to rote memorisation. Hauwa and Hauwa (2018) identify real instructional materials as prerequisite to complement the teaching and learning of Life science. Additionally, Omariba *et al*. (2017) conducted interviews in which participants (Life science educators) proffered the practicality of science in didactics thus espousing the importance of improvised resources. According to Ayoola *et al*. (2022), Life Sciences is a resource intensive discipline and securing authentic materials is difficult because of poor funding. Instructional materials create meaningful teaching and learning and improve performance, however it is not reflected in the education system since there are shortages (Ayoola *et al*. 2022).

In studying the effects of improvised materials on learner performance, an analogy can be made between Mboto *et al*. (2011) and Hauwa and Hauwa (2018) in that they both employ quantitative approaches to research. Their research is motivated by empirical evidence and is rooted in the scientific paradigm. Furthermore, an experimental design is used outlining the experimental variable and controlled variable. Hauwa and Hauwa (2018) report that the experimental group taught, utilising improvised resources achieved higher scores contrary to their controlled group counter parts, taught using the lecture method. Similarly, Mboto *et al*. (2011) solidify the cruciality of improvised resources as their findings indicate that resources were used to enhance cognitive processes of their experimental group. Eizechi (2019), Saminu and Usman (2017) formulated a null hypothesises to assist in guiding their study; their null hypotheses stated that there was no significant difference between academic performance in Life sciences of learners who were taught using improvised materials and those taught without. Likewise, both their null hypotheses were rejected as the student participants responded positively to reinforcement through improvised resources.

Educator's Pedagogical Knowledge of Improvised Resources

Ezechi (2019) opined that although the use of improvised resources has been propagated as a viable option, some teachers still teach Life science through exposition of scientific concepts and facts. Comparatively, Abdullahi *et al*. (2017) reviewed evidence that teachers tend to use the lecture method as a means for content delivery. Although teacher centred strategies could hinder academic performance in Life science, teachers may opt for this strategy because they do not possess the pedagogical knowledge or the skill for integration into the lesson. In other words, the lack of professional development may militate efforts to improve student performance. Amos *et al*. (2022) states that Life Science teachers are not proficient in improvisation, and they teach in abstraction, therefore counteracting academic performance. Ramaila and Zondi (2020) state that integration of improvised resources in Life sciences classrooms is predicated on the educator's pedagogical content knowledge. Amos *et al*., (2022) on the other hand, states that poor academic performance is attributed to a teacher's ability to improvise. A competent teacher is able to modify and employ strategies to suit the learners' needs. Furthermore, a teacher has a repertoire of techniques and practices to act in accordance with the demands of the classroom (Amos *et al*., 2022). The teacher must enable transformation and professional development while making learning of Life Science concept comprehensible to struggling learners.

Challenges of Implementing Improvised Resources

South Africa is a developing country therefore, challenges in Life science classrooms are bound to become pervasive across rural schools. Ezechi (2019) iterates how Life sciences is a resource intensive subject however, Ogbe and Omenka (2017) identify technicalities which relate to accuracy the improvised resources produce, which may compromise the validity of results. Mboto *et al*. (2011) concur that the materials used need to provide the desired result. In other words, the manipulation of the instructional materials must be effortless and uncomplicated. The teacher must ensure the functionality of these materials before the lesson (Amos *et al*., 2022). Abdullahi *et al*. (2017) add that educational institutions expect teachers to procure the materials at their own cost which may make them less inclined to make the purchase and instead employ teacher centred methods. Amos *et al*., (2022) accentuates the affordability of instructional materials and states the materials should be cost-effective and within an institution's budget.

Methodology

The study impels the investigation into an under-resourced high school thus examining the correspondence between academic performance and employment of improvised resources in a Life Science grade 11 class. This study will make use of a quasi-experimental research design that will adopt a quantitative paradigm. True experiments administer treatments randomly, however, since this study is school based, and classes are formed at the beginning of the year, practicality and feasibility are compromised. This study preludes a true experimental design, therefore the cogent design for this study is a quasi-experimental design.

Quantitative research accentuates numeric and statistical outputs (Eyisi, 2016). According to Ericikan and Roth (2006) quantitative research is deemed objective and replicable, additionally, its preference lends to the reduction of errors and biases. The disadvantage, however, is that the researcher is detached from the subject matter limiting depth of study and understanding of phenomena (Eyisi, 2016). Similarly, this was a low-risk study as the researcher was not directly involved with the participants. The study has subscribed to an ethical framework in which harm was mitigated and protocols were designed to simultaneously minimise harm. The context of this study was a local high school, thus teaching and learning occurred naturally without imposing harm on the participants.

This research targets a comprehensive group of individuals. The study is contextualised to a secondary school with the participants being learners and a Life Science teacher. According to Thompson (1999), a quantitative researcher is partial to statements regarding probability which encompasses participants having an equal chance for being selected for the study. Simple random sampling is subsumed under the probability sampling technique. As mentioned previously, simple random sampling denotes equal opportunity of participants to be selected. The participants for this study are Grade 11 Life Sciences learners and an educator. A sample of 40 learners from a population of 68 Life Science learners were chosen through simple random sampling to participate in this study. Since randomisation is used, any study on this sample should yield good internal and external validity. This sampling method is pertinent because it is being used on a limited population of Life Science learners that can easily be sampled.

The designated tool for data collection was the pre-test and post-test. The 40 Life Science learners completed the pre and post-test. Révész and Roger (2019) convey the purpose of the pre-test to be a basis for comparison of participants prior to the experimental treatment and the post-test allows the researcher to evaluate the effects of the administered treatment. The treatment refers to teaching using improvised resources reserved for the experimental group and teaching using the lecturer method for the controlled group. Data was gathered by implementing an investigation that requires scientific processing skills. The task was aimed at determining the effect of exercise on the depth of breathing and the pulse rate. The following improvised resources were used: a 2 litre plastic bottle, a large plastic dish, rubber tubing, a permanent marker and a stopwatch. Take note of the use of these resources as opposed to a conventional spirometer which is a sophisticated and expensive piece of equipment designed to achieve the same purpose. The pre-test and post-test were experimental in nature as it included recording of observations, analysing results, discussions, and conclusions. When designing the test, the researcher consulted the CAPS document to ensure alignment with curriculum. Two classes engaged in the pre-test administered by the Life Science educator. The post-test was administered after the teacher had conducted her lesson by implementing improvisation of materials for the experimental group and lecture method for the controlled group. This research was orientated by a comparative study. The method adopted in the proposed study was comparative and quantitative. Learners' response to a pre-test and post-test were compared in which one group was taught using improvised resources and one group was taught using the lecture method.

This study complements the descriptive nature of statics since the study attempts to investigate the relationship between improvised resources and learner performance. Statistical analysis techniques for data inherent in quantitative research still assist correlating data in comparative studies. An ANOVA Two Factor Analysis was generated to comparatively determine the threshold for significance. This was achieved using Microsoft Excel, processing both pre-test and post-test scores. The results tabulated displayed measures of central tendency which include mean, standard deviation and variance of scores obtained by the Life Science learners.

Findings and Discussions

This section encompasses the illustration and discussion of results. The findings from the study are presented graphically, through bar graphs, tabulated results obtained through an ANOVA analysis on Microsoft Excel and a scatterplot. The findings are presented and a subsequent discussion and analysis of the graphic or illustration is followed.

Comparative mean scores of pre-test and post-test scores achieved in Life science

The data illustrated in figure 1 represents the mean scores achieved by Grade 11 Life Science students. A statistical variation can be seen between the control and improvised group. Figure 1 shows the mean score achieved by Life Sciences learners taught using improvised resources as 13.15 contrastingly, the learners taught using rote learning scored statistically lower than their counterpart. The difference in performance is evident.

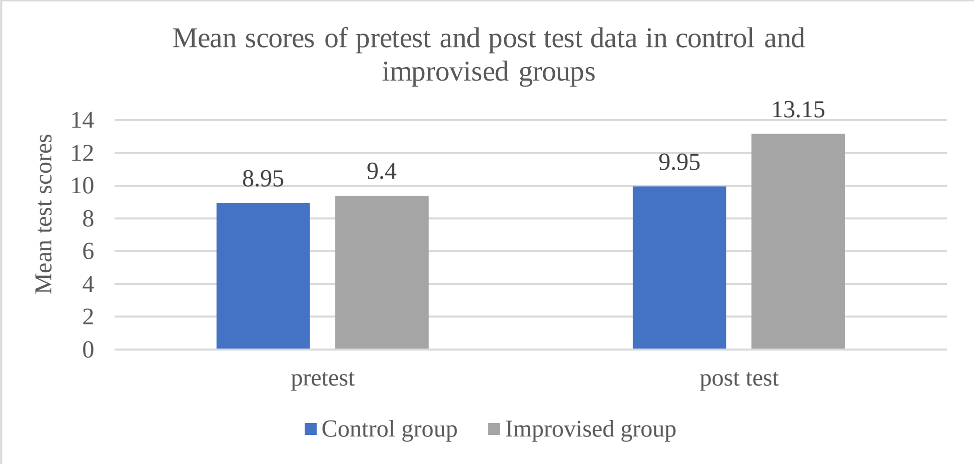

Figure 1: Mean Scores Achieved in Pre-Test and Post-Test for Both Control and Improvised Resources

Comparatively, Ndayambaje *et al.* (2019) used a t-test to exemplify their data which demonstrated and generated an elevated mean score for students taught using improvised resources. A pivotal difference lies in the controlled variable. In this study the controlled group were inculcated through behaviouristic means whereas, Ndayambaje, *et al*. (2019) utilised laboratory equipment as the controlled variable. Nevertheless, the mean score of those taught with improvised materials surpassed those taught using conventional methods. Correspondingly, Saminu and Usman (2017) investigated the effect of improvised resources on learner performance in Biology. They posit that students are cognisant and informed about the materials they use, furthermore Saminu and Usman (2017) elucidate that since the instruments were produced through process, their interest was stimulated. Although, instruments were not aesthetically pleasing, comprehension of concept was optimised and test scores using improvised instruments were augmented thus invalidating and rejecting their null hypothesis.

Mboto *et al.* (2011) composed a similar study, however, the discipline was Physical Sciences focusing on radiology. Their empirical study reported higher retention using improvised resources since visual stimuli was introduced. Mboto *et al*. states that interactive and co-operative learning resulted in higher performance. Additionally, a t-test was also used to represent the tabulation of findings. This study aligns and corresponds with research mentioned in this study. Subsequently, it can be said that the findings of this study conclusively support and confirm those found in Mboto *et al*., (2011), Ndayambaje, *et al*., (2019) and Saminu and Usman (2017).

This study directly contrasts with Ndayambaje *et al*. (2018) findings. The researchers conducted a study to investigate whether improvised materials constructed and used by students at a teacher's college, would augment their performance in Physics. A multivariate analysis was used to evaluate the data, however, Ndayambaje *et al*., (2018) reports data that show no statistically significant result. In other words, the difference in scores between students taught with improvised and those without, are ineffective and show no development. Therefore, it can be said that this study negates the findings propagated by Ndayambaje *et al.* (2018).

Tabulation of results generated from the conventional and improvised group

Table 1: Summary Results for The Conventional Group

Conventional group	**Pre-test**	**Post-test**	**Total**
Count	20	20	40
Sum	179	199	378
Average	8.95	9.95	9.45
Variance	6.79	7.63	7.28

Table 1 above encapsulates the sample size, average scores and variance between the pre-test and post-test of the control group. The count is indicative of the sample size; therefore 20 Grade 11 Life Sciences students' scripts were randomly selected for the control group and 20 for the improvised group.

Table 2: Summary of Results for The Improvised Group

Improvised group	Pre-test	Post-test	Total
Count	20	20	40
Sum	188	263	451
Average	9.4	13.15	11.28
Variance	10.57	7.19	12.26

Table 2 conveys a tabulation of results gathered for the group of students taught using improvised resources. A comparative difference is observed between the two tables as the mean post-test score for students taught using improvised resources is significantly higher than the mean of the students taught using conventional teaching methods. Table 2 illustrates a variance of 7.19 that is lower than that in Table 1. A lower variance stipulates that many of the test scores are spread around the mean and a high variance infers a larger data spread from the mean. Since a lower variance is observed in Table 2, it could be interpreted that many students have exceeded their pre-test scores signalling a critical improvement in performance. The average difference in in pre-test and post-test scores in the improvised group is 3.75 and 1 in the conventional group, therefore a notable increase in the pre-test and post-test of the improvised group provides conclusive proof that cost-effective resources in science classrooms maintain efficacy.

The determination of Significance and analysing the P value, generated by an ANOVA two factor analysis.

Table 3: ANOVA Two Factor Analysis

Source of Variation	*SS*	*df*	*MS*	*F*	*P-value*	*F crit*
conventional/improvised	66.61	1	66.61	8.28	0.01	3.97
Pre-test and post-test	112.81	1	112.81	14.03	0.00	3.97
Interaction	37.81	1	37.81	4.70	0.03	3.97
Within	611.25	76	8.04			
Total	828.49	79				

An ANOVA two factor analysis was generated using Microsoft Excel. An alpha of 0.05 was used to determine the significance threshold. Since the P-value is less than the alpha of 0.05, this study can reject the null hypothesis and accept the alternative hypothesis. In other words, the statistics produced show significant value. A comparison between the F statistic and F critical value is needed to determine significance. If the F statistic value is greater than the F critical value, the test is deemed significant. Therefore, Table 2 reveals that indeed, students' academic performance is elevated when taught using improvised resources.

The determination of correlation in pre-test and post-test scores

A scatterplot is able to determine positive or negative correlation. If the points on the scatterplot closely resemble a straight line, then the form is considered linear. In addition, the correlational coefficient determines how well the plotting forms a straight line. Scatterplots can either have positive or negative correlation.

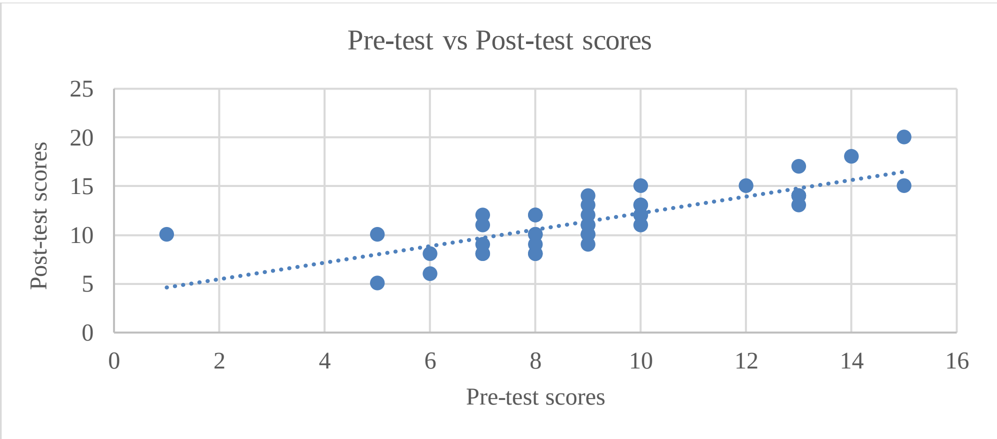

Figure 2: Scatterplot of Test Scores Achieved in Pre-Test and Post-Test

A scatterplot is able to determine positive or negative correlation. If the points on the scatterplot closely resemble a straight line, then the form is considered linear. In addition, the correlational coefficient determines how well the plotting forms a straight line. Scatterplots can either have positive or negative correlation. The trend line in this study is indicative of strong positive correlation. In other words, the increase of one variable (pre-test scores) leads to the increase of the other (post-test scores). The post-test scores of the learners reveal improvement in performance after being taught using improvised resources. The correlation is determined by how tightly clustered the points are aligned in forming of the scatterplot in addition to the generation of the *r* coefficient below. A scatterplot does not explain causation but rather determines relationships between variables.

Table 4: A Correlational Matrix to Determine Strength and Direction of Scatterplot

	Pre-test	**Post-test**
Pre-test	1	
Post-test	0.787784	1

The strength and direction are derived from the value of the *r* coefficient which is 0.787784.. According to Baker (2017) a strong correlational coefficient is between 1 and –1 according to Pearson's *r* coefficient. The variables display direct proportionality as both variables show an increase in value. The above correlational matrix was generated from Microsoft Excel using the analytical tool, therefore demonstrating that the variables in this study possess strong positive correlation shown in Figure 2.

Conclusions

There is a perceptible decline in the sciences as learner performance in under-resourced schools tends to plummet. However, according to various literature cited in this study, there has been significant improvement in test scores of students who were taught using improvised materials. Implementing improvised resources fills the desperate need for learners to grasp scientific concepts. Improvisation improves didactics. However, an educator's propensity to improvise comes into question as it taps into their pedagogical content knowledge. South Africa still suffers from the effects of a repressive system; however, it can be relinquished through the innovative prowess of an educator to improvise. From the results gleaned on the effects of improvised resources on student performance, it was found that teaching using improvised resources yields substantial results. The socioeconomic context in which South Africa finds itself is entrenched in the effects of a repressive past. However, the science educator is responsible for mitigating cognitive barriers and making science more palatable in the classroom.

Resource paucity pervades most schools across South Africa. Thus, cost-effective improvised resources are indispensable to the cognitive and performative benefit of the learners. The use of conventional or state-of-the-art scientific tools can stagger development because of unfamiliarity, the latter alternative being improvised resources, consolidates science and real-world application as students use the materials present in everyday life to investigating scientific phenomena. Based on this study's findings, the following recommendations must be taken into account:

1. *Science teaching and learning should be practical and science process skills should be employed to facilitate a student-centered approach to learning. Educators should utilise improvised materials as students will grasp science concepts about their local environment.*
2. *Pedagogical development is needed to teach using improvised resources effectively. Workshops on improvised teaching and learning should be conducted to improve competence in this area.*
3. *Policymakers need to be cognisant of the need for science as a school subject. The provision of science materials should be accommodated as they are stipulated in the CAPS document.*

Limitations were experienced in this study. Since this was a low-risk study, the researcher had no interaction with learners or observance of the lesson delivery. Therefore, insight into the educator's ability to improvise could not be investigated. This element is imperative as it determines the success or failure of the research. Pedagogical content knowledge is a divergent construct as it differs between educators and their experience in the field. Additionally, the Covid 19 pandemic made access difficult since learners used a rotational timetable. Reports on lost teaching time and syllabus completion contributed to the limitation of this study.

Recommendations for future research should investigate educators' ability to improvise in the Life Science classroom. In addition, the scope should be widened to include a number of schools, in other words, increasing the sample size to yield meaningful results.

Acknowledgement

All authors have read and agreed to the published version of the manuscript.
Author Contributions: Conceptualization, Dr Dhurumraj & Z Moola; methodology, Dr Dhururmaj and Z Moola.; formal analysis, Dr Dhurumraj and Z Moola; investigation, Z Moola; resources, Dr Dhurumraj; writing—original draft preparation, Dr Dhururmaj and Z Moola; writing—Dr Dhurumraj and Z Moola.
Informed Consent Statement: Informed consent was obtained from all subjects involved in the study.
Data Availability Statement: The data presented in this study are available on request from the corresponding author. The data are not publicly available due to restrictions.
Conflicts of Interest: The authors declare no conflict of interest.

References

Abdullahi, S. A., Ibrahim, A., & Ibrahim, S, A. (2019). Improvisation in teaching and learning biology in senior secondary schools: Prospects and challenges. *International Journal of Scientific Research in Multidisciplinary Studies,* 5(1), 33-36.

Lawrence, A., & Muftawu, H. Teachers'attıtudes toward ımprovısatıon of ınstructıonal materıals for teachıng and learnıng chemıstry. *Journal of Science, Technology, Mathematics, and Education (JOSMED)*, 15(3), 135-143.

Amos, S., Eghan, M. P. K., & Oppong, E. (2022). The Impact of Instructional Materials in Teaching and Learning of Biology in the Colleges of Education in the Central Region of Ghana. *Open Journal of Educational Research*, 213-221. https://doi.org/10.31586/ojer.2022.400

Osei-Himah, V., Parker, J., & Asare, I. (2018). The Effects of Improvised Materials on the Study of Science in Basic Schools in Aowin Municipality-Ghana. *Research on humanities and social sciences*, 8, 20-23. https://core.ac.uk/reader/234676290

Olumorin, C. O., Babalola, E. O., & Ayoola, D. A. (2022). Design and development of human excretory system model to teach a biology concept in Ilorin, Nigeria. *Indonesian Journal of Teaching in Science*, 2(2), 107-116. http://dx.doi.org/10.17509/

Azumah, D., A. (2020). Using simple improvised materials to explain some concepts in science. *International Journal of Novel Research in Education and Learning*, 7(1), 1-4. https://www.noveltyjournals.com/

Baker, C. (2017). Quantitative research designs: Experimental, quasi-experimental, and descriptive. *Evidence-based practice: An integrative approach to research, administration, and practice*, 155-183. http://samples.jblearning.com/

Eyisi, D. (2016). The usefulness of qualitative and quantitative approaches and methods in researching problem-solving ability in science education curriculum. *Journal of education and practice*, 7(15), 91-100. https://eric.ed.gov/

Ezechi, N. G. (2019). Effect of improvised instructional materials on senior secondary school students achievement in biology in enugu south local government area of enugu state, Nigeria. *International Journal of Engineering, Science and Mathematics*, 8(3), 53-61. https://www.indianjournals.com/

Hauwa, A., & Hauwa, D. U. (2018). Effect of real and improvised materials on retention and performance of female student in secondary school's basic science in Kaduna Metropolis, Kaduna State Nigeria. *Knowledge Review,* 37(1), 130-137.

Mabasa, T., & Singh, S. (2020). Decolonising continuing teacher professional development in the teaching of physical science through improvisation in rural areas. *South African Journal of Higher Education*, 34(3), 146-163. https://hdl.handle.net/10520/ejc-high-v34-n3-a9

Mahlatse, R., & Ramaila, S. (2020). Factors influencing teachers' inclination to use improvised resources in Life sciences classrooms. In Carmo, M, (Ed), *Education and New Developments.* 12-15. Lisboa: inScience Press. http://dx.doi.org/10.36315/2020end003

Ramnarain, U., & Mamutse, K. (2016). The use of improvised resources in inquiry-based teaching in South Africa. *Part 17 Strand 17 Science in the secondary school*, 2795. https://d1wqtxts1xzle7.cloudfront.net/

Mboto, F. A., Ndem, N. U., & Stephen, U. (2011). Effects of improvised materials on students' achievement and retention of the concept of radioactivity. *African Research Review*, 5(1), 342-353.

Ndihokubwayo, K., Uwamahoro, J., & Ndayambaje, I. (2018). Use of improvised experiment materials to improve Teacher Training College students' achievements in Physics, Rwanda. *African Journal of Educational Studies in Mathematics and Sciences*, 14, 71-84. https://www.ajol.info/

Ndihokubwayo, K., Uwamahoro, J., & Ndayambaje, I. (2019). An assessment of the impact of improvised versus conventional laboratory equipment on students' performance in thermal expansion. *African Journal of Educational Studies in Mathematics and Sciences*, 15(1), 135-140. https://dx.doi/10.4314/ajesms.v15i1.11

Okori, O. A., & Jerry, O. (2017). Improvisation and utilization of resources in the teaching and learning of science and mathematics in secondary schools in Cross River state. *Global Journal of Educational Research*, 16(1), 21-28. https://doi.org/10.4314/gjedr.v16i1.4

Olatunde-Aiyedun, T. G., Olamoyegun, S. O., & Ogunode, N. J. (2022). Assessment of Science Resources in Higher Education. *Olatunde-Aiyedun, TG, Olamoyegun, SO & Ogunode, NJ (2022). Assessment of Science Resources in Higher Education. Central Asian Journal of Theoretical & Applied Sciences*, 3(7), 186-197. *https://cajotas.centralasianstudies.org/index.php/CAJOTAS*

Ong'amo, B. L., Ondigi, S. R., & Omariba, A. (2017). Effect of utilization of biology teaching and learning resources on students' academic performance in secondary schools in Siaya District-Kenya. *International Journal of Education Research*, 5(1), 253-272. http://repository.mut.ac.ke:8080/

Ramaila, S., & Ramthwala, M. (2020). Factors influencing teachers' inclination to use improvised resources in life sciences classrooms. *Education and New Developments 2020*, 12-15. https://dx.doi/10.36315/2020end003

Zondi, S., & Ramaila, S. (2020). Pedagogical practices adopted by teachers when using improvised resources in Life Sciences classrooms. *Education and New Developments*, 105. https://www.researchgate.net/

Ramaila, S. (2022). The use of improvised resources in science classrooms in South African township schools. *Education and New developments*, 367-370.

Rogers, J., & Revesz, A. (2020). Experimental and quasi-experimental designs. Routledge.

Usman, N., & Saminu, I. (2017). Effect of Improvisation of instructional materials on learning biology concepts by secondary school students in charanchi local government area of Katsina State. *Gombe Technical Education Journal*, 10(1).

Thompson, C. (1999). If you could just provide me with a sample: examining sampling in qualitative and quantitative research papers. *Evidence-Based Nursing*, 2(3), 68-70. http://dx.doi.org/10.1136/ebn.2.3.68

Stephen, U. A. S. (2015). Problems of improvising instructional materials for the teaching and learning of physics in akwa ibom state secondary schools: Nigeria. *British journal of Education*, 3(3), 27-35. https://www.researchgate.net/

Publisher's Note: SSBFNET stays neutral with regard to jurisdictional claims in published maps and institutional affiliations.