

THE AFFORDANCES OF IMPROVISED RESOURCES IN PHYSICAL SCIENCES CLASSROOMS

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Abstract

The development of meaningful conceptual understanding in science teaching and learning is a key ingredient required for the development of scientifically literate citizenry. The use of improvised resources to demystify the complexity of scientific phenomena is of crucial significance. In recognition of this crucial imperative, the study explored the pedagogical affordances associated with the use of improvised resources in Physical Sciences classrooms at a selected South African township school. The study adopted a case study design located within the interpretive research paradigm. Data was collected through semi-structured interviews and lesson observations involving three purposively selected Physical Sciences teachers. The study demonstrated that the use of improvised resources promotes active learner participation, sustained intellectual engagement in the teaching and learning activity, enhancement of teachers' pedagogical content knowledge, development of learners' reflective and cognitive skills as well as the provision of meaningful opportunities for collaborative learning and development of meaningful conceptual understanding. Key findings of the study have profound implications for pedagogic innovation within the broader South African educational context.

Keywords: *Improvisation, low-cost resources, pedagogic innovation.*

1. Introduction

The significance of pedagogic innovation as a means to enhance meaningful science teaching and learning cannot be over-emphasized. A substantial number of schools in South Africa are still under-resourced and this predicament adversely affects the provision of quality education for all. The use of improvised instructional resources can be adopted as part of pedagogic innovation to demystify abstract scientific concepts. Teacher professional development interventions ought to provide sustainable opportunities for teachers to enhance their expertise on the integration of improvised instructional resources in science teaching and learning. There is a critical need to grapple with the complex disjuncture between theoretical teaching and practical teaching with a view to meaningfully implement contemporary pedagogic approaches such as inquiry-based learning. Ong'amo, Ondigi and Omariba (2017) posit that students frequently taught using improvised resources performed better than those rarely taught using improvised resources. Yet, teachers lack appropriate skills to use improvised teaching resources in schools (Akuma & Callaghan, 2016). This study primarily explored the pedagogical affordances of improvised resources in physical sciences classrooms in South African township schools.

2. Research design and methodology

The study adopted a case study design located within the interpretive research paradigm. Data was collected through semi-structured interviews and lesson observations involving three purposively selected Physical Sciences teachers in South African township schools. These township schools were largely under-resourced.

3. Findings

Table 1 below provides teachers' views on the pedagogical affordances of improvised resources in physical science classrooms. While the teachers expressed fundamental appreciation of the pedagogical affordances of improvised resources in physical sciences teaching and learning, they further outlined challenges associated with the integration of improvised resources in their lessons. The prevalence of these challenges may be attributed to lack of appropriate professional training on the integration of improvised resources in physical sciences teaching and learning.

Table 1. Teachers' views on the affordances of improvised resources in physical sciences classrooms.

Teachers	Key areas of investigation						
	Improved resources and the challenges	Using improvised resources in classroom	How to develop lessons based on improvised resources	Can improvised resources improve pedagogical content Knowledge?	How can improvised resources stimulate learner engagement?	How can improvised resources be used to enhance learner conceptual understanding?	Assessment of cognitive skills after using improvised resources in practical lessons
Teacher 1	Challenge is cost-free teaching resources may not be user-friendly	By doing experiments with improvised resources	By diversifying improvised resources	Yes as improvised resources broaden content of subject	Interest of learners is stimulated	Learners can relate to importance of resources used	Summative assessment
Teacher 2	They don't resemble real life scenario	Make models to resemble real life scenario and demonstrations	Outcomes must match models Align objectives with lesson plan	Yes, can help interpret situations and improve communication	By discussions Visuals participation	Different interpretations of each situation	Group Work
Teacher 3	Specifications may not be met precision may be missed	Use material dyes	Titration lessons based on natural dyes	Yes, but one may find self stranded without standard equipment	Excites learners, Standard equipment make learners feel subject is hard	Enhances its applicability in their daily lives	Comparisons have to be done with standard equipment

3.1. Examples of improvised resources designed by the teachers

The teachers demonstrated remarkable creativity in relation to the design of improvised resources used in physical sciences teaching and learning. Examples of improvised resources designed to demonstrate filtration as a key experimental mechanism are illustrated in Figure 1 below.

Figure 1. Improvised resources designed to demonstrate filtration.



Electric motors play an increasingly important role in everyday life. Figure 2 below depicts improvised resources that were designed to explain the operation of a direct current motor.

Figure 2. Improvised resources designed to explain the operation of a direct current motor.



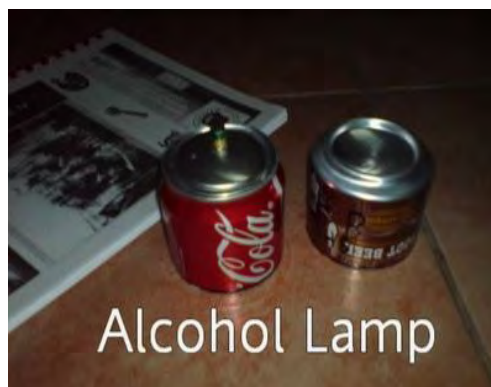
The development of learners' understanding of electromagnetic phenomena can be a daunting task for teachers. An improvised resource designed to explain the mapping of a magnetic field is illustrated in Figure 3 below.

Figure 3. Improvised resource designed to explain the mapping of a magnetic field.



Electrolysis is a fundamental chemical phenomena that ought to be fully understood by learners in physical sciences classrooms. An improvised resource designed to demystify the complexity of electrolysis is depicted in Figure 4 below.

Figure 4. Improvised resource designed to demystify the complexity of electrolysis.



4. Discussion

The study demonstrated that the use of improvised resources promotes active learner participation, sustained intellectual engagement in the teaching and learning activity, enhancement of teachers' pedagogical content knowledge, development of learners' reflective and cognitive skills as well as the provision of meaningful opportunities for collaborative learning and development of meaningful conceptual understanding. The teachers expressed fundamental appreciation of the pedagogical affordances of improvised resources in physical sciences teaching and learning. However, they outlined challenges associated with the integration of improvised resources in their lessons. The prevalence of these challenges may be attributed to lack of appropriate professional training on the integration of improvised resources in physical sciences teaching and learning. Behrendt and Franklin (2014) posit that improvised resources enhance science learning and development of meaningful conceptual understanding. In addition, improvised resources help teachers deliver information more accurately especially in instances where repetitions are required for concrete learning to occur (Ong'amo, Ondigi & Omariba, 2017). However, many science teachers are not equipped with skills to incorporate new ideas in the teaching of science in the classroom (Silverstein, Dubner, Glied & Loike, 2009). Harnessing the pedagogical affordances of improvised resources requires the provision of sustainable teacher development opportunities on the integration of improvised resources in science lessons. The key advantage of using improvised resources is that they can be produced from readily available materials within the environment (Asare, Parker & Osei-Himah, 2018). According to Asare, Parker and Osei-Himah (2018), the whole purpose of using improvised teaching resources is to achieve the same desired outcomes that could be achieved with the traditional laboratory resources. The key goal is essentially to get learners actively engaged in science teaching and learning in order to acquire necessary scientific skills through involvement in hands-on learning activities. Improvised resources are often produced to address learning difficulties (Akuma & Callaghan, 2016). The use of improvised resources has profound implications for the enhancement of the overall quality of science education and human capital development within the broader South African context.

5. Conclusion

The use of improvised instructional resources appears to promote active learner participation, sustained intellectual engagement in the teaching and learning activity, enhancement of teachers' pedagogical content knowledge, development of learners' reflective and cognitive skills as well as the provision of meaningful opportunities for collaborative learning and development of meaningful conceptual understanding. There is a critical need to harness the pedagogical affordances of improvised resources to foster pedagogical innovation that is responsive to the critical needs of learners.

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