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HARNESSING PEDAGOGICAL AFFORDANCES OF ONLINE TOOLS TO ENHANCE GRADE 11 PHYSICAL SCIENCES LEARNERS' CONCEPTUAL UNDERSTANDING OF ELECTROMAGNETISM

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Abstract

This study explored the utilization of online tools to enhance grade 11 Physical Sciences learners' conceptual understanding of Electromagnetism. The empirical investigation adopted a quasi-experimental design and involved purposively selected grade 11 Physical Sciences learners as participants. Quantitative data was collected through the administration of a questionnaire. The questionnaire was administered as a pre-test and post-test with a view to evaluate the efficacy of the utilization of online tools as an instructional intervention. Findings emanating from the study demonstrated that the utilization of online tools served to enhance grade 11 Physical Sciences learners' conceptual understanding of Electromagnetism as a key knowledge area. There is a crucial need for teachers to fully embrace pedagogic innovation to improve learner outcomes in Physical Sciences teaching and learning. Theoretical implications for pedagogic innovation are discussed.

Keywords: *Conceptual understanding, affordances, Physical Sciences, pedagogic innovation.*

1. Introduction

Physical Sciences is perceived to be a difficult subject by most learners. One of the Physical Sciences topics that learners find difficult is Electromagnetism (Raduta, 2005). Various research studies revealed that learners have misconceptions associated with Electromagnetism (Raduta, 2005; Bozzi et al., 2019). Online tools can be used to enhance learners' understanding of Electromagnetism. There are several online tools for teaching and learning such as simulations and game-based applications. The utilization of information and communication technology (ICT) has grown in popularity in education by virtue of its capability to provide dynamic and innovative teaching and learning environments. Teachers are required to integrate ICT in their teaching with a view to supersede traditional methods with modern tools and facilities (Ertmer, 1999). ICT refers to the hardware, software, networks and media for the collection, storage, processing, transmission and presentation of information as well as related services (Evoh, 2007). According to Perron et al (2010), information and communication technologies are described as technologies used to convey, manipulate and store data by electronic means. These technologies include electronic mail (e-mail), short message service (SMS), video chat, online social media (e.g., Facebook, Mix-it) as well as different computing devices (e.g., laptops, desktops and smart phones) that carry out a wide range of communication and information functions. All these electronic tools constitute ICTs and are used to convey, manipulate and store information (Perron, *et. al*., 2010).

2. Purpose of the study

The study examined pedagogical affordances of online tools as a means to enhance grade 11 physical sciences learners' conceptual understanding of electromagnetism. The empirical investigation was underpinned by the following concomitant objectives.

- To explore the effect of the utilization of online tools on grade 11 physical sciences learners' conceptual understanding of Electromagnetism.
- To identify grade 11 physical sciences learners' misconceptions associated with Electromagnetism.

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3. Research design and methodology

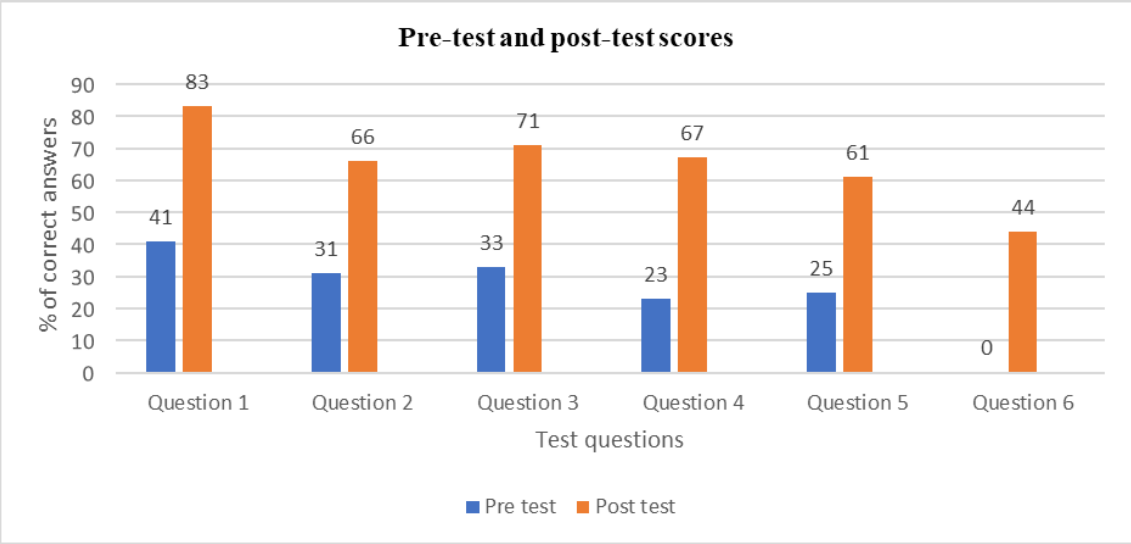
The empirical investigation adopted a quasi-experimental design and involved purposively selected grade 11 Physical Sciences learners as participants. Quantitative data was collected through the administration of a questionnaire. The questionnaire was administered as a pre-test and post-test with a view to evaluate the efficacy of the utilization of online tools as an instructional intervention.

4. Research findings

4.1. Findings emanating from the administration of the Electromagnetism Test

Figure 1 below shows pre-test and post-test scores emanating from the administration of the Electromagnetism Test.

Figure 1. Pre-test and post-test scores.

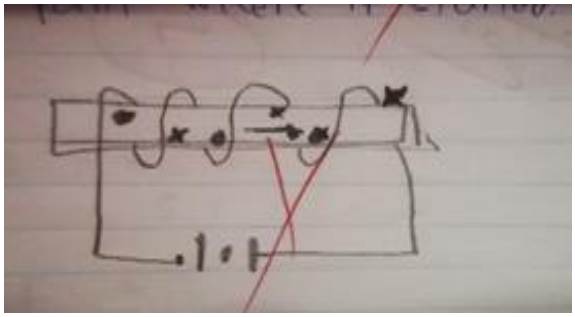


The findings indicate that learner academic performance improved significantly as a result of utilization of online tools. This implies that pedagogical affordances of online tools ought to be harnessed as part of pedagogic innovation to enhance learner academic performance in Physical Sciences teaching and learning.

4.2. Learners' misconceptions associated with Electromagnetism

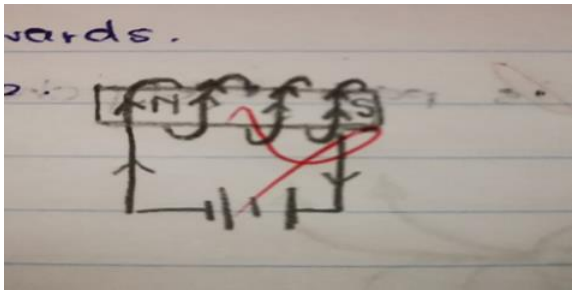
The learners exhibited misconceptions about the direction of the magnetic field around the current-carrying conductor. The prevalence of misconceptions about the direction of the magnetic field around the current-carrying conductor is depicted in Figure 2 below.

Figure 2. Prevalence of misconceptions about the direction of the magnetic field around the current-carrying conductor.

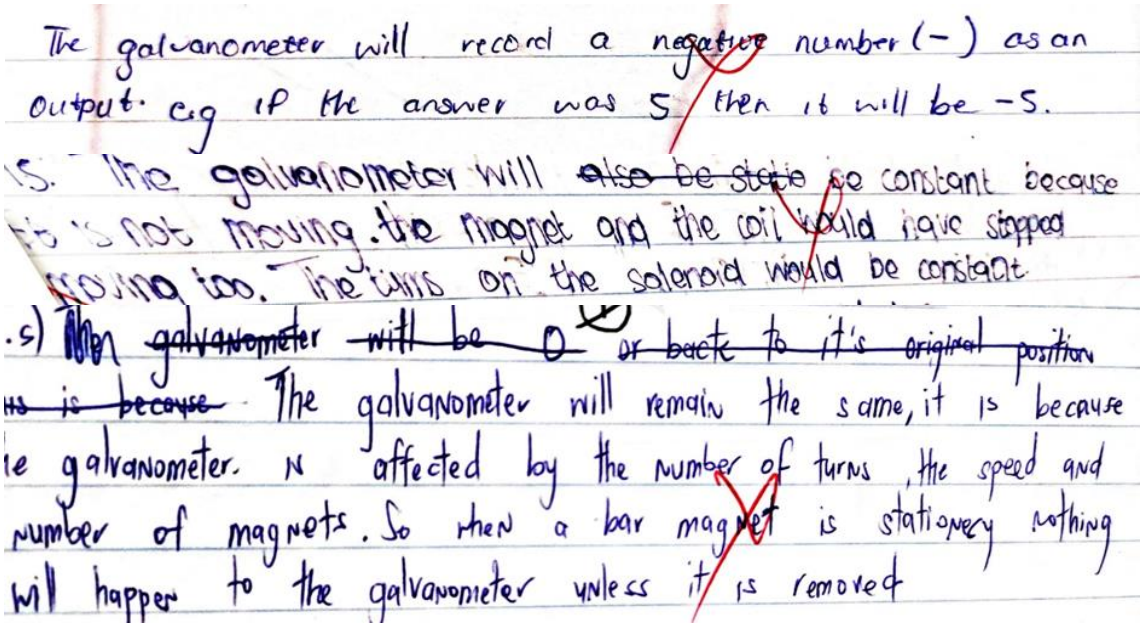


The learners confused the direction of electric current and the direction of the magnetic field as illustrated in Figure 3 below.

Figure 3. Prevalence of misconceptions about the direction of electric current and the direction of the magnetic field.



The learners demonstrated inadequate understanding of the effect of movement of the magnet on galvanometer reading. The inadequate understanding is reflected in the following excerpts.



5. Discussion

Learner academic performance improved significantly as a result of utilization of online tools. This implies that pedagogical affordances of online tools ought to be harnessed as part of pedagogic innovation to enhance learner academic performance in Physical Sciences teaching and learning. However, the method used by the teacher to teach electromagnetism is another important factor to consider. If the usual conventional method of teaching is used in science classes, students are likely to memorize concepts without meaningful conceptual understanding (Akinsola, 1994; Ireogbu, 1998; Ukoh, 2012). Physics education goals cannot be achieved by conventional science teaching but that most Physics lectures generally are teacher-centered and theoretical (Rivard & Straw, 2000). It is imperative to develop a meaningful understanding of Electromagnetism as a key Physical Sciences topic. According to Guisasola et al. (2008), electromagnetic interactions play a very important role in explaining the natural world. Learners should have good understanding of electromagnetic concepts to harness advantages of electromagnetism through application of knowledge (Maloney et al., 2001). The learners exhibited misconceptions about the direction of the magnetic field around the current-carrying conductor. In addition, the learners confused the direction of electric current and the direction of the magnetic field. Furthermore, the learners demonstrated inadequate understanding of the effect of movement of the magnet on galvanometer reading. These findings are consistent with a study conducted by Thomas et al. (1995) which revealed that most students find electromagnetism to abstract and difficult.

6. Conclusion

The utilization of online tools is promising as a means to enhance learner academic performance in Physical Sciences teaching and learning. The development of scientific literacy hinges to a large degree on pedagogic innovation. There is a crucial need for teachers to fully embrace pedagogic innovation to improve learner outcomes in Physical Sciences teaching and learning in particular.

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