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TECHNOLOGY INTEGRATION IN GRADE 10 LIFE SCIENCES TEACHING AND LEARNING

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Abstract

This study explored the role of technology in grade 10 Life Sciences teaching and learning. The study adopted embedded mixed method design. The empirical investigation involved purposively selected grade 10 Life Sciences teachers and learners as participants. Quantitative data was collected through the administration of a questionnaire. Qualitative data was collected through classroom observations. The learners demonstrated significant improvement in academic performance as a result of technology integration in Life Sciences teaching and learning. This improvement underscores the need for coherent utilization of technological tools to be embraced as an effective means to enhance learner academic performance in science teaching and learning. The teachers employed various pedagogical strategies when integrating technology in Life Sciences teaching and learning. However, technology integration in Life Sciences teaching and learning posed instructional challenges to teachers. There is a crucial need to enhance teacher professional competence on technology integration in science teaching and learning. Theoretical implications for pedagogic innovation are discussed.

Keywords: *Life Sciences, technology integration, academic performance.*

1. Introduction

The use of information and communication technology (ICT) provides a myriad of pedagogic benefits in various instructional settings such as provision of meaningful opportunities for sharing of resources, promotion of collaborative learning and an inclination towards greater learner autonomy (Eze, Adu, & Ruramayi, 2013). According to Ciroma (2014), the use of ICT in education supports the development of 21st century skills such as collaboration, problem-solving, decision-making, critical thinking, creativity and innovation. The use of ICT cannot be confined to provision of access to computers and internet connection. In this regard, Mereku and Mereku (2015) contend that the use of ICT ought to be underpinned by pedagogically sound learning activities. Lack of knowledge to integrate ICT tools, availability of resources, affordability by learners and insufficient teacher training provisions stifle meaningful ICT integration in teaching and learning (Dhakal, 2018). In view of this key strategic imperative, this study explored the role of technology as a means to enhance learner academic performance in grade 10 Life Sciences teaching and learning.

2. Purpose of the study

This study explored the role of technology as a means to enhance learner academic performance in grade 10 Life Sciences teaching and learning. The empirical investigation was underpinned by the following concomitant objectives.

- To examine the effect of technology integration on the academic performance of grade 10 Life Sciences learners.
- To identify pedagogical practices adopted by teachers when integrating technology in grade 10 Life Sciences teaching and learning.

3. Research design and methodology

The study adopts embedded mixed method design. Embedded mixed method design enables researchers to embed qualitative research into a quantitative experiment to support the elements of experimental design (Creswell et al., 2009). In the quantitative dimension of the research, a quasi-experimental design was used. Quasi-experimental research is characterized by the manipulation of an independent variable (Gopalan, Rosinger, & Ahn, 2020). In quasi-experimental research designs, researchers seek to develop an acceptable hypothetical, or what would have occurred in the absence of the policy or intervention, to offer a baseline from which causal impacts can be calculated better to understand the causal effect of any policy or action (Gopalan, Rosinger & Ahn, 2020). Quasi-experimental research designs use non-experimental variation as the primary independent variables as interest, replicating experimental settings where specific individuals are randomly exposed to treatment while others are not (Gopalan, Rosinger & Ahn, 2020). The rationale for using a quasi-experimental research design is that it is less expensive and requires fewer resources compared with individual randomized controlled trials or cluster-randomized trials (Harris, et al., 2006). The empirical investigation involved 52 purposively selected participants (2 teachers and 50 learners) from South African township schools. Quantitative data was collected through the administration of a Life Sciences Test. The Life Sciences Test was administered as a pre-test and a post-test with the participants. Qualitative data was collected through classroom observations. Quantitative data was analysed using descriptive statistics while qualitative data was analysed using an observation checklist. The analysis of observational data was guided by the Technology Integration Panel (TIP) proposed by Li and Dawley (2019). TIP is a research-based classroom observation tool that serves to provide information to schools and researchers about the capacity of using technology to support learner-centred learning in the classroom. The Technology Integration Panel aims to recognize the complexity of teaching and learning with technology while providing a clear guidance that can support teachers in their professional practice. Unlike many one-dimensional rubrics that conflate technology access with learning or teaching, the general design of the framework accounts for variation in a classroom along three intersecting continua: (a) pedagogy (b) learning context, and (c) access to technology and usage of technology tools.

4. Findings

4.1. Findings emanating from the administration of a Life Sciences Test

Table 1 below shows pre-test and post-test scores emanating from the administration of a Life Sciences Test.

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

School A		School B	
Pre –Test Score	Post –Test Score	Pre-Test Score	Post-Test Score
60	70	72	92

The findings indicate that learner in School B demonstrated significant improvement in academic performance as a result of technology integration Life Sciences teaching and learning as compared to School A. This implies that pedagogical affordances of technology ought to be harnessed as part of pedagogic innovation to enhance learner academic performance in science teaching and learning.

4.2. Findings emanating from observational data

4.2.1. Lesson observation: Teacher A. Teacher A (Male) taught grade 10 Life Sciences at a township school and had 7 years of teaching experience. The teacher held a Bachelor of Education degree. The school was largely under-resourced. The topic of the lesson was Biodiversity. The teacher clearly outlined learning objectives pertaining to the topic under discussion. The teacher adopted a learner-centred teaching approach. Pedagogical strategies that were employed included collaborative learning, problem-based learning, observational learning and cooperative learning. While the learning tasks engaged learners in analysis, application and synthesis, the teaching provided limited opportunities for learners to build connections between knowledge. The learners were afforded opportunities to make choices in the learning process. However, the teacher appeared to be inadequately skilled as a facilitator to scaffold learning using digital resources. The physical space within the classroom was adequate. The classroom space design supported collaboration and observational learning. In addition, the learning space was flexible and adaptable. There were authentic teacher-learner and learner-learner interactions in the classroom. Technological devices used during the lesson were laptop, smart board and smart phones. As there was no computer laboratory at the school, the teacher was compelled to use his own laptop.

While the smart board was used during the lesson, not all the learners possessed smart phones which translated into a low technology-learner ratio. The teacher demonstrated inadequate level of proficiency when integrating technology in Life Sciences teaching and learning. This inadequate level of proficiency can be attributed to the teacher's inadequate technological pedagogical content knowledge.

4.2.2. Lesson observation: Teacher B. Teacher C (Female) taught grade 10 Life Sciences at a township school and had 9 years of teaching experience. The teacher held a Bachelor of Science degree and a Higher Education Diploma. The school was relatively well-resourced. The topic of the lesson was Biodiversity. The teacher clearly outlined learning objectives pertaining to the topic under discussion. The teacher adopted a learner-centred teaching approach. Pedagogical strategies that were employed included collaborative learning, problem-based learning, observational learning, cooperative learning, inquiry-based learning, project-based learning and self-directed learning. The learning tasks engaged learners in analysis, application and synthesis and the teaching provided meaningful opportunities for learners to build connections between knowledge. The learners were afforded opportunities to make choices in the learning process and the teacher was adequately skilled as a facilitator to scaffold learning using digital resources. The physical space within the classroom was adequate. The classroom space design supported collaboration and observational learning. In addition, the learning space was flexible and adaptable. There were authentic teacher-learner and learner-learner interactions in the classroom. Technological devices used during the lesson were laptops, smart board, tablets, smart phones, and interactive applications such as Kahoot. Access to technological devices was not a major problem as the school had a well-resourced computer laboratory. The availability of technological devices translated into a high technology-learner ratio. The teacher demonstrated a high level of proficiency when integrating technology in Life Sciences teaching and learning. This high level of proficiency can be attributed to the teacher's adequate technological pedagogical content knowledge. The teacher also demonstrated professional competence in the implementation of contemporary teaching approaches such as inquiry-based learning whose uptake is generally lower in rural and township schools within the broader South African context. Technical support was provided to the teacher when integrating technology in Life Sciences teaching and learning. The school environment was WIFI active and internet connectivity was not a major issue.

5. Discussion

Learner academic performance improved significantly as a result of technology integration in Life Science teaching and learning. This implies that pedagogical affordances of technology ought to be harnessed as part of pedagogic innovation to enhance learner academic performance in science teaching and learning. However, one of the teachers observed appeared to be inadequately skilled as a facilitator to scaffold learning using digital resources. Various studies have demonstrated that few teachers can effectively use ICT in the classroom (Nkula & Krauss, 2014; Padayachee, 2016). A study conducted by Tamim et al. (2015) identified prevailing misconceptions associated with the use of ICT in various educational settings. Meaningful ICT integration in the classroom is hampered by a myriad of factors. These factors include lack of time (Assan & Thomas, 2012), lack of clarity regarding the e-Education Policy (Vandeyar, 2015), lack of support both in terms of infrastructure and policy (Vandeyar, 2015), lack of skills (Msila, 2015) and more focus on the technical aspects as opposed to the pedagogical and theoretical frameworks (Tamim et al., 2015). Technology-enhanced learning has not advanced at the expected pace in South Africa (Department of Basic Education, 2015). According to Mooketsi and Chigona (2014), the slow pace of technology-enhanced learning advancement can partly be attributed to the disparity between government expectations and teachers' practices.

The other teacher was adequately skilled as a facilitator to scaffold learning using digital resources. The teacher demonstrated a high level of proficiency when integrating technology in Life Sciences teaching and learning. This high level of proficiency can be attributed to the teacher's adequate technological pedagogical content knowledge. The teacher also demonstrated professional competence in the implementation of contemporary teaching approaches such as inquiry-based learning whose uptake is generally lower in rural and township schools. Meaningful understanding of ICT integration can serve as a panacea to bridge the gap between theory and practice. Padayachee (2016) found that the development of an appropriate guideline for the professional development of teachers with respect to the pedagogical use of ICT can be an extremely difficult and complex undertaking. In recognition of this dilemma, du Plessis and Webb (2012) posit that current stipulated guidelines for the professional development of mathematics teachers provide inadequate information on how teachers and schools can practically integrate ICT in teaching and learning within the broader South African context.

6. Conclusion

Technology integration is promising as a means to enhance learner academic performance in science teaching and learning. However, technology integration in Life Sciences teaching and learning poses instructional challenges to teachers. There is a crucial need to enhance teacher professional competence on technology integration in science teaching and learning.

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