

TECHNOLOGY INTEGRATION IN NATURAL SCIENCES TEACHING AND LEARNING IN SOUTH AFRICAN TOWNSHIP SCHOOLS

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Abstract

This study examined technology integration in Natural Sciences teaching and learning in South African township schools. A mixed method approach was adopted as part of an exploratory descriptive survey design. Data was collected through semi-structured interviews, classroom observations as well as administration of open-ended survey questionnaire. The study involved purposively selected grade 9 Natural Sciences teachers and learners as participants. The empirical investigation is underpinned by technological pedagogical content knowledge (TPACK) as the underlying theoretical framework. The participants demonstrated a positive disposition about technology integration in Natural Sciences teaching and learning. In particular, technology integration was perceived to provide opportunities for the enhancement of meaningful Natural Sciences teaching and learning in township schools. Digital resources were largely viewed as essential educational tools that can be deployed to demystify abstract scientific concepts with a view to enhance scientific literacy. Theoretical implications for technology-enhanced teaching and learning are discussed.

Keywords: *Technology integration, TPACK, technology-enhanced learning, digital resources.*

1. Introduction

The advent of the Fourth Industrial Revolution provides meaningful opportunities for embracing pedagogic innovation as an integral part of digital transformation. However, there is a crucial need to bridge the digital divide between under-resourced and well-resourced schools within the broader South African context. Challenges stifling meaningful integration of technology in teaching and learning include poor literacy of educators (Johnson, Jacovina, Russell & Soto, 2016). Bozkurt (2014) posits that teachers do not have knowledge about technology and technological pedagogical content knowledge (TPACK) as a whole. Costley (2014) asserts that technology has become a common tool that most people use in their households and schools. Technology integration has the potential to transform teacher-centred environments into learner-centred environments. Learner-centred environments provide opportunities for learners to become more flexible and to take charge of their learning (Keser, Uzunboyly & Ozdamli, 2012). In support of this notion, Miller (2011) posits that learners develop their technological abilities through sustained practice and involvement in teaching and learning.

2. Background

Meaningful information and communication technology (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). ICT integration in teaching and learning remains a key focus area across the globe. Many companies are investing in ICT infrastructure, equipment and professional development in order to improve teaching and learning in schools (Buabeng-Andoh, 2012). The current belief is that ICT is an important catalyst and tool for encouraging educational reforms that transform students into productive knowledge workers (Pelgrum, 2001). Technology is a powerful and flexible tool for learning as it has also become an important part of student lives' beyond and within the classroom (Rabah, 2015). In addition, Rabah (2015) further argues that the

primary goal of educational technology within a pedagogical context is to facilitate the teaching and learning process. There is a critical need to examine the complexity of barriers impeding ICT integration in teaching and learning with a view to foster pedagogic innovation within the broader South African context.

3. Research design and methodology

This study adopted a mixed method approach as part of exploratory descriptive survey design located within the interpretivist paradigm. Exploratory descriptive survey design makes provision for the determination and description of the situation and comparing how sub-groups view a certain issue (Gay, Mills, & Airasian, 2011). According to Burns and Bush (2006), exploratory research design provides opportunities for gathering information in an informal and unstructured manner. Exploratory research helps a researcher to build understanding about the problem of the research. In addition, exploratory research design is not limited to one specific paradigm as it may use either qualitative or quantitative approaches. Data was collected through semi-structured interviews, classroom observations as well as administration of open-ended survey questionnaire. The study involved purposively selected grade 9 Natural Sciences teachers and learners as participants.

4. Research findings

Table 1 below provides participants' level of proficiency associated with various competencies. While the participants demonstrated moderate levels of proficiency in relation to various competencies, they demonstrated a positive disposition about technology integration in Natural Sciences teaching and learning. In particular, technology integration was perceived to provide opportunities for the enhancement of meaningful Natural Sciences teaching and learning in township schools. Digital resources were largely viewed as essential educational tools that can be deployed to demystify abstract scientific concepts with a view to enhance scientific literacy.

Table 1. Participants' level of proficiency associated with various competencies.

Competency	Level of proficiency
Learning how to use a new application	Moderate
Acting as a guide to learners when teaching using the internet	Satisfactory
Troubleshooting problems that occur when using technology	Moderate
Using technology to differentiate technology	Moderate

Table 2 below depicts participants' opinions about technology integration in Natural Sciences teaching and learning. While the participants expressed varied opinions about technology integration in Natural Sciences teaching and learning, they expressed fundamental appreciation of the key pedagogical affordances of technology integration. Access to technological resources remained a pervasive challenge for teachers and learners in township schools. Harnessing the affordances of technology integration requires provision of adequate resources. In addition, there is a need to provide training for teachers on technology integration in order to strengthen their professional competence to fully embrace technology-enhanced teaching and learning.

Table 2. Participants' opinions about technology integration in Natural Sciences teaching and learning.

Statement	Strongly Agree	Agree	Disagree	Strongly Disagree
When using the internet...				
Learners create products that show higher levels of learning	15	28	10	7
Learners are more motivated	25	20	10	5
There is more student collaboration	20	15	15	10
The abundance of unreliable sources is disturbing	2	58	0	0
I think...				
Electronic media will replace printed text within five years	10	20	20	10
Learners are more knowledgeable than I am when it comes to technology	10	50	0	0
Technology is a good tool for collaboration with other teachers when building unit plans	2	58	0	0
Technology is unreliable	15	35	5	5

5. Discussion

While the participants expressed positive disposition about technology integration in Natural Sciences teaching and learning, access to essential resources remained a pervasive challenge. The participants demonstrated moderate levels of proficiency in relation to various competencies. Teachers are often overwhelmed by heavy teaching loads which do not make provision for training opportunities (Sabaliauskas, Ghavifekr *et al.*, 2016). According to Laabidi and Laabidi (2016), there is a critical need to enhance professional competence of teachers through skills training to ensure that learners are adequately prepared for a technological society. Teachers who have little or no confidence to apply technologies in their occupation will try to escape from those occupations altogether (Laabidi & Laabidi, 2016). The teachers acknowledged the fact that learners were more knowledgeable than them when it comes to technology use. Technology was perceived to be a good tool for collaboration with other teachers when building unit plans. However, the teachers bemoaned the fact that technology can often be unreliable. There is a crucial need to enhance teachers' technological pedagogical content knowledge with a view to foster meaningful ICT integration in teaching and learning (Cox *et al.*, 1999).

6. Conclusion

Technology integration can serve as an innovative catalyst to foster pedagogic innovation in Natural Sciences teaching and learning in township schools. There is a crucial need to enhance teacher professional competence on technology integration with a view to enable them to fully embrace digital transformation.

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