PROMOTING SELF-REGULATED LEARNING IN NATURAL SCIENCES TEACHING THROUGH TECHNOLOGY INTEGRATION

Sam Ramaila

Department of Science and Technology Education, University of Johannesburg (South Africa)

Abstract

The advent of the Fourth Industrial Revolution presents enormous opportunities for teachers to embrace digital transformation. The adoption of innovative pedagogical strategies is central to coherent development of scientific literacy in science classrooms. Coherent development of scientific literacy in science classrooms requires teachers as key agents of educational change to embrace pedagogic innovation. This study examined the role of technology integration as a sustainable means to promote self-regulated learning in Natural Sciences teaching in South African township schools. The study adopted a mixed-method approach as part of exploratory descriptive survey design and involved purposively selected teachers from South African township schools as participants. Quantitative data was collected through the administration of a survey questionnaire with the participants while qualitative data was collected through semi-structured interviews and classroom observations. Key findings demonstrated that technology integration plays a pivotal role in the promotion of self-regulated learning in Natural Sciences teaching. Theoretical implications for technology-enhanced learning are discussed.

Keywords: Self-regulated learning, natural sciences, technology integration.

1. Introduction

The prevalence of COVID-19 pandemic provided opportunities for self-regulated learning. The transition to remote teaching and learning underscored the need for self-directed learning to be embraced for purposes of realizing stipulated learning outcomes. Remote teaching and learning is largely predicated on technology integration. Synchronous and asynchronous delivery of virtual lessons requires coherent integration of technological applications. Self-regulated learning refers to a person's ability to understand learning environment and to have strategies to control this environment as a means to achieve one's goals (Zimmerman & Schunk, 2001). According to Park (2018), self-regulated learning encapsulates the ability to set academic goals and monitor progress to achieve these goals. Bandura (1986) further states that achievement of these goals requires selection and coherent implementation of pedagogical strategies. While research on self-regulated learning grew exponentially over the years, there is paucity of research studies focusing on how technological tools can be integrated to foster self-regulatory behaviour in science education (White & DiBenedetto, 2018). This study explored technology integration as a means to promote self-regulated learning in Natural Sciences teaching in South African township schools.

2. Background

By its very nature, the constantly evolving educational environment presents opportunities to embrace digital transformation. As key agents of educational change, teachers are required to carefully examine the pedagogic value of technology integration in teaching and learning. Firmin and Genesi (2013) posit that the proper use of technology results in true learning as a result of the enhancement and transformation of classrooms into smart learning environments. Smart learning environments create resourceful and student-centred learning opportunities that make learning more contextualised, social, reflective and active (Firmin & Genesi, 2013). Teachers play a central role in the integration of technology in the classroom. According to Chen et al. (2009), there has to be coherence among factors that affect the integration of technology in teaching and learning. These factors include teacher beliefs, knowledge and goals. Beliefs influence how teachers select and prioritize the goals of learning. In addition, beliefs influence teachers' perceptions of classroom interactions and their decisions about tools to be used in the process of learning. At another pragmatic level, access to technology determines whether teachers will employ technology in their classrooms or not (Farjon et al., 2019). According to Abdu

(2018), teachers are mainly responsible for the adaptation and implementation of information and communication technologies (ICT) in the classrooms and if they cannot access these technologies due to poor infrastructure or lack of finances, they cannot create smart environments. Another challenge facing teachers in the educational quest for technology integration is lack of ICT competence (De Vera et al., 2021). Teachers without technological knowledge find it increasingly challenging to address technological problems during teaching and learning. ICT competence is important as it allows teachers to devise and be creative enough in implementing technologies that are specific to their learning environments. Successful implementation of technology integration in the classrooms requires availability of digital tools in schools (Atabek, 2020).

3. Purpose of the study

The study explored the role of technology integration as a means to promote self-regulated learning in Natural Sciences teaching in South African township schools. The empirical investigation was underpinned by the following concomitant objectives.
- To identify technological tools used by teachers in Natural Sciences teaching.
- To explore the role of technology integration as a means to promote self-regulated learning in Natural Sciences teaching.

4. Research design and methodology

The study adopted a mixed-method approach as part of exploratory descriptive survey design. Exploratory descriptive survey design makes it possible for the researcher to gain new insights into a phenomenon (Saunders et al, 2012). The empirical investigation involved 63 purposively selected participants (3 teachers and 60 learners) from South African township schools. Quantitative data was collected through the administration of a survey questionnaire administered as a pre-test and a post-test with the participants. Qualitative data was collected through semi-structured interviews and classroom observations. Quantitative data was analysed using descriptive statistics while qualitative data was thematically analysed.

5. Research findings

Table 1 below provides technological applications used by teachers in Natural Sciences teaching coupled with the description of each technological application.

Table 1. Technological applications used by teachers in Natural Sciences teaching.

Technological application	Description of technological application
1. Ace your self-study	This tool provides personal support for learners by providing flexible and informative activities. This App also monitors progress and suggests different strategies which individuals may use to track and improve academic progress.
2. Self-mentor App	This is a personality development tool which helps individuals to improve by motivating them. Individuals get to collaborate and share ideas through this tool.
3. WhatsApp	This is a social platform which is easily accessible and helps learners communicate to help each other, share, debate and construct knowledge.
4. Study tips App	This tool provides different study tips for learners. These are tips which learners may use to attain academic goals.
5. Higher goals-goal setter and habit tracker	This tool helps individuals to set personal goals and brainstorm ways in which these goals may be achieved.
6. Progress tracker	This tool helps learners to track progress as a means to help them to achieve their goals.
7. Multi-notes handy, reminder notes	This tool is used as a diary where learners can write notes and to remind themselves of what they had planned to achieve.

Table 2 below provides results emanating from the questionnaire administered as a pre-test and a post-test with the participants. The results reflected a significant shift in the participants' disposition about technology integration as a means to promote self-regulated learning in Natural Sciences teaching. The post-test results showed that the participants demonstrated a largely positive disposition about the efficacy

of technology integration as an instructional intervention. In addition, the results underscore the need to embrace the use of various technological applications in science teaching with a view to foster pedagogic innovation. However, the advent of the Fourth Industrial Revolution critically exposed socio-economic disparities within the South African basic education system. Provision of technological resources is a key requirement for coherent integration of technology to promote self-regulated learning in science teaching.

Table 2. Pre-test and post-test results.

Item	Pre-test					Post-test				
	Strongly Agree	Agree	Uncertain	Disagree	Strongly Disagree	Strongly Agree	Agree	Uncertain	Disagree	Strongly Disagree
I keep track of my progress to attain my goal	0%	16%	30%	47%	7%	13%	87%	0%	0%	0%
I call in others for help when you need it	7%	33%	33%	20%	7%	0%	60%	20%	20%	0%
I am able to accomplish goals I set for myself.	0%	0%	13%	80%	7%	7%	10%	47%	20%	17%
I can study and learn on my own.	7%	3%	53%	17%	20%	3%	77%	17%	3%	0%
I have trouble following through with things once I've made up my mind to do something.	13%	40%	40%	17%	7%	0%	7%	47%	33%	13%
As soon as I see a problem or challenge, I start looking for possible solutions.	7%	13%	27%	43%	10%	0%	83%	17%	0%	0%
I have a hard time setting goals for myself.	10%	60%	20%	10%	0%	0%	0%	7%	77%	17%
I have trouble making plans to help me reach my goals	10%	53%	20%	17%	0%	10%	60%	17%	13%	0%
I set goals for myself and keep track of my progress.	10%	7%	43%	37%	3%	0%	50%	27%	23%	0%
I have rules that I stick by no matter what	10%	13%	10%	53%	13%	0%	10%	70%	20%	0%

Key findings emanating from qualitative data were clustered according to themes that emerged during data analysis, namely: efficacy of technology integration as a means to promote self-regulated learning in Natural Sciences teaching and teacher professional development needs on technological integration.

5.1. Theme 1: Efficacy of technology integration as a means to promote self-regulated learning in Natural Sciences teaching

The participants demonstrated a positive disposition about the efficacy of technology integration as a means to promote self-regulated learning in Natural Sciences teaching. They indicated that technology integration enables them to embrace pedagogic innovation. These sentiments are encapsulated in the following excerpt.

The use of various technological applications affords learners opportunities to monitor their own learning while actively engaging with the learning material. These applications enables teachers to be innovative.

5.2. Theme 2: Teacher professional development needs on technological integration

While the participants expressed fundamental appreciation of the pedagogical affordances of technology integration in Natural Sciences teaching, they bemoaned lack of sustainable professional development opportunities on the use of various technological applications. It is incumbent upon the Department of Basic Education to provide sustainable teacher professional development opportunities on technology integration. These sentiments are reflected in the following excerpt.

The use of technological applications is often problematic to us due to lack of adequate training. It will be appreciated if training opportunities on technology integration can be provided to professionally empower teachers.

6. Discussion

The participants demonstrated a positive disposition about technology integration as a means to promote self-regulated learning in Natural Sciences teaching. This implies that technology integration provides teachers and learners with opportunities to embrace digital transformation. The proper use of technology results in true learning as a result of the enhancement and transformation of classrooms into smart learning environments (Firmin & Genesi, 2013). Smart learning environments create resourceful and student-centred learning opportunities that make learning more contextualised, social, reflective and active (Firmin & Genesi, 2013). The participants indicated that technology integration enabled them to embrace pedagogic innovation. While the participants expressed fundamental appreciation of the pedagogical affordances of technology integration in Natural Sciences teaching, they bemoaned lack of sustainable professional development opportunities on the use of various technological applications. There is a critical need for careful identification of factors that serve as enablers and constraints of meaningful technology integration in science teaching. According to Chen et al. (2009), there has to be coherence among factors that affect the integration of technology in teaching and learning. Access to technology determines whether teachers will employ technology in their classrooms or not (Farjon et al., 2019). In addition, teachers are mainly responsible for the adaptation and implementation of information and communication technologies (ICT) in the classrooms and if they cannot access these technologies due to poor infrastructure or lack of finances, they cannot create smart learning environments (Abdu, 2018). Another challenge facing teachers in the educational quest for technology integration is lack of ICT competence (De Vera et al., 2021). Successful implementation of technology integration in the classrooms requires availability of digital tools in schools (Atabek, 2020).

7. Conclusion

Technology integration can serve as a catalyst for the promotion of self-regulated learning in science teaching. Teachers ought to be implored to embrace digital transformation with a view to foster pedagogic innovation in science classrooms. The advent of the Fourth Industrial Revolution presents enormous opportunities for harnessing pedagogical affordances of various technological applications.

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