EXPLORING THE INFORMING ASPECTS OF SCIENCE TEACHERS' ADOPTION OF DIGITAL TECHNOLOGY IN TEACHING SCIENCE IN MANZINI PRIMARY SCHOOLS OF ESWATINI

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Abstract
The adoption of digital technology into science education has become a global priority. This study explores the informing aspects of science teachers' adoption of digital technologies in teaching Science curriculum in Eswatini. The objective of this study was to determine the informing aspects of science teachers' adoption of digital technology in teaching Science curriculum in primary schools. The study was guided by the Unified theory of acceptance and use of technology (UTAUT). The study adopted an interpretivist research paradigm using the qualitative research approach where a multiple case study research design was utilised. Convenience sampling was used to select three primary schools and purposive sampling was used to select six (6) participants. The data was generated using two instruments: semi-structured interviews and document analysis. Furthermore, the study adopted a thematic as means of organising data for analysis. The findings of the study revealed that the Science were informed by personal, school and external factors to adopt digital technologies in their teaching practices. Based on the findings of the study, the researchers recommended that a peer mentoring program in the school's clusters so that teachers who are proficient with technology can assist others and that schools should ensure that physical infrastructure and resources are available for the teachers and learners to effectively adopt digital technology in the teaching and learning process.

Keywords: Adoption, Informing, Digital technology, Science

Introduction

The need to increase and improve learners' engagement, encourage inquiry-based learning, and cultivate 21st-century skills has made the integration and adoption of digital technology into science education a global priority (Chakosela, 2025). Particularly for primary school learners, digital technologies like interactive platforms, multimedia resources, and simulations provide chances to make difficult scientific concepts more tangible and approachable. As a result, a number of educational systems have implemented curriculum changes that motivate teachers to use digital technology into the teaching and learning process. But effective use of digital technology in the classroom is still difficult and unequal, especially where teachers deal with a variety of contextual and professional issues (Akaadom and Gorni, 2023). Adoption of digital technologies is influenced by a number of factors, such as teachers' pedagogical expertise, technological confidence, curriculum requirements, institutional support, and the larger school environment, rather than just having access to digital technologies **(**Yulin & Danso, 2025). It is crucial to comprehend these informative factors because they influence the instructional decisions made by teachers and the degree to which digital technology is effectively incorporated into science lessons.

Problem statement

In Eswatini, the primary Science curriculum, syllabus and the education policies support the use of digital technology to improve instruction in primary schools (Ministry of Education and Training, 2018). The use and adoption of digital technology in science instruction in primary schools is still uneven and restricted despite these documents' suggestions. Research shows that technology adoption is challenged by issues related to professional development and infrastructure (Mpofu, 2025; Mabuza & Thwala, 2025; Dludlu, 2020; & Nkambule et al, 2022). However, the majority of this study has concentrated on challenges, and preparedness, paying little attention to the information that influences and informs Science teachers' decisions in adopting digital technology in their teaching practices.

Thus, an exploration of the informing aspects influencing Science teachers' use of digital technology in science instruction in primary schools, is required.

Theoretical Framework

This study was guided by the Unified theory of acceptance and use of technology (UTAUT). The unified theory of acceptance and use of technology is a conceptual framework which was founded by Venkatesh, Davis, Davis and Morris (2003). This framework explores and understands individual intentions to use and accept the adoption of digital technologies. The conceptual framework of UTAUT proposes that the adoption and use of technology is determined by behavioural intentions. The likelihood of using and adopting technology is dependent on the direct effect of four key constructs. The four key constructs include: performance expectancy, effort expectancy, social influence, as well as facilitating conditions. The four constructs work together to explain and predict individuals' intentions in adopting and using technology in different contexts. Furthermore, UTAUT explains sociodemographic factors such as gender, age, and experience which have a moderating effect on how people use and adopts digital technology. These modifiers assisted the researchers in determining the degree to which it influences the adoption and application of digital technology in the teaching and learning process.

Literature review

Literature has shown that there are factors that influence the adoption of digital technology in the classroom. For instance, Ouma and Monda (2024) and Medwin et al. (2025), in their studies revealed that schools especially those in the rural areas are facing challenges that includes limited infrastructure, inadequate access to digital tools, and lack of training. These factors negatively influence the adoption of digital technologies. On the same note, Nnadozie and Govender (2024) explored the integration of digital technologies in the teaching and learning process. The study showed that learners have embraced technology in their learning while teachers have limited knowledge and confidence on integrating technology in their teaching practices. These studies shows that challenges teachers face when adopting digital technologies shape and influence whether teachers adopt technology in their teaching practices or not.

Teachers' attitudes and belief systems plays a significant role in adopting technology in their teaching practices (Laius & Orgusaar, 2025). Studies show that a positive attitude among teachers increases the likelihood of adopting digital technology in teaching. For example, Cukurova, Miao, and Brooker (2023), mentioned that teachers attitude informs the adoption of technology. A positive attitude results in embracing technology in teaching. Viberg, Khalil, Gaved, Hatakka, Bower, Al-Shehri, and Zhang (2023) demonstrated that cultural values influence and inform teachers' adoption of digital technologies.

Beyond teachers' attitudes, beliefs and knowledge about technology, schools' support and readiness also plays an important role in the adoption of digital technologies in teaching. Institutions that prioritise technology integration and provide assistance and training makes teachers feel empowered to try new innovations (Davis & Hennessy, 2020). According to Yulin and Danso (2025), teachers can have a positive attitude towards technology adoption, but schools weaken and undermine actual adoption. Peng, Abdul Razak, and Halili (2023) states that digital competences that are offered by institutions have great effect on adoption. On the same note, school policies promote and influence technology adoption (Kimmons, Graham & West, 2020). There is a convergence of evidence from literature suggesting that schools and institutions play an important role in the adoption of digital technologies in the teaching and learning process. Teachers are more likely to adopt technologies when they are properly trained and in the presence of policies that guide adoption. Also, this emphasises the

necessity of a comprehensive strategy that takes into account schools' preparedness as well as teacher competence in order to support successful and effective technology adoption in the classroom.

The outbreak of COVID-19 was another catalyst for the adoption of technologies in schools. Adedoyin and Soykan (2020), notes that the outbreak of the virus transformed the teaching and learning process, where schools used digital platforms like Zoom and, social media platforms, and Google Classroom. On the same note, Onyema et al. (2020) mentioned that COVID-19 prompted teachers to adopt online learning. Based on this evidence, it is clear that the outbreak of COVID-19 forced schools to adopt teaching using technologies since face-to-face teaching and learning was impossible.

Objective

The objective of this study was to:

Determine the informing aspects of science teachers' adoption of digital technology in teaching Science curriculum in primary schools

Methodology

The study adopted an interpretivist research paradigm in exploring the informing aspects of science teachers' adoption of digital technology in teaching Science curriculum in the Manzini primary schools of Eswatini. According to Draper and Smith (2014), interpretivist paradigm is an approach that looks for meaning and motives behind peoples' actions like experiences. Under interpretivist research paradigm, research is done in a natural setting within the phenomenon and relies much on naturalistic approaches in generating data (Angen, 2018). On another note, this study employed the qualitative research approach. Ndoziya (2014) outlines that this approach provides an in-depth, intricate, and detailed understanding of meanings, actions; non-observable as well as observable phenomenon, attitudes, intentions, and behaviours, and these are well served by naturalistic enquiry. Thus, the reason for choosing this approach was to explore the informing aspects of science teachers' adoption of digital technology in science teaching.

Research design

A multiple case study research design was adopted in this study. The multiple-case study allows for a more in-depth evaluation of the phenomenon in its natural setting and addresses a situation in which the lines between phenomena and contexts are blurred (Cresswell, 2020). The utilisation of a multiple-case study research design generates in-depth data from a variety of sources (Cresswell, 2020). In using the multiple-case strategy, the researchers addressed complex issues that needed to be explored in-depth and to understand the informing aspects of adopting digital technology by Science teachers.

Sampling procedures

The study employed a convenience and purposive sampling in selecting the participants of this study. The convenience sampling strategy permits researchers to choose participants according to geographical proximity, easy accessibility, and their availability to participate in a study (Cohen et al., 2011; Maree, 2017). This sample was used to select the schools where data was generated. In purposive sampling the researchers target the specific participants with the knowledge that the participants selected will provide data that cannot be generated elsewhere (Bertram & Christiansen, 2020; Cohen et al., 2018; Creswell, 2020; Maree, 2017; Okeke & Van Wyk, 2016). The purposive sampling was the researcher's strategy to choose a small group that is knowledgeable and informative about the issue under discussion. The researcher purposely selected two (2) Science teachers from each school making a total of Six (6) particpants who participated in the study.

Data analysis

Cresswell (2020) claims that data analysis is an activity that involves preparing and organising data where it is reduced to themes. The researcher identifies themes where the generated data were interpreted. Marre (2017) posited that the main concern of analysing data is to separate the large chunk of data into smaller, meaningful parts. Data analysis brings meaning to the large data that the

researcher has generated from the field. This shows that data analysis has to be dealt with in an organised manner. With that being said, this study employed a thematic analysis in analysing the generated data.

Results

The findings revealed that the adoption of digital technologies was not automatic; several factors influenced its adoption and implementation by science teachers. The participants explained that these factors were based on personal, school, and external influence.

Personal factors

The findings of the study showed that Science teachers are driven by personal factors towards the adoption of digital technologies in teaching the Science curriculum. The participants argued that if their belief and attitude are positive towards technology adoption and see it as an effective and beneficial tool, chances are high that they will adopt it in their teaching practices.

Teacher 2, School A mentioned that *"I have experienced technological assistance when I was doing my degree at SANU. I was able to do my assignments and research effectively, and that changed my attitude towards using it in my teaching".* Similarly, School B, Teacher 3 also mentioned that *"The learners understand better and enjoy the lessons when technology is involved, and that compelled me to use them often when teaching".*

Personally, I am a curious person. I like trying new things, strategies in improving my learners' learning outcomes. So, I am driven by the desire to make the teaching and learning process successful and effective" (School B, Teacher 4).

Some participants reflected that experience and skills propelled them to adopt technology in their teaching. Teacher 1 from School A postulated that "*Recently, I enrolled for an online teaching certificate at UNESWA. The skill I obtained when doing this programme encouraged and motivated me to use technology in teaching as I was applying what I was learning".*

The first construct of the UTAUT theory, performance expectancy, alludes to the degree to which individuals think and perceive that the use of digital technologies will enable, help, and enhance their tasks. This means that if a person believes that using new technology or innovation will enhance and improve their productivity at work, they are more likely to have a high level of expectancy and adopt and use that technology. The responses from the Science teachers above demonstrate that the estimated usefulness of digital technologies is high, leading them to adopt and utilise technology in their teaching practices.

School Factors

The participating Science teachers noted that the COVID-19 outbreak was a major catalyst influencing the adoption of digital technology in teaching and learning. They explained that the virus caused several challenges, such as lockdowns, closures, and social distancing, which in turn created opportunities for schools to adopt and use digital technologies to continue the teaching and learning process despite the pandemic.

On the same note, School A, Teacher 1 declared that *"After COVID-19, as a school, we opted for blended learning since the learners were now familiar with technology. We used to send them homework and learning materials on digital platforms.* It can be further noted that some of the teachers were greatly informed and influenced by their colleagues. Teacher 2 from school A shows that "*My colleagues also influenced and motivated me to use technology. I used to observe them using it, and that reduced resistance in me".*

The third construct of the UTAUT theory, social influence, refers to the degree to which an individual perceives the importance of others' beliefs that he or she should adopt or use the new digital technology (Venkatesh et al, 2003). This reflects the perceived likelihood of using and adopting digital technologies. It includes the users' perception of what others (colleagues, family, or friends) think

regarding the use of technology. It also captures the users' beliefs concerning the expectations of others. The sentiments expressed by Teacher 2 indicated that social influence significantly affects individuals' decisions to adopt digital technologies in their teaching practices.

The study also revealed that the availability of resources in the school significantly influenced the adoption of digital technologies in teaching. Participants from school A and B indicated that having a computer lab in their schools has made the adoption successful, convenient, feasible, and effective.

Teacher 1 from school A acknowledges that *"The presence of the computer lab makes things easy for us. We have access to computers, projectors, and with these materials, we have embraced technology in our teaching."*

Teacher 3 from school B corresponds with Teacher 1 and said, *"Our computer lab has removed the barrier of limited digital tools. This has influenced and encouraged us to use technology in our teaching practices, especially when explaining abstract and difficult scientific concepts."*

Similarly, Teacher 4 from school B said, "*I lacked exposure to technological things and that made me hesitant in using technology in my teaching. So, the presence of our computer lab has helped to overcome this."*

Facilitating conditions in the UTAUT theory refer to the extent to which individuals perceive and believe that a technical and organizational infrastructure exists to support their adoption and use of technology (Venkatesh et al., 2003). This means that the availability of infrastructure aids the adoption and use of new digital technologies in the classroom. Facilitating conditions are important because they are the only predictor with a direct impact on use behavior, which reflects how users actually utilise digital technology. The responses from Science teachers indicate that the availability of resources influences the use of digital technology in teaching.

The sentiments made by the Science teachers above entail that the presence of digital resources, computer labs, in schools plays an important role in influencing and informing Science teachers to embrace and adopt digital technology in their teaching. This motivates teachers to use technology in their teaching when the necessary resources are available.

External factors

The Science teachers asserted that the national curriculum framework and the Science syllabus also inform their adoption of digital technology. The participants revealed that although these documents are not specific, they suggest that digital technologies should be utilised in the teaching and learning process.

Teacher 4 from school B expressed that *"During last year's workshop, the inspector read the teaching syllabus which stated that technology literacy is one skill that learners need to acquire. She emphasised that as Science teachers we need to use technology in our teaching regularly."*

On the same note, Teacher 6 from School C stated, "*The national curriculum framework of 2018 stipulates that as teachers we must use digital technology in our teaching. However, this document is not specific as to how this has to be done."*

In analysing the documents, the Eswatini Education and Training Sector Policy (2018) outline that teachers must use technology and teach ICT in schools to develop skills and knowledge of ICT among learners. Digital technologies are thought to be crucial in helping to develop 21st-century skills and achieve Eswatini's national development goals. The objectives are divided into short, medium, and long-term categories. They are intended to facilitate the use of digital technologies for teaching, management, and administration of education and training establishments, as well as to guarantee that schools have sufficient ICT infrastructure. The Science teaching syllabus also emphasised that digital technologies should be used in the teaching process since they play an important role in the teaching and learning of science.

Sentiments by Science teachers expressed that these documents informed the adoption of digital technology in primary schools. The views expressed by the teachers demonstrate that it is essential for the government to create clear, well-designed documents that meet the needs of teachers. This becomes a driving force that sustains technology adoption in the classroom.

Discussion

The findings of the study revealed that the decision of science teachers to adopt digital technologies in their teaching practices is informed by personal factors, which include their beliefs and perceptions about technology. The study mentioned that when their attitude is positive, the chances are high that they will adopt and utilise it in the teaching and learning process. This finding is in agreement with a study by Hazzan et al. (2025), which pointed out that teachers' intrinsic motivation strongly informs and influences teachers to adopt and integrate technology in their teaching practices. This shows the importance of having an optimistic attitude towards new renovations. Correspondingly, Laius and Orgusaar (2025) concur with this finding and argue that when teachers see and acknowledge the importance of digital technologies, they are more inclined to use technology in their teaching practices.

In addition, this finding resonates with the first construct of UTAUT, performance expectancy, which states that when technology is perceived as effective and useful, teachers are motivated to adopt and use it in the teaching and learning process. This means that if a person believes that using new technology or innovation will enhance and improve their productivity at work, it is more likely that they will have a high level of expectancy and they will adopt and use that technology.

The study also found that resources in schools act as a major determinant of teachers' adoption of digital technologies in teaching. The participants reflected that the presence of digital tools in their schools facilitated the effective adoption of technology. This shows that the availability of resources actualises teachers' intentions of adopting technologies in teaching. This finding agrees with the literature, which states that the availability of infrastructure is a blockade or enabler of teachers' adoption in schools. For instance, according to Aydın (2023), the presence of infrastructure like computers and the internet affects how teachers can adopt and use technologies when teaching. In the absence of relevant resources and infrastructure, even motivated and positive Science teachers are constrained (Ndibalema, 2022).

Furthermore, the study's findings showed that the COVID-19 outbreak was another catalyst for the adoption of technologies in schools. The Science teachers' demonstrations showed that the outbreak of COVID-19 forced them to adopt teaching using technologies since face-to-face teaching and learning were impossible. This finding is in line with a study by Adedoyin and Soykan (2020), who noted that the outbreak of the virus transformed the teaching and learning process, where schools used digital platforms like Zoom and Google Classroom. On the same note, Onyema et al. (2020) point out that COVID-19 prompted teachers to adopt online learning in trying to continue with their teaching in spite of what was happening.

The findings of the study showed that the participants were informed by the presence of documents to adopt digital technologies in their teaching practices. These documents provide direction, expectations, and serve as a point of reference on how technology should be used in schools. This finding is in agreement with a study by Tounder (2018), which shows that the availability of documents like policies in schools assists teachers in aligning their teaching practices with national objectives. The study further points out that these documents reduce uncertainty in teachers with issues regarding technology adoption. This means that teachers are certain of their technology use and are backed by the national goals and objectives. When supporting documents are not used, it's highly possible that teachers can lack confidence and direction, which can lead to inconsistent use of technology.

The findings of the study demonstrated that it is important for the government to make clear documents and policies that are well-designed and meet the needs of the teachers. This becomes a driving force that sustains technology adoption in the classroom.

Conclusions

The study concludes that Science teachers are informed by factors to adopt digital technologies in their teaching practices. Science teachers are informed by personal factor, which is their believe and perceptions about technology, school factors, where the presence of resources in their schools acts as

a major determinant of science teachers' adoption of digital technologies, and external factors, where the presence of documents provides direction and act as a point of reference on how technology should be adopted in schools.

Recommendations

Based on the findings of the study, the researchers recommended that:

- Establish a peer mentoring program in the school's clusters so that teachers who are proficient with technology can assist others.
- It is recommended that the schools should ensure that physical infrastructure and resources are available for the teachers and learners to effectively adopt digital technology in the teaching and learning process.

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