






The Pedagogical Shift in the Emergence of Digital Technology: Transforming Teaching Practices

Nomasonto Goodness Mthembu¹ , Wanjiru Gachie¹  &
Desmond Wesley Govender¹ 

¹ University of KwaZulu Natal, South Africa.

ABSTRACT

The rapid advancement in digital technology has necessitated a fundamental transformation in the approach to teaching and learning in the classroom. Consequently, teachers must recognize and adapt to this shift by employing appropriate and effective pedagogical methods. However, the lack of comprehensive literature and well-defined policies pertaining to pedagogical adjustments in response to the emergence of technology has left numerous issues unresolved. Therefore, this research investigated the pedagogical approaches adopted by teachers in light of technological advancements in this digital age. The pedagogical shift accompanying the emergence of technology holds significant importance for effective teaching and learning. The research question that was asked to address this pedagogical shift was: In what ways are teachers applying pedagogical approaches in the context of digital technology emergence? To address the research question, a combination of quantitative and qualitative data was collected from high school teachers in the Pinetown district located in Durban KwaZulu-Natal Province through questionnaires and interviews. The findings revealed that teachers are not adequately equipped to implement the pedagogical approaches required for the integration of technology. Furthermore, teachers often perceive technology as a mere tool for occasional use in teaching and learning. Relying solely on laptops and electronic gadgets, without effectively integrating technology into the curriculum and pedagogical approaches, as well as fostering authentic teaching and learning experiences, does not ensure that learners will be prepared to thrive in the era of technology. Additionally, the research discovered that only 31.1% of teachers employed problem-based learning, while 21.7% employed project-based learning as their pedagogical approach. Consequently, there is a need for well-structured policies that can support teachers in making the necessary pedagogical shift to accommodate the emergence of technology.

Correspondence

Nomasonto Goodness
Mthembu
Email:
msonto78@gmail.com

Publication History

Received 4th August, 2023
Accepted 22nd September, 2023
Published online:
8th December, 2023

Keywords: *Teaching and learning, Pedagogical approaches, Technology integration, Digital technology, Digital skills.*

INTRODUCTION

The emergence of technology has brought about a fundamental shift in education, requiring a pedagogical transformation.¹ In this context, teachers play a vital role in equipping learners with the skills and knowledge necessary to thrive in a digitally enabled workforce, which has undergone significant changes due to

¹ Marianne Undheim, "Children and Teachers Engaging Together with Digital Technology in Early Childhood Education and Care Institutions: A Literature Review," *European Early Childhood Education Research Journal* 30, no. 3 (2022): 472–89; Xiaoman Wang et al., "Trends and Priorities of Educational Technology Research: A Delphi Study," *Contemporary Educational Technology* 14, no. 4 (2022): ep383; Jussara Reis-Andersson, "School Organisers' Expression on the Expansion of the Access and Application of Digital Technologies in Educational Systems," *The International Journal of Information and Learning Technology* 40, no.1(2023): 73–83.

technological advancements. Scholars in the field of digital technology, such as Mirra, Marcovitz and Deacon, Laufer, & Schafer, have emphasized the influence of access to digital data on learners' ability to generate new knowledge.² They argue that learners need to interpret and synthesize information, evaluate its credibility, effectively utilize digital tools, and engage in the learning process.³

The impact of the digital age is also evident in the South African educational system, where the integration of digital technology has become imperative for teaching and learning.⁴ This highlights the need for teachers' digital pedagogy to adapt and respond to the changing landscape of effective learning. Specifically, teachers must address three key aspects of digital technology: (1) equipping learners with industry-relevant skills, (2) employing appropriate pedagogical approaches, and (3) utilizing digital tools to facilitate knowledge dissemination.⁵

While previous discussions have underscored the importance of the three aspects of digital technology emergence in relation to pedagogical shifts, many researchers exploring the pedagogical approaches of teachers in the context of digital technology emergence have failed to provide practical and well-structured policies that cater to the diverse settings of South African high schools. Additionally, these researchers have not adequately considered the potential limitations of singular methods used to examine teachers' pedagogical approaches in the context of digital technology emergence. Consequently, high school teachers may lack a clear understanding of how to effectively apply appropriate pedagogical approaches in the digital era, resulting in ineffective teaching and learning practices.

Caverly et al., have observed that many learners face challenges in being proficient in job sectors and universities due to inadequate digital skills.⁶ However, learners who have already had exposure to digital technology in informal settings are better equipped to cope.⁷ This suggests that if teachers can undergo a pedagogical shift relevant to digital technology emergence, they should demonstrate the benefits of integrating digital technology across the school.⁸ Learners will make a smooth transition from high school to post-secondary education if they effectively employ digital technology pedagogical approaches.

Despite the latter research in the field of digital technology integration, the gap still exists where there is insufficient emphasis on the shift of pedagogical practices of teachers in the emergence of digital technology. Moreover, little is known about the pedagogical practices of teachers in the emergence of digital technology. It is not clear whether teachers have completely transformed to adapt to the digital changes. Therefore, this research argues that teachers should teach about ICT by connecting content with digital technologies, using digital technology tools for lesson presentation, and teaching for the attainment of digital skills needed by learners in the digital era. This approach to teaching digital technology will encourage real-life digital technology usage among learners and better prepare them for life beyond high school.⁹ Previous studies, such as those conducted by Grice, Prestridge, and Maher, Schuck, and Perry,¹⁰ have primarily focused on pedagogical

² Nicole Mirra, "From Connected Learning to Connected Teaching: Reimagining Digital Literacy Pedagogy in English Teacher Education," *English Education* 51, no. 3 (2019): 261–91; David M. Marcovitz, "The Intersection of Social Justice and Educational Technology: The Educational Technology Social Justice Matrix," *Education and Information Technologies* 27, no. 4 (2022): 5129–51; Bronwen Deacon, Melissa Laufer and Len Ole Schäfer, "Infusing Educational Technologies in the Heart of the University-A Systematic Literature Review from an Organisational Perspective," *British Journal of Educational Technology* 54, no.2(2023):441–66.

³ Lisbeth Amhag, Lisa Hellström, and Martin Stigmar, "Teacher Educators' Use of Digital Tools and Needs for Digital Competence in Higher Education," *Journal of Digital Learning in Teacher Education* 35, no. 4(2019): 203–20; Nurhak Cem Dedebeali, "Analysis of Digital Literacy and Metaphoric Perceptions of Teacher Candidate," *International Journal of Educational Methodology* 6, no.1 (2020): 135–45.

⁴ Oluwole O Durodolu and Samuel Maredi Mojapelo, "Contextualisation of the Information Literacy Environment in the South African Education Sector.," *Electronic Journal of E-Learning* 18, no. 1 (2020): 57–68; Edna Nwanyizuor Ogwu et al., "Educational Technology Adoption in Instructional Delivery in the New Global Reality," *Education and Information Technologies* 28, no. 1 (January 16, 2023): 1065–80, <https://doi.org/10.1007/s10639-022-11203-4>.

⁵ James K. Njenga, "Digital Literacy: The Quest of an Inclusive Definition," *Reading & Writing* 9, no. 1 (August 30, 2018), <https://doi.org/10.4102/rw.v9i1.183>; Amhag, Hellström, and Stigmar, "Teacher Educators' Use of Digital Tools and Needs for Digital Competence in Higher Education"; Dedebeali, "Analysis of Digital Literacy and Metaphoric Perceptions of Teacher Candidate."

⁶ David C Caverly et al., "Identifying Digital Literacies to Build Academic Literacies," *Journal of College Reading and Learning* 49, no. 3 (2019): 170–205.

⁷ Lauri Hietajärvi et al., "Are Schools Alienating Digitally Engaged Students? Longitudinal Relations between Digital Engagement and School Engagement," *Frontline Learning Research* 8, no. 1 (February 26, 2020): 33–55, <https://doi.org/10.14786/flr.v8i1.437>.

⁸ Louise Starkey, "A Review of Research Exploring Teacher Preparation for the Digital Age," *Cambridge Journal of Education* 50, no. 1 (January 2, 2020): 37–56, <https://doi.org/10.1080/0305764X.2019.1625867>.

⁹ Josef Buchner and Alberto Andujar, "The Expansion of the Classroom through Mobile Immersive Learning.," *International Association for Development of the Information Society*, 2019.

¹⁰ Christine Grice, "Leading Pedagogical Reform," *International Journal of Leadership in Education* 22, no. 3(2019): 355–70; Sarah Prestridge, "Examining the Shaping of Teachers' Pedagogical Orientation for the Use of Technology," *Technology, Pedagogy and Education* 26, no.4 (2017): 367–81; Damian Maher, Sandy Schuck, and Rachel Perry, "Investigating Knowledge Exchange amongst

approaches for integrating ICT in teaching, factors influencing teachers during integration in South African high schools,¹¹ and teachers' perceptions of integrating digital technology in teaching.¹² Consequently, there has been a greater emphasis on using digital technology as a teaching tool rather than teaching its content. This research aims to examine the pedagogical shift in the context of digital technology emergence. With the research problem in mind, the research seeks to address the following research question: In what ways are teachers applying pedagogical approaches in the context of digital technology emergence?

This research aims to contribute valuable insights to the existing literature in the field of digital technology. The findings of this research can benefit educational policymakers, teachers, school administrators, and other stakeholders. Higher learning institutions can also benefit from the research's findings as they plan to train teachers for the 21st century.

LITERATURE REVIEW

Digital Technology in South African Schools

The Department of Basic Education in South Africa has initiated Education Innovation projects aimed at integrating digital technology.¹³ These projects involve implementing technological innovations in a limited number of schools within a province, with the intention of serving as models for wider implementation across the province and eventually the entire country.¹⁴ Education innovation projects are driven by both top-down management decisions and bottom-up local initiatives.¹⁵ However, studies have shown that many of these projects fail to generate comprehensive and sustainable innovation.¹⁶ Lembani, et al., caution against the unsupervised and ill-conceived use of education innovation projects for technological implementation, as it may lead to stagnation and false claims of innovation by organizations.¹⁷

Teachers' Pedagogical Approaches

Examining teachers' pedagogical approaches is crucial as they have a responsibility to educate learners and shape individuals who can thrive in the era of digital technology.¹⁸ Teachers must undergo a mindset shift and adopt pedagogical approaches that allow for continuous and sustainable development.¹⁹ While many teachers claim to be lifelong learners, the reality is that many South African teachers fall into monotonous and repetitive

School Teachers, University Teacher Educators and Industry Partners," *Australian Journal of Teacher Education* 42, no.3(2017):73–90.

¹¹ Verona Leendertz et al., "The Development, Validation and Standardisation of a Questionnaire for ICT Professional Development of Mathematics Teachers," *Pythagoras* 36, no. 2 (2015); Aditya Johri and Ashish Hingle, "Students' Technological Ambivalence toward Online Proctoring and the Need for Responsible Use of Educational Technologies," *Journal of Engineering Education* 112, no. 1 (2023): 221–42.

¹² Zuheir Khlaif, "Teachers' Perceptions of Factors Affecting Their Adoption and Acceptance of Mobile Technology in K-12 Settings," *Computers in the Schools* 35, no. 1, (2018): 49–67; J. Elizabeth Casey et al., "Using the Technology Acceptance Model to Assess How Preservice Teachers' View Educational Technology in Middle and High School Classrooms," *Education and Information Technologies* 28, no. 2 (February 15, 2023): 2361–82, <https://doi.org/10.1007/s10639-022-11263-6>.

¹³ Molise David Nhlapo and Dipane Joseph Hlalele, "Successes and Failures of the University-Community Partnership: A Case Study of Imbali Semi-Rural Settlement," *Education and Urban Society* 55, no. 2 (February 25, 2023): 222–37.

¹⁴ Alona Forkhosh-Baruch et al., "'Islands of Innovation' and 'School-Wide Implementations': Two Patterns of ICT-Based Pedagogical Innovations in Schools," *Human Technology: An Interdisciplinary Journal on Humans in ICT Environments*, 2005.

¹⁵ Miikka de Vocht and Antti Laherto, "Profiling Teachers Based on Their Professional Attitudes towards Teaching Responsible Research and Innovation," *European Journal of Science and Mathematics Education* 5, no. 3 (2017): 271–84; Gábor Halász, "Measuring Innovation in Education: The Outcomes of a National Education Sector Innovation Survey," *European Journal of Education* 53, no. 4 (December 7, 2018): 557–73, <https://doi.org/10.1111/ejed.12299>.

¹⁶ Caroline Pade-Khene, "Embedding Knowledge Transfer in Digital Citizen Engagement in South Africa: Developing Digital Literacy," *Reading & Writing* 9, no. 1 (July 27, 2018), <https://doi.org/10.4102/rw.v9i1.193>; Valerie Mujinga Tshiani and Maureen Tanner, "South Africa's Quest for Smart Cities: Privacy Concerns of Digital Natives of Cape Town, South Africa," *Interdisciplinary Journal of E-Skills and Lifelong Learning* 14 (2018): 055–076; Andrew Dawes et al., "Early Learning Assessment Innovation in South Africa: A Locally Appropriate Monitoring Tool," *Childhood Education* 94, no. 1 (January 2, 2018): 12–16.

¹⁷ Reuben Lembani et al., "The Same Course, Different Access: The Digital Divide between Urban and Rural Distance Education Students in South Africa," *Journal of Geography in Higher Education* 44, no. 1 (January 2, 2020): 70–84.

¹⁸ Paulo Alves, Luísa Miranda, and Carlos Morais, "The Influence of Virtual Learning Environments in Students' Performance," *Universal Journal of Educational Research* 5, no. 3 (2017): 517–27; Mohamad Ariffin Abu Bakar and Norulhuda Ismail, "Exploring Students' Metacognitive Regulation Skills And Mathematics Achievement In Implementation Of 21st Century Learning In Malaysia," *Problems of Education in the 21st Century* 78, no. 3 (June 20, 2020): 314–27, <https://doi.org/10.33225/pec/20.78.314>.

¹⁹ Lalu Sumardi, Arif Rohman, and Dwi Wahyudiati, "Does the Teaching and Learning Process in Primary Schools Correspond to the Characteristics of the 21st Century Learning?," *International Journal of Instruction* 13, no. 3 (July 1, 2020): 357–70.; Hidayu Shafie, Faizah Abd Majid, and Izaham Shah Ismail, "Technological Pedagogical Content Knowledge (TPACK) in Teaching 21st Century Skills in the 21st Century Classroom," *Asian Journal of University Education* 15, no. 3 (December 31, 2019): 24.

practices that fail to meet the needs of their learners.²⁰ Some teachers develop an ignorant attitude and persist with it despite realizing its detrimental impact on their learners.²¹

Shifting Pedagogical Approaches in the Emergence of Technology

The emergence of technology offers numerous benefits for both learners and educators when integrated properly in the classroom.²² Bodily, Leary and West emphasize the importance of teachers incorporating technology, as it promotes higher-order thinking, self-directed learning, and interactive engagement.²³ Digital technology enables learners to access knowledge beyond traditional textbooks, explore real-world issues, and develop communication and problem-solving skills.²⁴ Furthermore, digital technology can accommodate learners' individual differences more effectively²⁵ and prepare them for future job sectors.²⁶ However, digital technology also faces negative perceptions, such as the belief that not all school subjects can fully embrace its use.²⁷

THEORETICAL FRAMEWORK

The theoretical framework of this research draws upon the social constructivism theory.²⁸ The choice to adopt constructivism is based on its ability to describe and explain the complex interactive social dynamics between teachers and learners in the context of teaching and learning. Therefore, this research focuses on understanding the teaching and learning experiences of teachers and learners in a digital classroom. The constructivism theory aligns with the research problem and guides the formulation of research questions.

Furthermore, the research problem acknowledges that digital technology brings forth a new culture and paradigm that must be well-taught and understood before being utilized as a tool for teaching and learning.²⁹ Constructivism provides a framework to explore the implications and requirements of this new digital culture and, by utilizing its concepts, defines the pedagogical shift necessary for this research. Additionally, Vygotsky asserts that teaching and learning involve problem-solving.³⁰ This highlights the importance of employing appropriate pedagogical approaches to educate learners in the digital era, which can be viewed as a process of social construction. Constructivism, therefore, encompasses the notion of the zone of proximal development, where a teacher, a learner, and a problem to be solved coexist.

Engagement with relevant literature in the field of digital technology emergence and pedagogy has further reinforced the application of constructivism theory in this research.

METHODOLOGY

This research employed a mixed-methods approach within a pragmatism paradigm, specifically adopting a sequential explanatory design.³¹ This enhanced the validity of this research by collaborating quantitative and

²⁰ Jessie S. Barrot, "English Curriculum Reform in the Philippines: Issues and Challenges from a 21st Century Learning Perspective," *Journal of Language, Identity & Education* 18, no. 3 (May 4, 2019): 145–60, <https://doi.org/10.1080/15348458.2018.1528547>.

²¹ Shafie, Abd Majid, and Ismail, "Technological Pedagogical Content Knowledge (TPACK) in Teaching 21st Century Skills in the 21st Century Classroom."

²² Sheri Stover and Korrin M Ziswiler, "Impact of Active Learning Environments on Community of Inquiry.," *The International Journal of Teaching and Learning in Higher Education* 29 (2017): 458–70, <https://api.semanticscholar.org/CorpusID:158651314>.

²³ Robert Bodily, Heather Leary, and Richard E. West, "Research Trends in Instructional Design and Technology Journals," *British Journal of Educational Technology* 50, no. 1 (January 27, 2019): 64–79, <https://doi.org/10.1111/bjet.12712>.

²⁴ Timur Sadykov and Hana Čtrnáctová, "Application Interactive Methods and Technologies of Teaching Chemistry," *Chemistry Teacher International* 1, no. 2 (December 18, 2019), <https://doi.org/10.1515/cti-2018-0031>.

²⁵ Avika Daya and Sumaya Laher, "Exploring the Influence of Educators' Access to and Attitudes towards Educational Technology on the Use of Educational Technology in Johannesburg Schools," *Africa Education Review* 17, no. 1 (2020): 159–80.

²⁶ J. Tondeur et al., "The Physical Placement of Classroom Technology and Its Influences on Educational Practices," *Cambridge Journal of Education* 45, no. 4 (2015): 537–56; Ljubinka Joksimović and Slavica Manić, "Exploring Education and Education Reforms from the Complex Systems Point of View," *Economic Themes* 56, no. 1 (April 1, 2018): 1–15.

²⁷ Shirshendu Roy, Samar Bhattacharya, and Prasun Das, "Learning Nuggets, Personalized ELearning (PeL) and Product Training for Professionals with Niche Skills: A Case Study from India," *Development and Learning in Organizations: An International Journal* 32, no. 4 (September 18, 2018): 18–21, <https://doi.org/10.1108/DLO-10-2017-0088>.

²⁸ West Governor's University (WGU), "What Is Constructivism?," Teaching & Education, May 27, 2020, <https://www.wgu.edu/blog/what-constructivism2005.html#close>; Bay Erdal, Basaran Mehmet, and Dös Bülent, "The Reasons for Gaining and Losing the Popularity of a Paradigm in Constructivism: Why? And How?," *Psycho-Educational Research Reviews* 10, no. 1 (2021): 8–24.

²⁹ Nicole Mirra, Ernest Morrell, and Danielle Filipiak, "From Digital Consumption to Digital Invention: Toward a New Critical Theory and Practice of Multiliteracies," *Theory Into Practice* 57, no. 1 (January 2, 2018): 12–19.

³⁰ Lev Semenovich Vygotsky and Michael Cole, *Mind in Society: Development of Higher Psychological Processes* (Harvard university press, 1978).

³¹ Louis Cohen, Lawrence Manion, and Keith Morrison, "Research Methods in Education (Eighth Ed)" (London: Routledge, 2018).

qualitative data. Furthermore, it combined a variety of research methods together to produce a picture that is a complete examination of the teaching practices of teachers in the emergence of digital technology.

The sequential explanatory design consists of two distinct phases: a quantitative phase followed by a qualitative phase. The purpose of the qualitative phase was to provide a deeper understanding of and enhance the quantitative results. In this research, a follow-up explanatory model was employed, allowing the researcher to identify unexpected outcomes that require qualitative examination in order to enrich the findings.

A completely mixed methods design was utilized, incorporating various aspects of mixing in the research process. This includes the combination of qualitative and quantitative elements in the research objective, the utilization of both qualitative (interviews) and quantitative (questionnaires) data sources, as well as the analysis and interpretation of data. The first phase of the research was quantitative, in nature, while the second phase was qualitative and served a conclusive purpose.³²

This research went through scientific phases of questionnaire development, which was explicitly explained in Cohen, Manion and Morrison to provide a reliable and validated questionnaire, through which Pinetown district's pedagogical shift of teachers in the context of digital technology emergence was examined for the first time in this research.³³

This research intended to meet these two goals to develop the desired model of a questionnaire. To do so, multi-item scales were applied. In generating the items, the researcher endeavoured to make easy-to-grasp items employing natural language to avoid any difficulty and ambiguity.³⁴ Moreover, this research tried to keep questions away from being double-barreled: a single item asking two or more questions. Further, this research tried not to let the questionnaire get too long.

In addition, this research used Likert as the most popular and widely used rating scale.³⁵ The five options employed by this research included strongly disagree; disagree; neutral; agree; and strongly agree. This is to avoid the respondents hedging and to make the data normally distributed.

The survey questions were grouped into the following variables: teachers' demographics, which consisted of questions requesting demographic data of the teachers which included age; gender; teaching experience; subject that they teach in high school; and highest qualification for the subject that they were teaching. The next section of the questionnaire consisted of pedagogical practice; teachers' background and knowledge of digital technology. This section of the questionnaire consisted of four tables with statements to examine teachers' pedagogical approaches; knowledge of digital technology; the styles of pedagogy that teachers used when teaching; and teachers' knowledge of a better pedagogical shift in the context of digital technology emergence. This section was intended to find data that assisted in answering the research questions. In addition, the questionnaire was divided into five items: dichotomous questions, multiple choice questions and a rating scale.

Considering the limitations of a questionnaire as a data collection method, which was to examine the pedagogical shift in the context of digital technology emergence, this research used interviews as an alternative qualitative data collection method, to recognise the views of teachers. In terms of one-on-one interview questions, they were designed to be similar to the section in the questionnaire. This was to ascertain that teachers who answered the questionnaires could give similar views on the interview questions. The questions were meant to examine the pedagogical shift of high school teachers in the context of digital technology emergence.

This research further allowed for the focus group questions to be approved by the researcher's supervisor and then were later taken to be approved by the University of KwaZulu-Natal's ethics board. The main objective of this research was to examine teachers' pedagogical approaches in the context of digital technology emergence. Thus, the questions were exploratory and open-ended, as they were intended to allow high school teachers to share their ideas and thoughts without judgement or the researcher's influence. This research has by all means avoided biased questions and not purposely tried to lead teachers into giving a particular answer.

Population and Sampling

This research took place in the KwaZulu-Natal province of South Africa, specifically focusing on the Pinetown District. The Pinetown District consists of four circuits: Mafukuzula-Gandhi, Umhlathuzana, Durban North-west, and Phoenix, encompassing a total of 140 high schools. For the purposes of this research, 25 schools were selected based on their quintile ranking, representing various categories such as rural, semi-rural, township, urban, and former Model C schools. The Pinetown District, being the third-largest district in KwaZulu-Natal

³² John W Creswell and Vicki L Plano Clark, *Designing and Conducting Mixed Methods Research* (Sage publications, 2017).

³³ Cohen, Manion, and Morrison, "Research Methods in Education (Eighth Edi)."

³⁴ Cohen, Manion, and Morrison, "Research Methods in Education (Eighth Edi)."

³⁵ Cohen, Manion, and Morrison, "Research Methods in Education (Eighth Edi)."

province, had limited existing research on the pedagogical approaches of teachers in relation to the emergence of digital technology.³⁶

A subgroup of 250 teachers from the 25 selected schools was chosen for the quantitative data collection phase. The selection process involved employing a multi-stage sampling technique. For the qualitative component, six teachers were conveniently sampled to participate in a focus group. The researcher approached these participants after they had completed the survey, and their willingness to take part in the focus group was confirmed. Additionally, four participants were conveniently sampled for one-on-one semi-structured interviews. The researcher approached these individuals based on their attendance at the same cluster meeting as the researcher, for the sake of convenience.

The research strictly adhered to the ethical codes prescribed by the University of KwaZulu-Natal (UKZN) and the Department of Education. The research was conducted from an unbiased and objective standpoint in order to minimize any potential biases that could influence the research outcomes.

RESULTS AND ANALYSIS

The latest version of the Statistical Package for the Social Sciences (SPSS) statistics package was used to analyze the quantitative data. Section A of the questionnaire included demographic data which was analyzed using descriptive statistics to determine the ratio of the participants in terms of age, gender, teaching experience, the subject they teach and qualifications status. Furthermore, data analysis was conducted according to the process described by Leech & Onwuegbuzie: (a) data reduction (reducing the dimensionality of the qualitative and quantitative data), (b) data display (describing pictorially the qualitative data), (c) data transformation (quantitative data are converted into narrative data to be analyzed qualitatively), (d) data correlation (quantitative data correlated with qualitative data), (e) data consolidation (both qualitative and quantitative data are combined to create new data set), and (f) data comparison comparing data from the qualitative and quantitative data sources.³⁷

This research was guided by the themes relating to pedagogical shift in the context of digital technology emergence to identify themes that emerged from the focus group discussions and one-on-one interviews with the teachers in order to unpack the question of what the data says and how is it interpreted in order to provide meaning to the readers.³⁸ Moreover, the process of analysing the qualitative data included the transcribing of audio recordings of the focus group discussions with four teachers from each circuit into text files. Before analysing the data, this research took into consideration the themes related to the pedagogical approaches of high school teachers in the context of digital technology emergence.

A pattern was observed across data sets which were necessary to the description of pedagogical approaches of high school teachers and was discovered through data expressions.³⁹ Data was categorised according to the themes, by counting words that fall into the category of a specific theme.

The research aimed to investigate the pedagogical approaches employed by teachers in response to the emergence of digital technology. Figure 1 presents the findings regarding the pedagogical approaches utilized by teachers and the following question was asked: What are teachers' pedagogical approaches in response to the emergence of digital technology? Among the respondents, problem-based learning received the highest percentage of replies (31%), followed by project-based learning (22%), as illustrated in Figure 1. However, these figures indicate that there is still room for improvement in the adoption and understanding of project and problem-based teaching approaches among teachers.

The literature highlights the importance of preparing teachers to create innovative learning environments, fostering collaborative learning through problem and project-based approaches, providing ample opportunities for the development of critical thinking skills, enhancing the quality of teaching and learning, and supporting teaching by facilitating access to course content. These findings underscore the need for further

³⁶ Cedric Bheki Mpungose, "Is Moodle or WhatsApp the Preferred E-Learning Platform at a South African University? First-Year Students' Experiences," *Education and Information Technologies* 25, no. 2 (March 6, 2020): 927–41, <https://doi.org/10.1007/s10639-019-10005-5>; Sharifa G Crandall et al., "Best Practices: Social Research Methods to Inform Biological Conservation," *Australasian Journal of Environmental Management* 25, no. 1 (2018): 6–23.

³⁷ Nancy L. Leech and Anthony J. Onwuegbuzie, "Guidelines for Conducting and Reporting Mixed Research in the Field of Counseling and Beyond," *Journal of Counseling & Development* 88, no. 1 (January 23, 2010): 61–69, <https://doi.org/10.1002/j.1556-6678.2010.tb00151.x>.

³⁸ Lorelli S Nowell et al., "Thematic Analysis: Striving to Meet the Trustworthiness Criteria," *International Journal of Qualitative Methods* 16, no. 1 (2017): 1609406917733847; Creswell and Clark, *Designing and Conducting Mixed Methods Research*; Cohen, Manion, and Morrison, "Research Methods in Education (Eighth Ed)."

³⁹ Nowell et al., "Thematic Analysis: Striving to Meet the Trustworthiness Criteria."

efforts to promote the implementation of these pedagogical approaches and enhance teachers' proficiency in leveraging digital technology for effective teaching and learning.

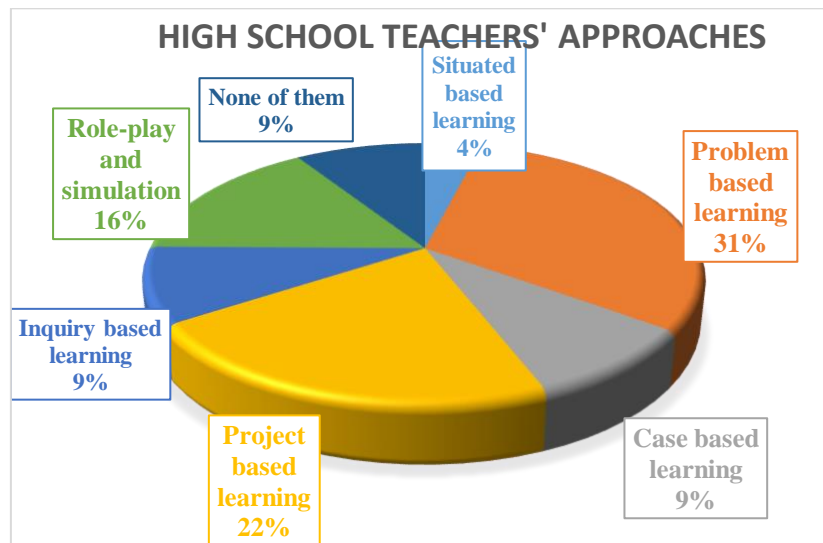


Figure 1 Teachers' Pedagogical approaches as shown in these research findings
Source: created by author for this research purpose

The analysis of the results revealed an important issue highlighted in Figure 3, where 9% of the respondents were unaware of the pedagogical approaches they employed. This finding suggests that these teachers may not have received proper professional guidance or training on teaching and learning approaches. Considering that the listed pedagogical approaches in Figure 3 are essential for preparing learners for the digital era, it is crucial for teachers to have a comprehensive understanding of all these approaches.

Results and analysis based on pedagogical approaches in the emergence of digital technology from the interview questions.

Further analysis based on the open-ended question: How do you use digital technology in your class when teaching? indicated that teachers are not adequately equipped to implement the pedagogical approaches required for the emergence of digital technology. Merely using laptops and electronic gadgets does not ensure that learners will thrive in a fully digital teaching and learning environment. Teachers need to be trained in appropriate pedagogical approaches that integrate digital technology effectively into their practice.

“I am allowing students to use electronic gadgets like laptops and computers to ensure they are properly taught in the digital era since teaching and learning follow this approach” (R44)

Interview results revealed that some teachers view digital technology solely as a tool for teaching and learning, neglecting its vital role in developing learners' competence in the field of digital technology. This aligns with the findings in the literature by Barnett-Slusher, Alves, Miranda, & Morais, and Elmali, Tekin, and Polat, which emphasize that many teachers perceive teaching in the digital technology era as merely using digital technology tools to deliver knowledge.⁴⁰ Some teachers also mentioned activities such as creating social media groups, browsing the internet, and watching videos on platforms like YouTube.⁴¹

“I have tried forming the history WhatsApp group and I have referred learners to use YouTube videos” (R36)

⁴⁰ Stacie Barnett-Slusher, “Equitable Technology Integration: Kentucky Technology Integration Certification” (Morehead State University, 2019); Alves, Miranda, and Morais, “The Influence of Virtual Learning Environments in Students’ Performance”; Filiz Elmali, Ahmet Tekin, and Ebru Polat, “A Study on Digital Citizenship: Preschool Teacher Candidates vs. Computer Education and Instructional Technology Teacher Candidates,” *Turkish Online Journal of Distance Education* 21, no. 4 (2020): 251–69.

⁴¹ Abu Bakar and Ismail, “Exploring Students’ Metacognitive Regulation Skills And Mathematics Achievement In Implementation Of 21st Century Learning In Malaysia.”

Table 1 below, illustrates teachers' pedagogical approaches, in reference to the literature outlining approaches in a digital classroom: real-life teaching and learning,⁴² making use of online platforms⁴³ and problem-based learning⁴⁴ and is represented by 12 Likert-type statements. Participants were allowed to respond to 12 Likert-type statements by indicating their responses on a five-point scale which ranged from SD, to indicate that the participant strongly disagrees with the provided statement, D, indicating that participants disagree, N, indicating neutral, A, indicating participants agree and SA, indicating that participants strongly agree as indicated in Table 1.

I recognise all teaching approaches that would encourage active learning participation.

The analysis also examined participants' recognition of teaching approaches that promote active learning participation, as presented in Table 1. The findings reveal that 68% (35% + 33%) of participants are in agreement that they recognise all teaching approaches that encourage active learning participation. This aligns with the perspective of Saykov and Trinactova, who describe interactive class activities involving online tools to stimulate learning.⁴⁵ It is encouraging to note that teachers allow learners to use digital technology tools during teaching and learning activities.

However, a fair percentage (21%) of participants responded to be unsure. This suggests that participants do not have any knowledge of any pedagogical approaches and they may need professional development, or they do not have any professional development due to their circumstances at the workplace. Table 1 further indicates that 16% (10% + 6%) of participants showed disagreement that they recognise all teaching approaches that will encourage active participation. Because this is the lowest percentage, it will not affect the pedagogical shift in the context of digital technology very much.

Overall, these findings emphasize the need for teacher training and support in effectively implementing pedagogical approaches that integrate digital technology in order to enhance teaching and learning experiences in the digital era.

Table 1 Results depicted from the questionnaires.

Statement	N=255	SD	D	N	A	SA
1	I make use of online settings to provide resources for my subject	22.0%	13.4%	19.3%	21.7%	23.2%
2	Use video conferencing and other online applications as a medium for role-playing	29%	16%	16%	21%	18%
3	Encouraging learners to design or create whatever they have learnt.	10%	18%	26%	26%	20%
4	Encouraging learners to reflect on self	9%	11%	20%	18%	42%
5	I allow learners to reflect on their past experiences as cases in order to solve current problems.	9%	11%	23%	33%	24%
6	Learners are encouraged to identify their own learning needs to solve the problems	12%	18%	17%	28%	25%
7	The challenge of learners applying knowledge in solving problems	5%	8%	14%	27%	45%
8	Introduction of complex problems as a stimulus for learning	13%	12%	25%	19%	32%
9	Use of online platforms to enhance real-life teaching and learning in the classroom	20%	22%	24%	14%	20%
10	Teaching approaches to encourage active learning participation	2%	8%	34%	22%	35%

⁴² Nahla A. K. Alhirtani, "The Use of Modern Teaching Methods in Teaching Arabic Language at Higher Education Phase from the Point View of Arabic Language Professors—A Case of a Premier University," *International Education Studies* 13, no. 1 (December 27, 2019): 32, <https://doi.org/10.5539/ies.v13n1p32>.

⁴³ Elnaz Safapour, Sharareh Kermanshachi, and Piyush Taneja, "A Review of Nontraditional Teaching Methods: Flipped Classroom, Gamification, Case Study, Self-Learning, and Social Media," *Education Sciences* 9, no. 4 (November 14, 2019): 273, <https://doi.org/10.3390/educsci9040273>.

⁴⁴ Jacob Davidsen, Pernille Viktoria Kathja Andersen, and Ellen Christiansen, "Problem-Based Learning in a Box: Lessons Learned from an Educational Design Experiment," *Journal of Problem Based Learning in Higher Education* 7, no. 1 (2019).

⁴⁵ Sadykov and Čtrnáctová, "Application Interactive Methods and Technologies of Teaching Chemistry."

11	Most of my classroom activities encourage real life teaching and learning	6%	10%	21%	33%	35%
12	I encourage learners to construct new knowledge through developing artefacts and projects	9%	24%	25%	17%	26%

Source: Designed by the researcher for research purposes

"I make use of online platforms to enhance real-life teaching and learning in my classroom."

The results presented in Table 1 indicated a significant knowledge gap regarding the use of online platforms among the participants. Findings show that 24% of the respondents were uncertain or unaware of whether they utilized online platforms in their teaching. This suggests a lack of familiarity or exposure to a teaching and learning environment that promotes online learning. Therefore, teachers need to explore creative ideas and strategies for incorporating new technologies into their teaching practices.⁴⁶ This research was concerned by the findings that 42% (20% + 22%) of respondents were in disagreement with online learning platforms. This suggests that more professional development needs to take place for teachers at school in order for digital pedagogy to take place and for teachers to embrace technology in their teaching.

Table 1 further indicates that 34% (20% + 14%) of participants showed a positive response to online teaching platforms as an enhancer of real-life teaching and learning in their classrooms. This is not too far apart from the negative 42% responses; however, the negativity is of concern. The positivity does suggest that there are some chances of effective pedagogical approaches by teachers in the context of digital technology emergence.

"I allow learners to reflect on their past experiences as cases in order to solve current problems."

Table 1 revealed that 20% (9% + 11%) of the respondents did not encourage their learners to reflect on their past experiences as a means to solve current problems. This suggests that the respondents neglect the fact that learners come to the classroom with acquired knowledge that needs to be constructed into organised knowledge. Instead, they serve as the main authorities of knowledge and treat learners as empty boxes. The latter kind of teaching and learning does not encourage 21st century knowledge skills and learning. Learners end up not coping with the autonomous and collaborative learning at higher learning institutions, where students learn from each other's experiences. In many classrooms, particularly in township and rural schools, teachers often deliver the same content to all students simultaneously, with minimal individual adjustments. This approach is perceived as efficient for teaching large groups of students and has been the traditional method for years.⁴⁷

However, this may not be sufficient for teaching learners in the digital technology era, as students are expected to possess high competence in digital technology. Neglecting the importance of learners' prior knowledge and treating them as passive recipients of knowledge inhibits the development of 21st-century knowledge, skills, and learning. Teachers need to shift towards a more student-centred approach that encourages active knowledge construction and critical thinking.⁴⁸ Given the high number of respondents 57% (33% + 24%) who agreed with the statement "I allow learners to reflect on their past experiences as cases in order to solve current problems" in Table 1, the researcher is hopeful that poor teaching practice cannot dominate good practice. This suggests that most teachers' pedagogical approaches are somehow still relevant in the context of digital emergence.

"I encourage learners to construct new knowledge through developing artefacts and projects."

Teachers should strive to foster creativity and change in the classroom. Table 1 demonstrated that a fair proportion of respondents 43% (17% + 26%) encouraged students to construct new knowledge through the creation of artefacts and projects. In particular, teachers should consistently seek to enhance learners' critical thinking and writing skills through collaborative research projects and experiential learning opportunities.⁴⁹ However, a significant proportion of respondents expressed uncertainty or lacked support for learners in this aspect. This was evident from the 25% of participants who were uncertain about their classroom practices.

⁴⁶ Shafie, Abd Majid, and Ismail, "Technological Pedagogical Content Knowledge (TPACK) in Teaching 21st Century Skills in the 21st Century Classroom."

⁴⁷ Farhan Uddin Raja and Najmonnisa Khan, "Comparing Traditional Teaching Method and Experiential Teaching Method Using Experimental Research," *Journal of Education and Educational Development* 5, no. 2 (December 13, 2018): 276.

⁴⁸ Raja and Khan, "Comparing Traditional Teaching Method and Experiential Teaching Method Using Experimental Research."

⁴⁹ Lana Obradovic and Michelle Black, "Teaching Deterrence: A 21st-Century Update," *Journal of Political Science Education* 16, no. 3 (July 2, 2020): 344–56; Paula López et al., "Effects of Direct Instruction and Strategy Modeling on Upper-Primary Students' Writing Development," *Frontiers in Psychology* 8 (June 30, 2017); Fatimah A Albrahim, "Online Teaching Skills and Competencies.," *Turkish Online Journal of Educational Technology-TOJET* 19, no. 1 (2020): 9–20.

Moreover, 33% (24% + 9%) of participants were in disagreement with encouraging learners to construct knowledge through developing artifacts and projects. These findings suggest that many teachers show little interest in facilitating knowledge construction among their students in the classroom. It is important for teachers to understand that projects can take various forms, such as inquiry-based activities, design projects, and debates, and can span across multiple subject areas.

DISCUSSIONS

The findings of this research indicate that educators lack the necessary skills to effectively teach in the context of digital technology emergence. Merely using laptops and electronic devices in the classroom does not guarantee successful learning in the digital era. Teachers need to be trained in pedagogical strategies that integrate digital technology into their instructional practices. However, it is evident that many teachers view digital technology solely as an instructional tool, overlooking its critical role in fostering learners' competence in the digital technology field. This finding is consistent with existing literature by Barnett-Slusher, Alves, Miranda, and Morais, and Elmali, Tekin, and Polat, which highlight the tendency of teachers to perceive teaching in the digital era as limited to using digital technology tools for knowledge delivery.⁵⁰

Teachers also demonstrated a lack of familiarity with pedagogical approaches that promote active learning and require extensive support in implementing project-based and problem-based teaching methodologies. Regardless of the contextual challenges faced in their high schools, teachers must take responsibility for learning new technologies and promoting active learning and teaching. Additionally, teachers need to create an inclusive classroom environment that allows students to express their unique identities and push the boundaries of education.

In many classrooms, particularly in township and rural schools, teachers adopt a one-size-fits-all approach, delivering the same content to all students simultaneously with minimal individual adjustments. This approach is often seen as the most efficient way to teach a large group of learners and has been ingrained in traditional teaching practices for years. However, this approach may not be sufficient for effective teaching in the digital technology era, where students are expected to possess advanced digital technology skills. Neglecting the importance of learners' prior knowledge and treating them as passive recipients of knowledge inhibits the development of 21st-century knowledge, skills, and learning.

Teachers should strive to foster creativity and change in their classrooms. Opportunities to promote creativity and change have been identified in the literature.⁵¹ Teachers should always be prepared to enhance learners' critical thinking and writing skills through collaborative research projects and experiential learning. However, it is concerning that a significant proportion of respondents were uncertain or lacked interest in promoting learners' knowledge construction. This suggests a limited focus on learners' active engagement in the classroom. Additionally, projects can take various forms, such as inquiry-based activities, design projects, and debates, and can be applied across multiple subject areas.

The literature supports the argument that learners' capacity to generate new knowledge is enhanced by engaging in real-life experiences and accessing digital data.⁵² Learners need to develop skills in interpreting, synthesizing, and making appropriate use of digital tools while learning about the process itself.⁵³ Teaching in the context of digital technology emergence requires a combination of pedagogical components, including content and teaching approaches. The results revealed that teachers either do not recognize the use of online learning platforms or choose to exclude them from their teaching practice. This suggests that pedagogical approaches that encourage the integration of digital technology are still lacking in teaching practices.

⁵⁰ Barnett-Slusher, "Equitable Technology Integration: Kentucky Technology Integration Certification"; Alves, Miranda, and Morais, "The Influence of Virtual Learning Environments in Students' Performance"; Elmali, Tekin, and Polat, "A Study on Digital Citizenship: Preschool Teacher Candidates vs. Computer Education and Instructional Technology Teacher Candidates."

⁵¹ Obradovic and Black, "Teaching Deterrence: A 21st-Century Update"; López et al., "Effects of Direct Instruction and Strategy Modeling on Upper-Primary Students' Writing Development"; Albrahim, "Online Teaching Skills and Competencies."

⁵² Mirra, "From Connected Learning to Connected Teaching: Reimagining Digital Literacy Pedagogy in English Teacher Education"; Trung Tran et al., "How Digital Natives Learn and Thrive in the Digital Age: Evidence from an Emerging Economy," *Sustainability* 12, no. 9 (May 7, 2020): 3819, <https://doi.org/10.3390/su12093819>.

⁵³ Amhag, Hellström, and Stigmar, "Teacher Educators' Use of Digital Tools and Needs for Digital Competence in Higher Education"; Dedejali, "Analysis of Digital Literacy and Metaphoric Perceptions of Teacher Candidate."; Gates Foundation, "Teachers Know Best," US Program, August 10, 2017, <https://usprogram.gatesfoundation.org/news-and-insights/articles/teachers-know-best>.

SUMMARY

Based on the findings of this research, the following inferences can be drawn in response to the research question: "In what ways are teachers applying pedagogical approaches in the context of digital technology emergence?"

The results indicate that teachers are still predominantly employing traditional methods of teaching and learning, with limited utilization and understanding of project-based and problem-based teaching approaches. This suggests a need for teachers to create more innovative and creative learning environments and to promote collaborative learning through these pedagogical approaches. By providing opportunities for students to develop critical thinking skills and utilizing digital technology tools effectively, teaching and learning quality in the context of digital technology emergence can be enhanced.

While there is a need for support from various stakeholders, such as facilitating access to course content and developing new policies, teachers also have a responsibility to equip themselves with the new technologies that emerge in the education field. They should actively seek professional development opportunities and stay updated with the latest advancements in digital technology.

Furthermore, given the limited literature on pedagogical approaches in the digital era, further research should be conducted to investigate the pedagogical approaches of teachers in primary schools. This research should focus on the appropriate integration of digital technology across the entire school curriculum, allowing for a comprehensive examination of teaching and learning practices in the digital era.

RECOMMENDATIONS

Based on the conclusions drawn from this research, the following recommendations are proposed to enhance the quality of teaching and learning in the context of digital technology emergence:

1. **Embrace the change:** Teachers should actively embrace the ongoing changes in schools, curricula, and society as a whole. This includes recognizing the importance of digital technology in education and being open to incorporating it into their teaching practices.
2. **Enhance digital technology content knowledge:** Teachers should strive to develop a comprehensive knowledge of digital technology content, including proficiency in various computer programs and applications relevant to their subject areas. This will enable them to effectively integrate digital technology into their instructional practices.
3. **Familiarize with electronic learning platforms:** Teachers should acquire knowledge and familiarity with various electronic learning platforms that can enhance teaching and learning experiences. This includes online learning management systems, educational apps, and digital resources that can support student engagement and collaboration.
4. **Support in pedagogical approaches:** The findings suggest that many teachers require additional support in terms of their understanding and implementation of pedagogical approaches, particularly problem-based and project-based learning. Schools should provide professional development opportunities and resources to enhance teachers' pedagogical skills in utilizing these approaches, incorporating digital technology where relevant.
5. **Ensure accessible digital technology infrastructure:** Schools should ensure that the necessary infrastructure is in place to provide easy access to digital technology devices for both teachers and students. This includes reliable internet connectivity, well-equipped computer labs, and the availability of digital devices in classrooms.
6. **Deep subject knowledge:** Teachers should strive to deepen their subject knowledge to effectively select and implement relevant pedagogical approaches. By having a strong grasp of the content, teachers can make informed decisions about the most suitable pedagogical strategies and leverage digital technology to enhance learning outcomes.

CONCLUSION

This research has investigated the pedagogical approaches adopted by teachers in light of technological advancements in this digital age. The research highlights the importance of embracing pedagogical shifts and effectively integrating digital technology into teaching practices. By implementing the provided recommendations, schools can create an environment that fosters effective integration of digital technology into teaching practices, promoting collaborative and critical thinking skills among students in alignment with 21st-century approaches. When these changes are duly institutionalized, teachers can create engaging and meaningful learning experiences that prepare students for the demands of the digital age.

BIBLIOGRAPHY

- Abu Bakar, Mohamad Ariffin, and Norulhuda Ismail. "Exploring Students' Metacognitive Regulation Skills And Mathematics Achievement In Implementation Of 21st Century Learning In Malaysia." *Problems of Education in the 21st Century* 78, no. 3 (June 20, 2020): 314–27. <https://doi.org/10.33225/pec/20.78.314>.
- Albrahim, Fatimah A. "Online Teaching Skills and Competencies." *Turkish Online Journal of Educational Technology-TOJET* 19, no. 1 (2020): 9–20.
- Alhirtani, Nahla A. K. "The Use of Modern Teaching Methods in Teaching Arabic Language at Higher Education Phase from the Point View of Arabic Language Professors—A Case of a Premier University." *International Education Studies* 13, no. 1 (December 27, 2019): 32. <https://doi.org/10.5539/ies.v13n1p32>.
- Alves, Paulo, Luísa Miranda, and Carlos Morais. "The Influence of Virtual Learning Environments in Students' Performance." *Universal Journal of Educational Research* 5, no. 3 (2017): 517–27.
- Amhag, Lisbeth, Lisa Hellström, and Martin Stigmar. "Teacher Educators' Use of Digital Tools and Needs for Digital Competence in Higher Education." *Journal of Digital Learning in Teacher Education* 35, no. 4 (October 2, 2019): 203–20. <https://doi.org/10.1080/21532974.2019.1646169>.
- Barnett-Slusher, Stacie. "Equitable Technology Integration: Kentucky Technology Integration Certification." Morehead State University, 2019.
- Barrot, Jessie S. "English Curriculum Reform in the Philippines: Issues and Challenges from a 21st Century Learning Perspective." *Journal of Language, Identity & Education* 18, no. 3 (May 4, 2019): 145–60. <https://doi.org/10.1080/15348458.2018.1528547>.
- Bodily, Robert, Heather Leary, and Richard E. West. "Research Trends in Instructional Design and Technology Journals." *British Journal of Educational Technology* 50, no. 1 (January 27, 2019): 64–79. <https://doi.org/10.1111/bjet.12712>.
- Buchner, Josef, and Alberto Andujar. "The Expansion of the Classroom through Mobile Immersive Learning." *International Association for Development of the Information Society*, 2019.
- Casey, J. Elizabeth, Jeff Kirk, Kimberly Kuklies, and Selina V. Mireles. "Using the Technology Acceptance Model to Assess How Preservice Teachers' View Educational Technology in Middle and High School Classrooms." *Education and Information Technologies* 28, no. 2 (February 15, 2023): 2361–82. <https://doi.org/10.1007/s10639-022-11263-6>.
- Caverly, David C, Emily M Payne, Amarilis M Castillo, Amber Sarker, Elizabeth Threadgill, and Daniel West. "Identifying Digital Literacies to Build Academic Literacies." *Journal of College Reading and Learning* 49, no. 3 (2019): 170–205.
- Cohen, Louis, Lawrence Manion, and Keith Morrison. "Research Methods in Education (Eighth Edi)." London: Routledge, 2018.
- Crandall, Sharifa G, Jennifer L Ohayon, Luz A de Wit, J E Hammond, Kate L Melanson, Monica M Moritsch, Rob Davenport, Diana Ruiz, Bradford Keitt, and Nick D Holmes. "Best Practices: Social Research Methods to Inform Biological Conservation." *Australasian Journal of Environmental Management* 25, no. 1 (2018): 6–23.
- Creswell, John W, and Vicki L Plano Clark. *Designing and Conducting Mixed Methods Research*. Sage publications, 2017.
- Davidsen, Jacob, Pernille Viktoria Kathja Andersen, and Ellen Christiansen. "Problem-Based Learning in a Box: Lessons Learned from an Educational Design Experiment." *Journal of Problem Based Learning in Higher Education* 7, no. 1 (2019).
- Dawes, Andrew, Linda Biersteker, Elizabeth Girdwood, Matthew Snelling, and C. G. Tredoux. "Early Learning Assessment Innovation in South Africa: A Locally Appropriate Monitoring Tool." *Childhood Education* 94, no. 1 (January 2, 2018): 12–16. <https://doi.org/10.1080/00094056.2018.1420358>.
- Daya, Avika, and Sumaya Laher. "Exploring the Influence of Educators' Access to and Attitudes towards Educational Technology on the Use of Educational Technology in Johannesburg Schools." *Africa Education Review* 17, no. 1 (2020): 159–80.
- Deacon, Bronwen, Melissa Laufer, and Len Ole Schäfer. "Infusing Educational Technologies in the Heart of the University—A Systematic Literature Review from an Organisational Perspective." *British Journal of Educational Technology* 54, no. 2 (March 27, 2023): 441–66. <https://doi.org/10.1111/bjet.13277>.
- Dedebali, Nurhak Cem. "Analysis of Digital Literacy and Metaphoric Perceptions of Teacher Candidate." *International Journal of Educational Methodology* 6, no. 1 (2020): 135–45.
- Durodolu, Oluwole O, and Samuel Maredi Mojapelo. "Contextualisation of the Information Literacy Environment in the South African Education Sector." *Electronic Journal of E-Learning* 18, no. 1 (2020): 57–68.

- Elmali, Filiz, Ahmet Tekin, and Ebru Polat. "A Study on Digital Citizenship: Preschool Teacher Candidates vs. Computer Education and Instructional Technology Teacher Candidates." *Turkish Online Journal of Distance Education* 21, no. 4 (2020): 251–69.
- Erdal, Bay, Basaran Mehmet, and Dös Bülent. "The Reasons for Gaining and Losing the Popularity of a Paradigm in Constructivism: Why? And How?." *Psycho-Educational Research Reviews* 10, no. 1 (2021): 8–24.
- Forkhosh-Baruch, Alona, David Mioduser, Rafi Nachmias, and Dorit Tubin. "'Islands of Innovation' and 'School-Wide Implementations': Two Patterns of ICT-Based Pedagogical Innovations in Schools." *Human Technology: An Interdisciplinary Journal on Humans in ICT Environments*, 2005.
- Gates Foundation. "Teachers Know Best." US Program, August 10, 2017. <https://usprogram.gatesfoundation.org/news-and-insights/articles/teachers-know-best>.
- Grice, Christine. "Leading Pedagogical Reform." *International Journal of Leadership in Education* 22, no. 3 (May 4, 2019): 355–70. <https://doi.org/10.1080/13603124.2018.1463462>.
- Halász, Gábor. "Measuring Innovation in Education: The Outcomes of a National Education Sector Innovation Survey." *European Journal of Education* 53, no. 4 (December 7, 2018): 557–73. <https://doi.org/10.1111/ejed.12299>.
- Hietajärvi, Lauri, Kirsti Lonka, Kai Hakkarainen, Kimmo Alho, and Katariina Salmela-Aro. "Are Schools Alienating Digitally Engaged Students? Longitudinal Relations between Digital Engagement and School Engagement." *Frontline Learning Research* 8, no. 1 (February 26, 2020): 33–55. <https://doi.org/10.14786/flr.v8i1.437>.
- Johri, Aditya, and Ashish Hingle. "Students' Technological Ambivalence toward Online Proctoring and the Need for Responsible Use of Educational Technologies." *Journal of Engineering Education* 112, no. 1 (January 9, 2023): 221–42. <https://doi.org/10.1002/jee.20504>.
- Joksimović, Ljubinka, and Slavica Manić. "Exploring Education and Education Reforms from the Complex Systems Point of View." *Economic Themes* 56, no. 1 (April 1, 2018): 1–15. <https://doi.org/10.2478/ethemes-2018-0001>.
- Khlaif, Zuheir. "Teachers' Perceptions of Factors Affecting Their Adoption and Acceptance of Mobile Technology in K-12 Settings." *Computers in the Schools* 35, no. 1 (January 2, 2018): 49–67. <https://doi.org/10.1080/07380569.2018.1428001>.
- Leech, Nancy L., and Anthony J. Onwuegbuzie. "Guidelines for Conducting and Reporting Mixed Research in the Field of Counseling and Beyond." *Journal of Counseling & Development* 88, no. 1 (January 23, 2010): 61–69. <https://doi.org/10.1002/j.1556-6678.2010.tb00151.x>.
- Leendertz, Verona, A. Seugnet Blignaut, Suria Ellis, and Hercules D. Nieuwoudt. "The Development, Validation and Standardisation of a Questionnaire for ICT Professional Development of Mathematics Teachers." *Pythagoras* 36, no. 2 (November 20, 2015). <https://doi.org/10.4102/pythagoras.v36i2.297>.
- Lembani, Reuben, Ashley Gunter, Markus Breines, and Mwazvita Tapiwa Beatrice Dalu. "The Same Course, Different Access: The Digital Divide between Urban and Rural Distance Education Students in South Africa." *Journal of Geography in Higher Education* 44, no. 1 (January 2, 2020): 70–84. <https://doi.org/10.1080/03098265.2019.1694876>.
- López, Paula, Mark Torrance, Gert Rijlaarsdam, and Raquel Fidalgo. "Effects of Direct Instruction and Strategy Modeling on Upper-Primary Students' Writing Development." *Frontiers in Psychology* 8 (June 30, 2017). <https://doi.org/10.3389/fpsyg.2017.01054>.
- Maher, Damian, Sandy Schuck, and Rachel Perry. "Investigating Knowledge Exchange amongst School Teachers, University Teacher Educators and Industry Partners." *Australian Journal of Teacher Education* 42, no. 3 (March 2017): 73–90. <https://doi.org/10.14221/ajte.2017v42n3.5>.
- Marcovitz, David M. "The Intersection of Social Justice and Educational Technology: The Educational Technology Social Justice Matrix." *Education and Information Technologies* 27, no. 4 (May 13, 2022): 5129–51. <https://doi.org/10.1007/s10639-021-10828-1>.
- Mirra, Nicole. "From Connected Learning to Connected Teaching: Reimagining Digital Literacy Pedagogy in English Teacher Education." *English Education* 51, no. 3 (April 1, 2019): 261–91. <https://doi.org/10.58680/ee201930076>.
- Mirra, Nicole, Ernest Morrell, and Danielle Filipiak. "From Digital Consumption to Digital Invention: Toward a New Critical Theory and Practice of Multiliteracies." *Theory Into Practice* 57, no. 1 (January 2, 2018): 12–19. <https://doi.org/10.1080/00405841.2017.1390336>.
- Mpungose, Cedric Bheki. "Is Moodle or WhatsApp the Preferred E-Learning Platform at a South African University? First-Year Students' Experiences." *Education and Information Technologies* 25, no. 2 (March 6, 2020): 927–41. <https://doi.org/10.1007/s10639-019-10005-5>.

- Mujinga Tshiani, Valerie, and Maureen Tanner. "South Africa's Quest for Smart Cities: Privacy Concerns of Digital Natives of Cape Town, South Africa." *Interdisciplinary Journal of E-Skills and Lifelong Learning* 14 (2018): 055–076. <https://doi.org/10.28945/3992>.
- Nhlapo, Molise David, and Dipane Joseph Hlalele. "Successes and Failures of the University-Community Partnership: A Case Study of Imbali Semi-Rural Settlement." *Education and Urban Society* 55, no. 2 (February 25, 2023): 222–37. <https://doi.org/10.1177/001312452111027368>.
- Njenga, James K. "Digital Literacy: The Quest of an Inclusive Definition." *Reading & Writing* 9, no. 1 (August 30, 2018). <https://doi.org/10.4102/rw.v9i1.183>.
- Nowell, Lorelli S, Jill M Norris, Deborah E White, and Nancy J Moules. "Thematic Analysis: Striving to Meet the Trustworthiness Criteria." *International Journal of Qualitative Methods* 16, no. 1 (2017): 1609406917733847.
- Obradovic, Lana, and Michelle Black. "Teaching Deterrence: A 21st-Century Update." *Journal of Political Science Education* 16, no. 3 (July 2, 2020): 344–56. <https://doi.org/10.1080/15512169.2019.1575228>.
- Ogwu, Edna Nwanyiuzor, Ngozi Ugonma Emelogu, Richard Ojinnakaeze Azor, and Fredrick Amunabo Okwo. "Educational Technology Adoption in Instructional Delivery in the New Global Reality." *Education and Information Technologies* 28, no. 1 (January 16, 2023): 1065–80. <https://doi.org/10.1007/s10639-022-11203-4>.
- Pade-Khene, Caroline. "Embedding Knowledge Transfer in Digital Citizen Engagement in South Africa: Developing Digital Literacy." *Reading & Writing* 9, no. 1 (July 27, 2018). <https://doi.org/10.4102/rw.v9i1.193>.
- Prestridge, Sarah. "Examining the Shaping of Teachers' Pedagogical Orientation for the Use of Technology." *Technology, Pedagogy and Education* 26, no. 4 (August 8, 2017): 367–81. <https://doi.org/10.1080/1475939X.2016.1258369>.
- Raja, Farhan Uddin, and Najmonnisa Khan. "Comparing Traditional Teaching Method and Experiential Teaching Method Using Experimental Research." *Journal of Education and Educational Development* 5, no. 2 (December 13, 2018): 276. <https://doi.org/10.22555/joed.v5i2.1816>.
- Reis-Andersson, Jussara. "School Organisers' Expression on the Expansion of the Access and Application of Digital Technologies in Educational Systems." *The International Journal of Information and Learning Technology* 40, no. 1 (January 11, 2023): 73–83. <https://doi.org/10.1108/IJILT-03-2022-0070>.
- Roy, Shirshendu, Samar Bhattacharya, and Prasun Das. "Learning Nuggets, Personalized ELearning (PeL) and Product Training for Professionals with Niche Skills: A Case Study from India." *Development and Learning in Organizations: An International Journal* 32, no. 4 (September 18, 2018): 18–21. <https://doi.org/10.1108/DLO-10-2017-0088>.
- Sadykov, Timur, and Hana Čtrnáctová. "Application Interactive Methods and Technologies of Teaching Chemistry." *Chemistry Teacher International* 1, no. 2 (December 18, 2019). <https://doi.org/10.1515/cti-2018-0031>.
- Safapour, Elnaz, Sharareh Kermanshachi, and Piyush Taneja. "A Review of Nontraditional Teaching Methods: Flipped Classroom, Gamification, Case Study, Self-Learning, and Social Media." *Education Sciences* 9, no. 4 (November 14, 2019): 273. <https://doi.org/10.3390/educsci9040273>.
- Shafie, Hidayu, Faizah Abd Majid, and Izaham Shah Ismail. "Technological Pedagogical Content Knowledge (TPACK) in Teaching 21st Century Skills in the 21st Century Classroom." *Asian Journal of University Education* 15, no. 3 (December 31, 2019): 24. <https://doi.org/10.24191/ajue.v15i3.7818>.
- Starkey, Louise. "A Review of Research Exploring Teacher Preparation for the Digital Age." *Cambridge Journal of Education* 50, no. 1 (January 2, 2020): 37–56. <https://doi.org/10.1080/0305764X.2019.1625867>.
- Stover, Sheri, and Korrin M Ziswiler. "Impact of Active Learning Environments on Community of Inquiry." *The International Journal of Teaching and Learning in Higher Education* 29 (2017): 458–70. <https://api.semanticscholar.org/CorpusID:158651314>.
- Sumardi, Lalu, Arif Rohman, and Dwi Wahyudiati. "Does the Teaching and Learning Process in Primary Schools Correspond to the Characteristics of the 21st Century Learning?" *International Journal of Instruction* 13, no. 3 (July 1, 2020): 357–70. <https://doi.org/10.29333/iji.2020.13325a>.
- Tondeur, J., E. De Bruyne, M. Van Den Driessche, S. McKenney, and D. Zandvliet. "The Physical Placement of Classroom Technology and Its Influences on Educational Practices." *Cambridge Journal of Education* 45, no. 4 (October 2, 2015): 537–56. <https://doi.org/10.1080/0305764X.2014.998624>.
- Tran, Trung, Manh-Toan Ho, Thanh-Hang Pham, Minh-Hoang Nguyen, Khanh-Linh P. Nguyen, Thu-Trang Vuong, Thanh-Huyen T. Nguyen, et al. "How Digital Natives Learn and Thrive in the Digital Age:

Evidence from an Emerging Economy.” *Sustainability* 12, no. 9 (May 7, 2020): 3819. <https://doi.org/10.3390/su12093819>.

Undheim, Marianne. “Children and Teachers Engaging Together with Digital Technology in Early Childhood Education and Care Institutions: A Literature Review.” *European Early Childhood Education Research Journal* 30, no. 3 (May 4, 2022): 472–89. <https://doi.org/10.1080/1350293X.2021.1971730>.

Vocht, Miikka de, and Antti Laherto. “Profiling Teachers Based on Their Professional Attitudes towards Teaching Responsible Research and Innovation.” *European Journal of Science and Mathematics Education* 5, no. 3 (July 15, 2017): 271–84. <https://doi.org/10.30935/scimath/9511>.

Vygotsky, Lev Semenovich, and Michael Cole. *Mind in Society: Development of Higher Psychological Processes*. Harvard university press, 1978.

Wang, Xiaoman, John Hampton, Albert D. Ritzhaupt, and Kara Dawson. “Trends and Priorities of Educational Technology Research: A Delphi Study.” *Contemporary Educational Technology* 14, no. 4 (August 7, 2022): ep383. <https://doi.org/10.30935/cedtech/12317>.

West Governor’s University (WGU). “What Is Constructivism?” *Teaching & Education*, May 27, 2020. <https://www.wgu.edu/blog/what-constructivism2005.html#close>.

ABOUT AUTHORS

Dr. Nomasonto Goodness Mthembu earned her PhD with a focus on Computer Science Education from the University of KwaZulu-Natal, including Bed, Bed Honours, and Bed Masters. Her research interests lie in linking indigenous knowledge with computer sciences (robotics) to enhance self-directed learning.

Dr. Wanjiru Gachie is a seasoned senior lecturer at the University of KwaZulu-Natal, South Africa, specializing in Information Systems and Public Administration. With over a decade of experience, her dynamic contributions to education, research, and student supervision make her a respected figure in the academic community.

Professor Desmond W. Govender is a distinguished academic, presently serving as the Discipline Leader in the Department of Computer Science Education at the University of KwaZulu-Natal. His extensive research background and commitment to quality assurance contribute significantly to the field, particularly in ICT integration in teaching and learning.