INNOVATIVE TEACHING STRATEGIES: A PRINCIPAL COMPONENT ANALYSIS

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How to cite this paper: Ramasimu, N. F. (2024). Innovative teaching strategies: A principal component analysis. *Corporate & Business Strategy Review, 5*(1), 87–98. https://doi.org/10.22495/cbsrv5i1art9

ISSN Online: 2708-4965
ISSN Print: 2708-9924

Received: 16.04.2023
Accepted: 15.01.2024

JEL Classification: A21, I21, J24
DOI: 10.22495/cbsrv5i1art9

Abstract

The paper investigated the degree of innovative teaching practices by secondary school teachers in the Vhembe District, South Africa, using a principal component analysis approach. Innovative teaching strategies refer to creative and efficient actions and performances that teachers use in the selection of materials, techniques, and learner assessments to encourage and develop learner creativity (Yu et al., 2021). Innovative teachers are those whose teaching methods differ from the conventional patterns of knowledge-transfer teaching and teacher-centred teaching. They solve educational problems in novel ways using new technologies and theoretical frameworks while guiding learners in deep learning and creativity (Tan et al., 2022). The objective of the study was to examine the innovative teaching strategies implemented by teachers in rural secondary schools to improve learner performance. A descriptive case study was employed in the paper, which was based on a quantitative research design. Using probability sampling approaches, 338 secondary school teachers were sampled. Data was collected through questionnaires and was analysed using descriptive statistical methods. The variables were reduced from 30 to 9 clusters using principal component analysis with varimax rotation. Clusters were termed stakeholders' engagement, school and classroom practices, learner support, collaboration, professionalism, technology, relationships, diversity, and expertise.

Keywords: Principal Component Analysis, Innovative Strategies, Teachers, Secondary Schools, Learner Performance, Vhembe District

Authors' individual contribution: The Author is responsible for all the contributions to the paper according to CRediT (Contributor Roles Taxonomy) standards.

Declaration of conflicting interests: The Author declares that there is no conflict of interest.

Disclaimer: This paper is mainly drawn from the unpublished doctoral thesis titled "Education Innovation in Rural Secondary Schools in the Vhembe District, Limpopo Province, South Africa" by Ntsieni Fitzgerald Ramasimu, 2021, Tshwane University of Technology, Pretoria, South Africa.

1. INTRODUCTION

Global changes in cultural and economic growth have resulted in educational paradigm shifts in recent decades. These improvements have resulted in changes in how educational practitioners or educators develop curricula. Learner-centered and problem-centered techniques are frequently stated as having greater potential to convey knowledge and skills to the next generation than subject-centered. Every day, teachers make numerous decisions, such as how to facilitate engagement with and among

learners. To improve each learner's learning and development and to avoid steady detachment, school failure, or dropout, teachers must ensure that their learners are engaged in the learning process. Teachers' actions in and out of the classroom are critical, including how they encourage teacher-learner engagement, their instructional delivery methods, their engagement with parents and the community, and their assistance towards learner engagement (Havik & Westergard, 2020). To facilitate an interesting class, teachers must devise techniques that increase student involvement and foster a feeling of community. This promotes instructor feedback, relationship building, and collaborative learning while enabling independent networking and self-directed proactive learning (Munich, 2014; Rogo & Portillo, 2015; Sharoff, 2019). Additionally, teachers must foster and support students' use of sophisticated thinking while also helping them to build a sense of self-reflection and a personal and professional ethos that will eventually lead to an increase in confidence (Chadha, 2017; Elledge et al., 2018; Sharoff, 2019).

Teachers' subject knowledge, good questioning techniques, emphases on the introduction of the lesson, clearly outlining the objectives of the lesson, effective time management, excellent lesson preparation, the use of technology, and effective classroom management are all common instructional elements that seem to be linked to positive learning outcomes in students. If teachers have many of those qualities, they might motivate students to do well in their classes (Kumar & Raju, 2021).

The development of innovative learners is dependent on the development of innovative teaching by teachers and encouraging teachers to innovate is a significant study topic in educational innovations. The growing number of policies, rules, and regulations, and government-funded initiatives aimed at empowering educators worldwide to embrace and support innovative teaching. The transformation between educator learning and creativity is complex and demanding, making it an important task to create the conditions that enable educators to inspire innovation (Yu et al., 2021).

Innovative teachers are those whose teaching methods differ from the conventional patterns of knowledge-transfer teaching and teacher-centred teaching by solving educational problems in novel ways using new technologies and theoretical frameworks while guiding learners to participate in profound learning and improve their creativity (Tan et al., 2022). In 2020, the COVID-19 pandemic had an influence on classroom teaching, forcing teachers to switch to online learning by providing innovative techniques. Online free learning tools like massive open online courses (MOOC), strategies for interactions among peers, and study group clubs were made available to teachers by some governments and educational institutions. These resources may help teachers use creative teaching methods. One research team discovered that educators' informal digital learning throughout the outbreak had a beneficial effect on their use of groundbreaking teaching methods (Yu et al., 2021). However, given that it offered a rare opportunity to incorporate greater innovation into educational activities, some scholars feel that COVID-19 enhanced both informal learning and innovative teaching (Tan et al., 2022; Hamburg, 2021).

Given this, the goal of this article is to explore innovative teaching strategies using a principal component analysis perspective. Therefore, the objective of this article is to assess the extent to which rural secondary school teachers practice innovation in their day-to-day practices in South Africa to improve learner performance using a principal component analysis method.

The results from this research work can encourage secondary school teachers with the knowledge of how to implement innovative teaching strategies in their day-to-day teaching and learning activities. The study's results will contribute to the current research on innovative teaching practices in rural secondary schools. Moreover, the study will present recommendations to policymakers and educational practitioners on how to maximize the benefits of effective innovative teaching strategies in secondary schools.

The paper is organized as follows. Section 1 contains the introduction. Section 2 is a literature review. Section 3 describes the research methodology. Section 4 contains the study's findings and discussions, while Section 5 contains the paper's conclusion and managerial implications.

2. LITERATURE REVIEW

2.1. Innovation

Innovation can be found in both the physical world, where new products of all kinds are constantly produced, and in language, whether it be formal or informal. Every day debates about innovation take place, turning the idea into a cliche. Innovation is a topic that is extensively covered in scientific literature. Public policies in every country turn innovation into a tool for economic policy. Even though innovation was hotly debated just a few decades ago, according to researchers, it has now established itself as an essential, integral part of modern life. Innovation has existed as an idea since the beginning of time, although it has not always had such a desirable high position (Godin, 2014; Kovacs, 2017). O'Sullivan and Dooley (2008) defined innovation as "the process of making changes, large and small, radical and incremental, to products, processes, and services that results in the introduction of something new for the organisation that adds value to customers and contributes to the knowledge store of the organisation" (p. 5). Furthermore, "Innovation is the management of all the activities involved in the process of idea generation, technology development, manufacturing and marketing of a new (or improved) product or manufacturing process or equipment" (Trott, 2008, p. 15). According to Rogers (2003), innovation is "a new idea, practice, or object to an individual" (p. 12). Denning (2004) contends that innovation is a shift in practice in society rather than the introduction of a unique idea or item. In South African education, innovation is described as making long-term improvements to the public education system through the implementation of innovative concepts, processes, and/or products that produce new value at scale ("Global Education Leaders' Partnership (GELP)", 2016). Furthermore, the concept of innovation, according to Malini and Rajkumar (2022), refers to the introduction of something new

and valuable, such as new methods, processes, or practices, as well as new or updated products or services. Teachers innovate or experiment in any part of their profession linked to teaching-learning, training, or school management to increase school efficiency.

In this paper, innovation in education will refer to the development and implementation of new ideas, strategies, technologies, or methodologies that aim to improve the teaching and learning process thereby enhancing learner performance and provision of quality education.

2.2. Innovative teaching strategies

Innovative teaching strategy refers to the creative and efficient behaviour and performance that teachers purposefully use in selecting teaching materials, techniques, and learner evaluation aimed at enhancing and developing learner creativity. Innovative teaching includes components such as innovative teaching ideation, innovative teaching action, and innovative teaching outcome (Yu et al., 2021). The ideation of innovation in teaching symbolizes the innovation of teaching ideas and thinking, such as a willingness to acquire novel teaching perspectives, a favourable and receptive perspective on education, and so on. Moreover, teachers' employment of novel teaching methods and tools, such as innovating teaching objectives, designing diverse course materials, adaptable instructional techniques, and diverse approaches to assessments, are all examples of innovative teaching action. Whereas teachers' efficacy in nurturing students' creativity is represented by the innovative teaching outcome, which includes promoting and fostering learners' innovative thinking, encouraging learners' innovative thinking and achievements, and acknowledging and valuing learners' innovative abilities (Yu et al., 2021). Teachers must play a variety of roles in teaching-learning situations, such as encouraging, supporting, and facilitating learners in discovering their talents, realizing their physical and intellectual potential, developing characters and desirable social and human values, and functioning as responsible adults (Malini & Rajkumar, 2022).

In education, innovative teaching approaches may include the use of new teaching techniques, the incorporation of new concepts into curriculum content, and learning experiences, or the introduction of new or current teaching materials, as well as the implementation of a new change in the assessment of learning outcomes (Cox, 2020; Kayode et al., 2020). Gbadamosi (2013) identified a creative teaching approach as the adoption of novel instructional or assessment methods that are different from standard "talk and chalk" lecture methods. These tactics can be used to teach a single topic, a group of concepts, a theme, an idea, or a specific science subject. Innovative teaching methods are frequently tried to improve the effectiveness of one's teaching or to answer a question or challenge in instruction.

Furthermore, teachers can use learning experience design as another innovative teaching technique. Designing educational experiences is a team effort that involves innovative teaching methods and technological advances play important roles. The goal of creative teaching is to close the divide between the classroom environment and the world of work by designing teaching-learning processes for student competency improvement, facilitating individual and professional advancement, and allowing learners to apply their knowledge in practical scenarios (Karunanayaka, 2023; Penttilä, 2016). Educational innovations encourage the acquisition of "21st-century skills", such as analytical thinking, collaboration, interpersonal interaction, and innovation. Engaging in meaningful learning with technology also fosters the acquisition of such more advanced thinking abilities, helping learners to function as useful citizens of the 21st century. The benefits of web technology and the rising availability of digital tools present several options for teachers to build unique learning experiences for their learners (Karunanayaka, 2023).

To develop an innovative economy, schools must encourage deeper learning and innovation as opposed to emphasizing comprehension of low-order knowledge (Zhu & Wang, 2014). Furthermore, education is critical in developing learner capabilities in the construction and creation of knowledge. As a result, teachers must use innovative teaching methods to satisfy the educational needs of various groups of learners (Hargreaves, 2003).

Zhu and Wang (2014) maintain that creative teaching encompasses the improvement of learners' cognitive capacities as well as the use of novel techniques and methods by teachers in the classroom context. As a result, as part of creative teaching, teachers must incorporate learner-centered teaching and problem-based learning. Learners in learner-centered are projected to increase their learning activities both in and out of the classroom as a result of their approach to the learning process (Qibtiah & Ulimaz, 2017). If learning activity develops in a positive manner, learning outcomes in the cognitive, emotional, and psychomotor domains will improve significantly (Ulimaz et al., 2023).

Teachers are at the heart of effective instructional design and implementation in schools (Republic of South Africa [RSA], 2013). Teachers are essential to the teaching and learning process. They must go above and beyond to prepare learners for their future in education. Schools should provide excellent teaching and learning to attain success in student performance. Teachers are held responsible in school for effective and creative teaching and learning (Mbuisa, 2016). According to Zhu and Wang (2014), teachers should use innovative teaching methods to promote active learning that benefits students and develops their ability to innovate. Similarly, Botha et al. (2011) contend that educators are accountable for the instructional and educational practices at school. As a result, educators are accountable to the entire school community.

According to Zhu and Wang (2014), teachers should have "domain-specific knowledge, communication, pedagogy, and attitude" (p. 13) in order to engage in innovative teaching. These abilities are represented through educators' teaching actions and behaviours, and they have the potential to improve learner performance. According to Stipek et al. (2001, as cited in Zhu & Wang, 2014), teachers' perceptions of creative teaching influence how they execute their everyday activities.

Teachers have an important role in arousing students' interest in learning. Teachers can incorporate information from numerous sources and efficiently use that data to overcome instructional issues for current students who are surrounded by

information and communication technologies (ICTs) (Segers & Verhoeven, 2009). According to Timperley (2008), teachers use supportive learning, investigative learning, and self-study to help students think creatively and develop knowledge. The researcher believes that teachers should be held accountable for their students' success in their disciplines.

The quality of teachers is critical in producing excellent human capital (Gerritsen et al., 2014). Similarly, Haamoonga (2017) confirms that teachers are vital in school settings since they are central in shaping the success or failure of a school's innovative activities. Knox and Anfara (2013) concur that the manner in which instructors carry out their separate responsibilities influences the performance of any school.

According to Organisation for Economic Co-operation and Development (OECD, 2013), educators ought to possess knowledge and abilities to assist their students in achieving learning outcomes. As a result, complex instruction is required to educate 21st-century learners on capabilities such as in-depth material mastery, critical thinking, problem-solving skills, and teamwork and communication. According to the State of Victoria (2014), teachers should recognize that students are worthy of learning and, as a result, individualize instruction to meet the needs of each student. Ingule et al. (2011) argue that teachers should comprehend and be aware of the different aspects that influence teaching and learning and, as a result, employ tactics that encourage learners' involvement.

The imperative literature has examined innovation for instructional purposes and established certain characteristics of teachers that could be associated with innovative teaching. Lin (2009) recognized domain-specific knowledge as crucial for innovative teaching in his study. Whereas Cowen (2012) identified "a high degree of subject knowledge, pedagogics, and learning psychology knowledge as critical for innovative teaching" (p. 23). Könings et al. (2007) and Zhu and Wang (2014) pointed out teachers' willingness to learn and continuous professional development as significant features for executing educational innovations. Koster et al. (2005) emphasized the importance of communication skills in innovative education. According to Pantić and Wubbels (2010), creating healthy human relationships and passion for profession and learners are crucial characteristics of innovative teaching. They also outlined other personal qualities such as "passion, interests, perseveration, courage, empathy, being democratic, and mindfulness of the profession's reputation and obligation" (Pantić & Wubbels, 2010, p. 17).

The use of digital technologies in teacher professional development assists educators in designing new technology-enhanced learning (Karunanayaka, 2023; Laurillard et al., 2018). The capacity development initiatives that include chances for learning by design would motivate and inspire teachers to evolve into innovative designers of technology-enhanced learning experiences for their students. Professional development programs for teachers necessitate a careful balance of subject matter information, instructional methodologies, and technological integrations (Karunanayaka, 2023). Thus, these programmes will have a positive impact on learner performance and curriculum delivery.

The incorporation of technology into educational practices refers to the use of technology to facilitate learner discovery, teacher-driven design, empathetic support, innovative problem-solving with computers, and the contented use of computer-based programs for prescribed educational goals (Adelabu et al., 2022; Callaghan et al., 2018). As a result, technology improves teaching and learning both inside and beyond the classroom. Furthermore, self-motivated elements like engaged methods of teaching and learning, high-tech features of new tools, and the possibility of transforming education are linked to technology integration (Adelabu et al., 2022; Viberg et al., 2020). Technology integration in education is crucial and is progressively being created since it is related with enhanced learner performance (Adelabu et al., 2022).

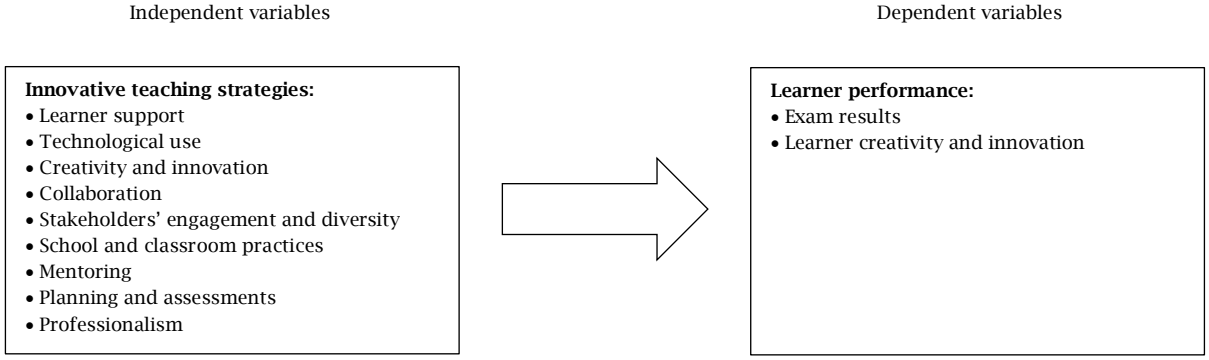
Different levels of teaching expertise among teachers are evident in their approaches to innovative teaching. On the one hand, inexperienced teachers and experienced teachers focus on various topics and have various learning objectives. Young teachers who wish to learn practical teaching skills, such as discipline knowledge and classroom management techniques, focus more on the material that is specifically geared toward teaching skills (Burns, 2008; Tan et al., 2022). Teachers with greater classroom experience tend to focus on innovative teaching techniques and are more likely to reflect on and research scholarly literature (Henze et al., 2009; Tan et al., 2022). On the other hand, educators with varying levels of classroom experience have varying perspectives on and approaches to innovative teaching. Teachers with more teaching experience have greater awareness and recognition of innovative teaching methods than teachers with less teaching experience (Li & Li, 2019; Tan et al., 2022), are more willing to devote time and resources to innovative teaching and perform innovative teaching more effectively (Chien & Hui, 2010; Huang, 2021). In other words, teachers with more experience pay more attention to basic teaching techniques and identify more with creative teaching, whereas teachers with less experience focus more on flexible use of teaching methods in informal learning.

Innovative teaching strategies as suggested in this study, are an effective way to teach all learners because they can be used to convey knowledge in a way that enhances learner engagement, makes lessons more interesting, easier for learners to understand, and improves learning and retention. Innovative teaching strategies that are used in classrooms may include the use of new teaching techniques, the addition of new concepts to the curriculum's learning objectives or learning experiences, the introduction of new or existing teaching materials, or the adoption of new advancements in the assessment of teaching and learning outcomes, and the adoption of new technologies (Kayode et al., 2020). Moreover, it could refer to the application of new, or tested, existing concepts, methods, and tools, which are frequently not entirely original but rather fresh iterations of tried-and-true methods that, because they have not yet gained widespread acceptance, appear novel to others.

Based on an extensive literature review on innovation and innovative teaching strategies, one could not find similar studies that were conducted

in rural areas, particularly the Vhembe District in the Limpopo Province, South Africa. Therefore, the study seeks to fill the population gap identified by trying to conduct research pertaining to the population that has not been sufficiently researched in the evidence base of earlier research.

Figure 1. Conceptual framework



3. RESEARCH METHODOLOGY

As part of the research methodology, this study consists of two basic components, that is a literature review as well as an empirical study. The study used a quantitative research design. Quantitative research is a methodical strategy that entails collecting and analysing numerical data to gain insights and develop conclusions (Al-Azzam & Al-Mizeed, 2021). This research method is based on the positivist concept, which emphasizes objectivity and the ability to measure variables (Saunders et al., 2015). Hameed (2020) asserts that quantitative research seeks to discover new details by simplifying difficulties in a more contrived setting.

The study used a survey research design. Survey research design is one of the most used quantitative research approaches. Survey research entails administering a survey to collect data from individuals or groups (Kumar, 2014). It enables researchers to gather both implicit qualitative data, such as opinions and behaviours, and explicit quantitative data, such as numerical descriptions and trends. The survey design is critical in quantitative research because it provides a standardized framework for collecting data from a sample of people who represent a wider population (Kumar, 2014). Researchers can collect data via questionnaires or online surveys when employing a quantitative survey study design. This strategy enables the collection of vast amounts of data from a wide variety of people. Furthermore, researchers might employ quantitative surveys to evaluate and interpret data using statistical, mathematical, or computational techniques.

According to Bryman and Bell (2014), a population represents the collection of units, including individuals, nations, cities, regions, and companies from which the sample will be selected. The population of this study includes all the teachers in Vhembe District, Limpopo Province, South Africa. The study population was 2793 teachers in the district. The study used a probability sampling strategy to sample respondents. McMillan and Schumacher (2014) indicate that in probability sampling, subjects are drawn from a population with known probabilities. Simple random sampling was utilized for the purposes of this research. It gave each participant in the population the same opportunity to be chosen, giving the researcher the opportunity to generalize from the sample to the population (Weil, 2017). The list of the names of secondary schools was requested from the Vhembe District Office. The list contains the names of schools and the number of teachers in each school.

The sample size was calculated according to the Raosoft sample size calculator (Raosoft, 2004) with a margin of error of 5% and a confidence level of 95% with a population size of N = 2793 and a response distribution of 50%. Therefore, the sample size for this study is N = 338.

The empirical approach entails data collection using questionnaires. The researcher hand-delivered the questionnaires to the sampled respondents to complete them, and the completed questionnaires were collected by the researcher at an agreed-upon time. The questionnaire was used in this study as an instrument to collect primary data. The questionnaire included structured questions that allowed respondents to easily convey their ideas on the issue under investigation. Respondents were able to indicate their level of innovative teaching practices that impact learner performance and quality education by using 5-point Likert scale questions. Good measures, reliability, and validity are unquestionably the keys to determining the credibility of any research work. A pilot study with 10 respondents was used to test the reliability of the questionnaire. Furthermore, the Cronbach's alpha was used to guarantee the study's reliability. Descriptive statistics and principal component analysis were used to analyse the data.

4. RESULTS AND DISCUSSION

A total of 338 secondary school teachers were sampled using simple random sampling techniques. Questionnaires were distributed to all sampled teachers to complete. A total of 243 completed questionnaires were returned. Allison (2001) claims that a missing value can represent or be a product of an unknown value. Data screening was performed to check for data entry accuracy, missing data, normality, and miscoded data. Data screening was performed to improve the data so that statistical analysis procedures are precise, and estimates have a broad base. Three steps were taken to remove the missing data. The researcher confirmed that no questionnaire was captured before determining

whether the questionnaire was fully completed. From the 243 questionnaires received, 207 were fully completed and thus captured using Statistical Package for the Social Sciences (SPSS) version 26.0. The remaining 36 incomplete questionnaires were discarded. Physical verification was also performed on the data entered SPSS version 26.0 and compared to the original data on the questionnaires. There were two stages to the data proof analysis. After entering the data into the SPSS version 26.0 software, the researcher performed an item-by-item check to ensure that all data had been correctly captured. A statistician was also tasked with looking for missing data. The questionnaire's missing data was checked using Microsoft Excel version 2016, SPSS version 26.0, and AMOS version 26.0. Thus, no data was found missing, and there were no outliers. The Kolmogorov–Smirnov test was employed to assess the normality of the data for the current study because the sample size was more than 100. The data may be believed to be normal because the significance value was more than 0.05. Table 1 shows the mean rating for innovative teaching strategies for improving learner performance and educational quality.

Principal component analysis

Data analysis became more challenging and complicated due to the high number of variables associated with teachers' innovative ways to increase learner performance and quality education. Principal component analysis is commonly utilized to circumvent this barrier by clustering together variables that have significant correlations into principal components, resulting in analysis simplicity. Principal components analysis, according to Leech et al. (2007), is a data reduction approach performed to narrow down an excessive number of variables into a more manageable set of basic components that summarize the most important details that make up the variables. The percentage of variance accounted for by the variable, the absolute variance accounted for by each principal component, and whether the component can be meaningfully interpreted all influence the decision of which principal components to keep. Varimax rotation was employed to turn the components into more easily interpretable factors. Factor rotation methods were created to aid in the comprehension of principal components. Kaiser's (1958) varimax orthogonal rotation method is used in this research investigation. Typically, principal components with eigenvalues higher than one are included.

The assumptions for principal component analysis, as stated by Leech et al. (2007), are as follows:

The sample size of 207 participants is adequate. *Normality:* Principal component analysis is not affected by the presumption of normality. The Kolmogorov–Smirnov test was used to ensure that the data was normal (significance value larger than 0.05). *Sample adequacy:* The Bartlett's test of sphericity (BTS) and the Kaiser–Meyer–Olkin (KMO) tests assess sample adequacy and are respectively utilized for determining the factorability of the matrix. If BTS is high and significant, and the KMO is more than 0.6, factorability is inferred. The KMO measure of sample adequacy is an index employed to assess the usefulness of factor analysis. High scores (between 0.5 and 1.0) imply that factor analysis is appropriate (Leech et al., 2007). The BTS and KMO suitability tests were performed to confirm the usage of principal component analysis (Table 2). The results (*BTS* of 2540,233 and degree of significance of $p = 0.000$) suggested that the data proved suitable for principal component analysis. The *KMO* measure of sample adequacy yielded a result of 0.740, indicating that the sample contains enough items in every element. The results of the two tests demonstrate the usefulness of the principal component analysis approach. According to Table 3, nine components with Eigen scores above one were responsible for 69.829% of the overall variance. Only factors with eigenvalues more than one must be retained, according to the requirements of principal component analysis.

1. Table 4 shows that the initial component contains an eigenvalue of 6.858 and a variance percentage of 24.493%. Six components make up the component. This component includes the elements *"I involve parents in the learners' work"* (0.815). This item has the highest factor loading. Other items include *"I communicate learners' progress with parents"* (0.755); *"I look for out-of-the-classroom applications"* (0.662); *"I participate in professional bodies"* (0.640); *"I know the vision and mission of the school"* (0.639), and *"I value diversity of learners in class"* (0.614). Cronbach's alpha of this component was 0.793, suggesting the cluster's reliability. The component is labelled "Stakeholders' engagement and diversity". According to Botha et al. (2011), teachers oversee the teaching and learning process at school. As a result, teachers should be accountable to the department, their students, their parents, and the community in general. Student diversity is exemplified in today's classrooms. Students at colleges and universities are diverse in many ways, including culture, religion, family background, area, and schools attended. Students' learning demands are getting increasingly diverse because of such diversity. A new issue is to find educational methods that can meet their needs (Naz & Murad, 2017). Teachers utilize a variety of innovative teaching and varied strategies and approaches in their classes to meet the diverse requirements of students at higher educational levels. As a result, teachers should use innovative teaching methods to address the educational needs of various student populations (Hargreaves, 2003).

2. The second component had an eigenvalue of 2.878 and a variance with a percentage of 10.278%. The component is made up of four items. This component includes the item *"I use assessment data to improve my lesson"* with a Cronbach's alpha of 0.794. This item has the highest factor loading. Other answers include: *"I design classroom-discipline policies with learners"* with a Cronbach's alpha of 0.736; *"I am able to recognize and support learners at risk"* with a Cronbach's alpha of 0.541, and *"I am active in the development of school initiatives"* with Cronbach's alpha of 0.445. Cronbach's alpha for this component was 0.710, reflecting the cluster's reliability. The component is labelled "School and classroom practices". Student diversity is exemplified in today's classrooms. Students at colleges and universities are diverse in many ways, including culture, religion, family background, area, and schools attended. Students' learning demands are getting increasingly diverse as

a result of such diversity. A new issue is to find educational methods that can meet their needs (Naz & Murad, 2017). Teachers utilize a variety of innovative teaching and varied strategies and approaches in their classes to meet the diverse requirements of students at higher educational levels. As a result, teachers should use innovative teaching methods to address the educational needs of various student populations (Hargreaves, 2003).

3. The third component had an eigenvalue of 1.900 and a variance percentage of 6.7877%. The component is made up of three items. This component has the following items: *"I develop learner-support techniques"* with a Cronbach's alpha of 0.796; *"I develop subject improvement plans"* with a Cronbach's alpha of 0.766, and *"I encourage group work"* with a Cronbach's alpha of 0.441. Cronbach's alpha for this component was 0.743, showing the cluster's reliability. The component is labelled "Learner support". A study by Yu et al. (2021) indicates that teachers' efficacy in nurturing learners' creativity is represented by the innovative teaching outcome, which includes supporting and encouraging learners' flexible thinking, rewarding learners' creative efforts and achievements, and recognizing and appreciating learners' creative abilities.

4. The fourth component has an eigenvalue of 1.680 and a percentage of the variance of 5.999%. The component consists of three items. The items included in this component include, *"I surround myself with positive, caring and hardworking colleagues"* with a Cronbach's alpha of 0.733; *"I always discuss best practices with colleagues"* with a Cronbach's alpha of 0.698; *"I have a connection with other teachers from different schools"* with a Cronbach's alpha of 0.584. Cronbach's alpha for this component yielded a value of 0.701 indicating the reliability of the cluster. The component is labelled "Collaboration". Admiraal et al. (2021) indicate that collaboration encompasses all activities that foster teacher collaboration and link teachers' work and professional growth. Some activities encourage teacher collaboration for example, "team teaching, collaborative action research, peer observation, and review", while others emphasize collaborative learning, for example, "knowledge networks, book clubs, learning laboratories". Other types of activities pertaining to the support of collaborative working and learning, such as "study days, knowledge café".

5. The fifth component has an eigenvalue of 1.442 and a percentage of the variance of 5.152%. The component consists of three items. The items included in this component include, *"I always conduct assessment according to assessment policy"* with a Cronbach's alpha of 0.812; *"I display professional conduct towards my learners"* with a Cronbach's alpha of 0.681; *"I attend all my classes regularly"* with a Cronbach's alpha of 0.524. Cronbach's alpha for this component yielded a value of 0.753 indicating the reliability of the cluster. The component is labelled "Professionalism". According to OECD (2013), teachers must possess knowledge and abilities to assist their students in achieving their educational goals. As a result, sophisticated teaching is required to educate 21st-century learners' capabilities, such as comprehensive content mastery, critical thinking, problem-solving skills, and teamwork and communication.

6. The sixth component has an eigenvalue of 1.412 and a percentage of the variance of 5.044%. The component consists of three items. The items included in this component include, *"I use technology to see others in action"* with a Cronbach's alpha of 0.770; *"I watch colleagues in action"* with a Cronbach's alpha of 0.683; *"I encourage learners to comment at the end of each lesson"* with a Cronbach's alpha of 0.586. Cronbach's alpha for this component yielded a value of 0.698 indicating the reliability of the cluster. The component is labelled "Technology usage". Teachers, as the primary source of knowledge, must be up to speed on curriculum and other resources, including the use of technology. Technology is a beneficial new tool for teaching learners, but it can only be used if teachers are trained in its use (Naz & Murad, 2017).

7. The seventh component has an eigenvalue of 1.219 and a percentage of the variance of 4.354%. The component consists of three items. The items included in this component include, *"I am friendly and supportive to my learners"* with a Cronbach's alpha of 0.684; *"I motivate and encourage learners"* with a Cronbach's alpha of 0.660, and *"I encourage group work"* with a Cronbach's alpha of 0.514. Cronbach's alpha for this component yielded a value of 0.696 indicating the reliability of the cluster. The component is labelled "Mentoring". Timperley (2008) indicates that "teachers make use of supportive learning, investigative learning, group work, and self-study to assist learners to think creatively and to be able to construct knowledge.

8. The eighth component has an eigenvalue of 1.125 and a percentage of the variance of 4.020%. The component consists of two items. The items included in this component include, *"I use different strategies when presenting lessons"* with a Cronbach's alpha of 0.863 and *"I encourage creativity and innovation"* with a Cronbach's alpha of 0.727. Cronbach's alpha for this component yielded a value of 0.813 indicating the reliability of the cluster. The component is labelled "Creativity and innovation". Ulimaz et al. (2023) found that implementing innovative teaching strategies using learner-centered learning models resulted in better teaching and learning activities when compared to conventional learning models. The problem-based learning paradigm is one learning model that can engage students in the classroom. Teachers must understand how to inspire and entice learners to like learning activities and the material offered (Dacholfany et al., 2022; Ulimaz et al., 2023).

9. The ninth component has an eigenvalue of 1.037 and a percentage of the variance of 3.703%. The component consists of three items. The items included in this component include, *"I always prepare my lessons"* with a Cronbach's alpha of 0.882; *"I influence learners positively"* with a Cronbach's alpha of 0.787, and *"I assess learners regularly using assessment timetable"* with a Cronbach's alpha of 0.677. Cronbach's alpha for this component yielded a value of 0.790 indicating the reliability of the cluster. The component is labelled "Planning and assessments". According to OECD (2013), teachers must possess knowledge and abilities to assist their students in achieving their educational goals. As a result, sophisticated teaching is required to educate 21st-century learners' capabilities, such as comprehensive content mastery, critical thinking, problem-solving skills, and teamwork and communication.

Table 1. Mean ranking of innovative teaching strategies by teachers

Item	*Mean*	*Std. deviation*	*N*
1. *I always conduct assessment according to assessment policy*	1.3527	0.47896	207
2. *I display professional conduct towards my learners*	1.3865	0.48812	207
3. *I always prepare my lessons*	1.3623	0.48184	207
4. *I influence learners positively*	1.3478	0.47744	207
5. *I know the vision and mission of the school*	2.1159	0.77340	207
6. *I am involved in the development of school strategies*	1.8213	0.77078	207
7. *I attend all my classes regularly*	1.2705	0.48697	207
8. *I assess learners regularly using assessment time-table*	1.6570	0.50554	207
9. *I use different strategies when presenting lessons*	1.6329	0.53106	207
10. *I encourage creativity and innovation*	1.7874	0.67783	207
11. *I provide regular and timeously feedback to my learners*	1.5700	0.51546	207
12. *I involve parents in the learners' work*	2.4638	0.91237	207
13. *I develop learner-support strategies*	1.9275	0.35467	207
14. *I develop subject improvement plans*	1.8744	0.49627	207
15. *I encourage group work*	1.5121	0.63750	207
16. *I value diversity of learners in class*	2.1063	0.68145	207
17. *I motivate and encourage learners*	1.4300	0.58598	207
18. *I use assessment data to improve my lesson*	1.9952	0.61925	207
19. *I develop classroom-discipline policy with learners*	1.9565	0.59369	207
20. *I am able to identify learners at risks and provide support*	1.9855	0.57012	207
21. *I communicate learners' progress with parents*	2.4879	0.99932	207
22. *I am friendly and supportive to my learners*	1.4010	0.62208	207
23. *I watch colleagues in action*	2.1256	0.79664	207
24. *I use technology to see others in action*	3.2560	1.01309	207
25. *I encourage learners to comment at the end of each lesson*	2.8937	1.39983	207
26. *I have a connection with other teachers from different schools*	2.0097	0.68966	207
27. *I surround myself with positive, caring and hardworking colleagues*	1.8213	0.49456	207
28. *I participate in professional bodies*	2.5749	0.94661	207
29. *I always discuss best practices with colleagues*	1.8599	0.53489	207
30. *I look for out-of-the-classroom applications*	2.6908	0.90364	207

Table 2. Kaiser–Meyer–Olkin and Bartlett's test

KMO and Bartlett's test	
Kaiser–Meyer–Olkin measure of sampling adequacy (KMO)	0.740
Bartlett's test of sphericity approx. (Chi-square)	2540.233
Df	378
Sign.	0.000

Table 3. Total variances explained

Item	*Initial eigenvalues*			*Extraction sums of squared loadings*			*Rotation sums of squared loadings*		
	Total	*% of variance*	*Cumulative %*	*Total*	*% of variance*	*Cumulative %*	*Total*	*% of variance*	*Cumulative %*
1	6.858	24.493	24.493	6.858	24.493	24.493	3.638	12.994	12.994
2	2.878	10.278	34.771	2.878	10.278	34.771	2.322	8.292	21.286
3	1.900	6.787	41.558	1.900	6.787	41.558	2.080	7.427	28.713
4	1.680	5.999	47.556	1.680	5.999	47.556	2.073	7.404	36.118
5	1.442	5.152	52.708	1.442	5.152	52.708	2.024	7.227	43.345
6	1.412	5.044	57.752	1.412	5.044	57.752	2.023	7.226	50.571
7	1.219	4.354	62.106	1.219	4.354	62.106	1.858	6.636	57.207
8	1.125	4.020	66.126	1.125	4.020	66.126	1.841	6.574	63.781
9	1.037	3.703	69.829	1.037	3.703	69.829	1.693	6.048	69.829
10	0.861	3.077	72.906						
11	0.784	2.801	75.706						
12	0.752	2.686	78.392						
13	0.714	2.549	80.942						
14	0.667	2.382	83.324						
15	0.581	2.075	85.399						
16	0.545	1.945	87.344						
17	0.475	1.697	89.042						
18	0.441	1.575	90.616						
19	0.423	1.510	92.126						
20	0.381	1.359	93.485						
21	0.349	1.248	94.733						
22	0.310	1.107	95.840						
23	0.271	0.969	96.808						
24	0.221	0.788	97.596						
25	0.195	0.696	98.292						
26	0.182	0.649	98.941						
27	0.170	0.606	99.547						
28	0.127	0.453	100.000						

Note: Extraction method — Principal component analysis.

Table 4. Rotated matrix

Item	Component								
	1	2	3	4	5	6	7	8	9
I involve parents in the learners' work	0.815								
I communicate learners' progress with parents	0.755								
I look for out-of-the-classroom applications	0.662								
I participate in professional bodies	0.640								
I know the vision and mission of the school	0.639								
I value diversity of learners in class	0.614								
I use assessment data to improve my lesson		0.794							
I develop classroom-discipline policy with learners		0.736							
I am able to identify learners at risks and provide support		0.541							
I am involved in the development of school strategies		0.445							
I develop learner-support strategies			0.796						
I develop subject improvement plans			0.766						
I encourage group work			0.441						
I surround myself with positive, caring and hardworking colleagues				0.733					
I always discuss best practices with colleagues				0.698					
I have a connection with other teachers from different schools				0.584					
I always conduct assessment according to assessment policy					0.812				
I display professional conduct towards my learners					0.681				
I attend all my classes regularly					0.524				
I use technology to see others in action						0.770			
I watch colleagues in action						0.683			
I encourage learners to comment at the end of each lesson						0.586			
I am friendly and supportive to my learners							0.684		
I motivate and encourage learners							0.660		
I encourage group work							0.514		
I use different strategies when presenting lessons								0.863	
I encourage creativity and innovation								0.727	
I always prepare my lessons									0.882
I influence learners positively									0.787
I assess learners regularly using assessment timetable									0.677
Cronbach's alpha	0.793	0.710	0.743	0.701	0.753	0.698	0.696	0.813	0.790

5. CONCLUSION

The purpose of this study was to look into the impact of innovative teaching practices on learner performance in rural secondary schools using principal component analysis. According to the study's findings, nine components with eigenvalues greater than one account for 69.829% of the total variance. Only factors with eigenvalues larger than one should be maintained, according to the requirements of principal component analysis. The components were labelled "Learner support", "Technological use", "Creativity and innovation", "Collaboration", "Stakeholders' engagement and diversity", "School and classroom practices", "Mentoring", "Assessments", and "Professionalism". According to Yu et al. (2021), teachers who use innovative teaching tactics are frequently regarded as partners and facilitators in the teaching and learning process rather than as information keepers. Furthermore, Yu et al. (2021) indicate that innovative teaching strategies are learner-centered, encourage creativity, encourage group work, motivate students to learn new concepts, reduce anxiety and stress when dealing with difficult concepts, and provide an active learning environment to facilitate interest, self-motivation, top performance, and class attendance. Innovative teaching strategies promote emotional stability and social learning, as well as creativity, divergent thinking, critical thinking, and the ability to invent. It improves the learner's psychomotor, cognitive, and emotive domains by providing a dynamic environment that fosters interest.

Thus, the results of the study highlighted the importance of innovative teaching strategies to improve learner performance. The principal theoretical implication of this study is that we confirmed that innovative teaching practices have an impact on learner performance. The study's practical implication is that policymakers must establish a suitable climate in schools to enable creative teaching approaches. To accomplish such an important objective, school leaders have to establish a supportive climate that fosters continuous learning through teamwork, participatory and collaborative decision-making, constant inquiry, and strategic leadership. The combination of this learning organization and a supportive environment can significantly increase teachers' organizational inventiveness (Tan et al., 2022) and as such enhance their innovative teaching practices. Moreover, school management and authorities must appreciate innovation support innovative teaching strategies, and develop school frameworks that promote the culture of innovation to enhance and sustain the knowledge economy.

There are four major limitations to this study that must be noted. Firstly, the cross-sectional design renders establishing the causal link between teachers' innovative teaching approaches and learner performance difficult. In particular, there is a process for externalizing learning benefits, and it may take some time to translate informal learning into creativity (Yu et al., 2021). As a result, future research should use longitudinal or mixed-method designs to investigate how these variables interact over time. Second, to assess instructors' innovative teaching practices, a self-report method was

adopted. As a result, relying solely on self-report methodologies to assess creative teaching inevitably simplifies our knowledge of the phenomenon (Huang, 2021). Other stakeholders' ratings (e.g., school governing body, parents, school management team, and learners) should be included in future study, and a variety of standards for innovative teaching practices should be used. Finally, the population used for this study came from a single district in South Africa's Limpopo Province. Given the variations in innovative teaching throughout the country's regions and cultures (Tan et al., 2022), more research in various provinces and cultural contexts must be conducted to deepen our understanding of the relationship between innovative teaching tactics and learner performance.

REFERENCES

1. Adelabu, F. M., Ngwabe, A., & Alex, J. (2022). Self-directed learning through computer-aided mathematics instruction: First-year teacher education experience. *International Journal of Higher Education, 11*(3), 79–89. https://doi.org/10.5430/ijhe.v11n3p79
2. Admiraal, W., Schenke, W., De Jong, L., Emmelot, Y., & Sligte, H. (2021). Schools as professional learning communities: What can schools do to support professional development of their teachers? *Professional Development in Education, 47*(4), 684–698. https://doi.org/10.1080/19415257.2019.1665573
3. Al-Azzam, A. F., & Al-Mizeed, K. (2021). The effect of digital marketing on purchasing decisions: A case study in Jordan. *The Journal of Asian Finance, Economics and Business, 8*(5), 455–463. https://doi.org/10.13106/JAFEB.2021.VOL8.NO5.0455
4. Allison, P. D. (2001). *Missing data*. SAGE publications. https://doi.org/10.4135/9781412985079
5. Botha, R. J., Kamper, G. D., & Van Niekerk, M. P. (2011). *Research methodology and theoretical foundation in education management*. University of South Africa.
6. Bryman, A., & Bell, E. (2014). *Research methodology: Business and management contexts*. Oxford University Press Southern Africa.
7. Burns, J. Z. (2008). Informal learning and transfer of learning: How new trade and industrial teachers perceive their professional growth and development. *Career and Technical Education Research, 33*(1), 3–24. https://doi.org/10.5328/CTER33.1.3
8. Callaghan, M. N., Long, J. J., van Es, E. A., Reich, S. M., & Rutherford, T. (2018). How teachers integrate a math computer game: Professional development use, teaching practices, and student achievement. *Journal of Computer Assisted Learning, 34*(1), 10–19. https://doi.org/10.1111/jcal.12209
9. Chadha, A. (2017). Comparing student reflectiveness in online discussion forums across modes of instruction and levels of courses. *Journal of Educators Online, 14*(2), 1–19. https://doi.org/10.9743/jeo.2017.14.2.8
10. Changawa, N. L. (2019). *Effect of innovative teaching strategies on the performance of public secondary schools in Kilifi County, Kenya* [Doctoral dissertation, University of Nairobi]. http://erepository.uonbi.ac.ke/handle/11295/109725
11. Chien, C. Y., & Hui, A. N. (2010). Creativity in early childhood education: Teachers' perceptions in three Chinese societies. *Thinking Skills and Creativity, 5*(2), 49–60. https://doi.org/10.1016/j.tsc.2010.02.002
12. Cowen, R. (2012). 1. Socrates was right? Teacher education systems and the state. In E. Thomas (Ed.), *World yearbook of education 2002: Teacher education-dilemmas and prospects* (1st ed.). Routledge.
13. Cox, J. (2020, January 28). What is the role of a teacher. *ThoughtCo*. https://www.thoughtco.com/what-is-the-role-of-a-teacher-2081511
14. Dacholfany, M. I., Fujiono, F., Safar, M., Hanayanti, C. S., & Ulimaz, A. (2022). Education management based on inspirational and meaningful learning in the age of digital technology. *Journal of Education and Counseling, 4*(6), 6853–6861.
15. Denning, P. J. (2004). The social life of innovation. *Communications of the ACM, 47*(4), 15–19. https://doi.org/10.1145/975817.975834
16. Elledge, R., Houlton, S., Hackett, S., & Evans, M. J. (2018). "Flipped classrooms" in training in maxillofacial surgery: Preparation before the traditional didactic lecture? *British Journal of Oral and Maxillofacial Surgery, 56*(5), 384–387. https://doi.org/10.1016/j.bjoms.2018.04.006
17. Gbadamosi, T. V. (2013). Effects of teaching citizenship component of social studies on primary school pupils' civic knowledge and skills. *Nigerian Journal of Social Studies, 14*(2), 124–133.
18. Gerritsen, S., Plug, E., & Webbink, D. (2014). Teacher quality and student achievement from a Dutch sample of twins. *Journal of Applied Econometrics, 28*(6), 643–660. https://doi.org/10.1002/jae.2539
19. Global Education Leaders' Partnership (GELP). (2016). *Education Reimagined*. https://education-reimagined.org/resources/global-education-leaders-partnership/
20. Godin, B. (2014). Innovation and creativity: A slogan, nothing but a slogan. In C. Antonelli & A. Link (Eds.), *Handbook of the economics of knowledge* (1st ed., pp. 17–29). Routledge.
21. Haamoonga, B. C. (2017). *Learner performance and teaching in public secondary schools in Zambia: A critical study* [Doctoral dissertation, University of South Africa]. Unisa Institutional Repository (UnisaIR). http://hdl.handle.net/10500/24461
22. Hamburg, I. (2021). COVID-19 as a catalyst for digital lifelong learning and reskilling. *Advances in Research, 22*(1), 21–27. https://doi.org/10.9734/AIR/2021/v22i130282
23. Hameed, H. (2020). Quantitative and qualitative research methods: Considerations and issues in qualitative research. *The Maldives National Journal of Research, 8*(1), 8–17. http://saruna.mnu.edu.mv/jspui/bitstream/123456789/8523/1/Quantitative%20and%20qualitative%20research%20methods%20%20considerations%20and%20issues%20in%20qualitative%20research.pdf
24. Hargreaves, A. (2003). *Teaching in the knowledge society: Education in the age of insecurity*. Teachers College Press.
25. Havik, T., & Westergård, E. (2020). Do teachers matter? Students' perceptions of classroom interactions and student engagement. *Scandinavian Journal of Educational Research, 64*(4), 488–507. https://doi.org/10.1080/00313831.2019.1577754
26. Henze, I., van Driel, J. H., & Verloop, N. (2009). Experienced science teachers' learning in the context of educational innovation. *Journal of Teacher Education, 60*(2), 184–199. https://doi.org/10.1177/0022487108329275

27. Huang, X. (2021). Striving for better teaching and student creativity development: Linking informal workplace learning and teaching for creativity. *Thinking Skills and Creativity, 41,* Article 100889. https://doi.org/10.1016/j.tsc.2021.100889
28. Ingule, F. O., Rono, R. C., & Ndambuki, P. W. (2011). *Introduction to educational psychology*. East African Educational Publishers.
29. Kaiser, H. F. (1958). The varimax criterion for analytic rotation in factor analysis. *Psychometrika, 23*(3), 187–200. https://doi.org/10.1007/BF02289233
30. Karunanayaka, S. P. (2023). Blending innovative pedagogy and technology for capacity development of educators during the pandemic. *Journal of Learning for Development, 10*(1), 24–37. https://doi.org/10.56059/jl4d.v10i1.783
31. Kayode, O. O., Ogundokun, R. O., Mohammed, R. E., & Olorundare, A. S. (2020). Review of innovative teaching strategies in senior secondary schools sciences. *i-Manager's Journal of Educational Technology, 17*(1), 56–65. https://eric.ed.gov/?id=EJ1269287
32. Knox, J. A., & Anfara, V. A., Jr. (2013). Understanding job satisfaction and its relationship to student academic performance. *Middle School Journal, 44*(3), 58–64. https://doi.org/10.1080/00940771.2013.11461857
33. Könings, K. D., Brand-Gruwel, S., & van Merrienboer, J. J. (2007). Teachers' perspectives on innovations: Implications for educational design. *Teaching and Teacher Education, 23*(6), 985–997. https://doi.org/10.1016/j.tate.2006.06.004
34. Koster, B., Brekelmans, M., Korthagen, F., & Wubbels, T. (2005). Quality requirements for teacher educators. *Teaching and Teacher Education, 21*(2), 157–176. https://doi.org/10.1016/j.tate.2004.12.004
35. Kovacs, H. (2017). Learning and teaching in innovation: Why it is important for education in 21st century. *Education Sciences, 2,* 45–60. https://doi.org/10.21549/NTNY.18.2017.2.4
36. Kumar, A. A., & Raju, T. S. (2021). A study on the innovative teaching strategies of physical science in secondary level schools.
37. Kumar, R. (2014). *Research methodology: A step-by-step guide for beginners* (4th ed.). SAGE Publications.
38. Laurillard, D., Kennedy, E., Charlton, P., Wild, J., & Dimakopoulos, D. (2018). Using technology to develop teachers as designers of TEL: Evaluating the learning designer. *British Journal of Educational Technology, 49*(6), 1044–1058. https://doi.org/10.1111/bjet.12697
39. Leech, N., Barrett, K., & Morgan, G. A. (2007). *SPSS for intermediate statistics: Use and interpretation* (3rd ed.). Routledge. https://doi.org/10.4324/9781410616739
40. Li, Z., & Li, L. (2019). An examination of kindergarten teachers' beliefs about creative pedagogy and their perceived implementation in teaching practices. *Thinking Skills and Creativity, 32,* 17–29. https://doi.org/10.1016/j.tsc.2019.03.001
41. Lin, C. (2009). *Researches into creative talents and creative education*. Economic Science Press.
42. Malini, K., & Rajkumar, R. (2022). Different innovative instructional designs for teacher education students. In A. Muthumanickam & B. Kannan (Eds.), *Essentials of techno-pedagogy* (pp. 60–70). Shanlax Publications. https://rb.gy/lugc19
43. Mbuisa, M. (2016). *Assisting Grade 12 learners in township schools to perform optimally: A case study in the Tshwane South District of Gauteng Province* [Doctoral dissertation, University of South Africa]. Unisa Institutional Repository (UnisaIR). https://uir.unisa.ac.za/bitstream/handle/10500/22717/dissertation_mbuisa_m.pdf?isAllowed=y&sequence=1
44. McMillan, J. H., & Schumacher, S. (2014). *Research in education evidence-based inquiry* (7th ed.). Pearson Education. https://files.pearsoned.de/ps/ext/9781292035871
45. Munich, K. (2014). Social support for online learning: Perspectives of nursing students. *International Journal of E-Learning & Distance Education, 29*(2), 1–12. http://ijede.ca/index.php/jde/article/view/891/1565
46. Naz, F., & Murad, H. S. (2017). Innovative teaching has a positive impact on the performance of diverse students. *SAGE Open, 7*(4). https://doi.org/10.1177/2158244017734022
47. O'Sullivan, D., & Dooley, L. (2008). *Applying innovation*. SAGE publications. https://doi.org/10.4135/9781452274898
48. Organisation for Economic Co-operation and Development (OECD). (2013). *Teachers' pedagogical knowledge and the teaching profession: Background report and project objectives*. https://www.oecd.org/education/ceri/Background_document_to_Symposium_ITEL-FINAL.pdf
49. Pantić, N., & Wubbels, T. (2010). Teacher competencies as a basis for teacher education — Views of Serbian teachers and teacher educators. *Teaching and Teacher Education, 26*(3), 694–703. https://doi.org/10.1016/j.tate.2009.10.005
50. Penttilä, T. (2016). Developing educational organizations with innovation pedagogy. *International E-Journal of Advances in Education, 2*(5), 259–267. https://doi.org/10.18768/ijaedu.15956
51. Qibtiah, M., & Ulimaz, A. (2017). Meningkatkan keterampilan berpikir kritis siswa kelas X3 SMA PGRI 6 Banjarmasin menggunakan model inkuiri pada materi perubahan lingkungan. *Jurnal Pendidikan Hayati, 2*(3).
52. Raosoft. (2004). *Raosoft sample size calculator*. Raosoft, Inc. http://www.raosoft.com/samplesize.html
53. Republic of South Africa (RSA). (2013). *South African year book*. Government Communication and Information System.
54. Rogers, E. M. (2003). *The diffusion of innovation* (5th ed.). Simon and Schuster.
55. Rogo, E. J., & Portillo, K. M. (2015). e-Model for online learning communities. *Journal of Dental Hygiene, 89*(5), 293–304. http://jdh.adha.org/content/89/5/293.full
56. Saunders, M., Lewis, P., & Thornhill, A. (2015). *Research methods for business students* (7th ed.). Pearson Education.
57. Segers, E., & Verhoeven, L. (2009). Learning in a sheltered Internet environment: The use of WebQuests. *Learning and Instruction, 19*(5), 423–432. https://doi.org/10.1016/j.learninstruc.2009.02.017
58. Sharoff, L. (2019). Creative and innovative online teaching strategies: Facilitation for active participation. *Journal of Educators Online, 16*(2), Article 2. https://doi.org/10.9743/JEO.2019.16.2.9
59. State of Victoria. (2014). *Professional practice and performance for improved learning: Performance and Development*. Victoria Department of Education and Early Childhood Development. https://www.education.vic.gov.au/Documents/school/principals/management/expired/ppilperfdevt.docx
60. Tan, X., Chen, P., & Yu, H. (2022). Potential conditions for linking teachers' online informal learning with innovative teaching. *Thinking Skills and Creativity, 45,* Article 101022. https://doi.org/10.1016/j.tsc.2022.101022
61. Timperley, H. (2008). *Teacher professional learning and development* (Educational Practices Series No. 18). UNESCO International Bureau of Education. https://unesdoc.unesco.org/ark:/48223/pf0000179161
62. Trott, P. (2008). *Innovation management and new product development*. Pearson Education.

63. Ulimaz, A., Yardani, J., & Widiyastuti, D. A. (2023). Increase student learning activities by using a problem-based learning model in legum technology lecture materials. *Edunesia: Jurnal Ilmiah Pendidikan, 4*(1), 238–246. https://doi.org/10.51276/edu.v4i1.329
64. Viberg, O., Grönlund, Å., & Andersson, A. (2020). Integrating digital technology in mathematics education: A Swedish case study. *Interactive Learning Environments, 31*(1), 232–243. https://doi.org/10.1080/10494820.2020.1770801
65. Weil, J. (2017). *Research design in aging and social gerontology: Quantitative, qualitative, and mixed methods* (1st ed.). Taylor & Francis. https://doi.org/10.4324/9781315450162
66. Yu, H., Liu, P., Huang, X., & Cao, Y. (2021). Teacher online informal learning as a means to innovative teaching during home quarantine in the COVID-19 pandemic. *Frontiers in Psychology, 12,* Article 596582. https://doi.org/10.3389/fpsyg.2021.596582
67. Zhu, C., & Wang, D. (2014). Key competencies and characteristics for innovative teaching among secondary school teachers: A mixed-methods research. *Asia Pacific Education Review, 15*(2), 299–311. https://doi.org/10.1007/s12564-014-9329-6