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Teachers' Content Knowledge and Strategies Used in Teaching Physical Science in Selected Schools at Buffalo City Municipality, South Africa

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Abstract. Physical Science encourages an ethical and responsible approach to studying, creating, and applying the sciences. In South Africa, there is a devaluation of indigenous scientific knowledge and limited access to scientific knowledge due to a history of poor, non-existent, or inadequate schooling in some communities. This paper investigates teachers' content knowledge and strategies for teaching Physical Science in selected schools at Buffalo City Municipality, East London, South Africa. This paper adopted a descriptive research design and used random sampling to select forty-two Physical Science teachers out of the total population of fifty-two. Self-designed structured questionnaire of Likert modified scale response, the Physical Science Teachers' Content Knowledge and Strategies Questionnaire (PSTCKSQ), was used to collect participant feedback. Three research questions were set for the paper and revealed the following respectively, a Mean ($\bar{x}$) 3.33 shows a general agreement across all items about the positive impact and importance of Physical Science education another Mean ($\bar{x}$) 3.14 shows a general agreement across all items about the effectiveness and use of different teaching strategies in Physical Science education and the mean score ($\bar{x}$ = 2.79) indicates moderate agreement on the adequacy of teacher training in Physical Science content. It is recommended among others that Physical Science teachers should establish a stimulating and productive learning environment that encourages students' curiosity, comprehension, and admiration of the topic by utilising their content expertise. The paper concludes that to address local and global concerns, assist economic development, promote scientific literacy, create employment possibilities, and encourage critical thinking and well-informed decision-making, Physical Science education is essential in South African schools for driving innovation and technological advancement.

Keywords: indigenous knowledge; physical science; scientific literacy; teachers' content knowledge; teaching strategies

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1. Introduction

The South African government launched several programmes to improve the quality of education after apartheid, one of which was filling the skills gap brought on by the previous administration's insufficient training programmes (Sibanda & Mukeredzi, 2018). In science and technology, for example, South Africa's national performance was either much behind or worse than economically poorer nations in many cases. Learner performance on benchmarked science and maths assessments has been linked to low-quality teachers (Spaull, 2013). This is because there was a shortage of maths and science instructors and inadequate training for these educators (Sibanda & Mukeredzi, 2018).

To address student underperformance, the Department of Higher Education and Training (DHET) stated that these deficiencies supported the need to raise the standard of teacher education in the nation (Sibanda & Mukeredzi, 2018). The belief that excellent instructors are essential to providing high-quality education served as the impetus for the government's attempt to hire "more teachers" and "better teachers" (Sibanda & Mukeredzi, 2018). The academic credentials and pedagogical abilities of instructors can promote quality education that satisfies the needs of a nation (Sibanda & Mukeredzi, 2018).

The professional development of teachers was found to be a critical component in the scientific curriculum's implementation. To tackle the scarcity of competent educators for teaching Physical Sciences, the government issued a strict directive to educate more teachers and give those already teaching more training (Jamil et al., 2021). One example of this programme is the Advanced Certificate in Education (ACE), which is used to train teachers in the Physical Sciences and other topics to address the lack of competencies among teachers and to allow educators to advance in their careers (Ramnarian & Fortus, 2013). Most teachers were supportive of the new curriculum, which had undergone major revamping, and they were well accepted (Jamil & Muhammad 2019). Nonetheless, Ramnarain and Fortus (2013) contend that rather than teachers' perceptions that the new curriculum was an improvement over the prior one, their support for it may have been driven by political allegiance to the new administration (Ramnarain & Fortus, 2013).

The effectiveness of instructional practices in the Physical Science classroom in South Africa has not increased student performance. According to Martin et al. (2012), South African students received the lowest scores of any nation that took part in the Trends in International Mathematics and Science Study (TIMMS 2003 and 2011). This is explained by the inability of educators and students to apply active, practical work practices. Most educators in the province of Mpumalanga failed to engage students in hands-on learning (Spaull, 2013), while teachers in the Eastern Cape Province disregarded practical work (Manashela & Kibirige, 2013). As a result, since 2009, enrollment in Physical Sciences has been declining. For example, enrollment fell by 18.2% from 220882 in 2009 to 180585, in 2011 (Department of Basic Education, 2012; Manashela & Kibirige, 2013). Perhaps this was a factor in the students' lack of enthusiasm for science.

The goal of the Physical Sciences is to utilise science to examine chemical and physical processes. It makes use of scientific ideas, models, and rules to forecast and explain occurrences in our physical world (Mitrevski, 2019). The goal of society to comprehend the physical environment's functions uses, and responsible maintenance is also addressed by this subject (Butler-Adam, 2018). Because of their impact on scientific and technical advancement, which supports both the economic growth of our nation and the social cohesion of our community, Physical Science is becoming more and more significant in the lives of learners.

Numerous technologies that we take for granted are supported by it, including computers and other information technologies (Tagutanazvo & Bhagwandeen, 2022). As we enter the twenty-first century, there is every reason to believe that the values, knowledge, and abilities people acquire in Physical Science will have an even greater influence on our lives, most especially the integrating indigenous knowledge into the teaching and learning of Physical Science would provide alternative perspectives and methodologies in science. Integrating this knowledge can make science education more inclusive, culturally relevant, and innovative in South Africa. Similarly, the efforts to decolonize the curriculum, promote equity in education, and incorporate indigenous knowledge into science teaching hold the potential to transform the educational landscape. These initiatives can help bridge the gap between indigenous and Western knowledge systems, fostering a more holistic and inclusive approach to science education (AlMarwani, 2020; Butler et al., 2017). The application of knowledge from the Physical Sciences has a significant influence on global challenges and events, including political, social, ethical, environmental, and technical ones. When individuals are asked to exercise their right to decide on and respond to the directions of research, their participation will be enhanced by an awareness of scientific viewpoints (Tagutanazvo & Bhagwandeen, 2022).

Physical Science encourages an ethical and responsible approach to studying, creating, and applying the sciences while allowing its findings, hypotheses, and models. In South Africa, there is a devaluation of indigenous scientific knowledge and limited access to scientific knowledge due to a history of poor, non-existent, or inadequate schooling in some communities (Bağ & Gürsoy, 2021; Butler-Adam, 2018). Consequently, the curriculum for the Physical Sciences must give students more access to scientific literacy and comprehension.

Critical thinking is being highlighted in science education as a means of fostering scientific advancement as well as democratic practices in the political, social, and cultural domains (AlMarwani, 2020). To be able to reason more logically and rationally, and so justify one's thought processes, one must first be able to see the areas of their thinking that are problematic and work on changing them. This process is known as critical thinking (Paul & Elder, 2020). Because of this, critical thinking is crucial for success and aids in self-defence in a world where there is an abundance of information and persuasive individuals (Tagutanazvo & Bhagwandeen, 2022). For instance, in the fourth industrial revolution era, rapid technological advancements often result in drastic changes that affect student learning outcomes (Butler-Adam, 2018). This is particularly true if teachers continue to teach science subjects using traditional methods (Oke & Fernandes, 2020). Considering this, critical thinking is a crucial skill that citizens, employees, and students may utilise to function well in a society that is changing so quickly (Tagutanazvo & Bhagwandeen, 2022).

1.1 Research Questions

The research questions that are set for this paper are

- What is the importance of Physical Science in schools?
- What teaching strategies do Physical Science teachers use to teach in schools?
- How do teachers use their content knowledge to teach Physical Science in schools?

2. Theoretical Framework

The Social Learning Theory developed by Vygotsky highlights the critical role that social contact plays in the formation of cognition. Thanks to Vygotsky's work, we now know that community is essential to the act of "making meaning". Some of the most important ideas in Vygotsky's notion of social learning after Physical Science instruction are as follows (Adu, 2023; Vygotsky, 1978). Vygotsky thought that social interaction has a major role in cognitive development. According to him, learning is a cooperative process in which students co-construct knowledge through shared experiences and social discourse, particularly when the subject involves practical application. Additionally, students studying Physical Science require someone with greater experience or skill to help them grasp a given activity, procedure, or idea. A teacher, coach, senior citizen, or peer could be the more knowledgeable individual (Adu, 2023; Vygotsky, 1978).

To distinguish what experienced teachers and learners accomplish on their own, there is a need for a Zone of Proximal Development (ZPD). The ZPD according to Vygotsky emphasises how social engagement can foster cognitive development. Vygotsky introduced scaffolding that supports learners tailored to their needs and abilities, designed to help them achieve a higher level of understanding or skill. Scaffolding can be gradually removed as the learner becomes more proficient, and the practical skills acquired during the teaching of Physical Science are the result of cascading from known to unknown (Adu, 2023; Vygotsky, 1978)

According to Vygotsky, language plays a significant role in the development of learners' cognition, language is an essential instrument for thinking and communicating and is crucial for the growth of higher cognitive functions. The language used by Physical Science teachers is very important to promote the desired learning outcome. Vygotsky argued that cognitive development is mediated by cultural tools, including language, symbols, and technology. In the contents of Physical Science, the necessary practical tools are spelt out to enhance delivery as well as help in shaping how learners think, understand, and interact with the world (Vygotsky, 1978; Zondo & Adu, 2024).

Vygotsky's theory has significant implications for education because it suggests that teaching should be focused on students' ZPD, where teachers act as facilitators, providing the necessary scaffolding to help students progress. Collaborative learning activities, peer tutoring, and group work are encouraged to solve problems, share knowledge, and learn from each other, fostering a deeper understanding through social interaction. During the practical engagement in Physical Science class, collaboration in the use of tools and apparatus is essential. This also promotes critical thinking (Paul & Elder, 2020).

The importance of cultural context in learning cannot be overemphasized because the learners' environment and background are very important to the selection of the type of materials and pedagogies to be used by the teacher. However, Vygotsky's theory laid too much emphasis on social interaction without considering individual learning capacity and cognitive development. Similarly, the theory can be somewhat vague in its application, with broad concepts that may be difficult to operationalize in practical settings as Physical involves practical (Spaull, 2013), Vygotsky's Social Learning Theory offers a framework for comprehending how learners' cognitive growth during the teaching of Physical Science is influenced by social interactions and cultural context. It highlights the value of group projects, the facilitator role of the instructor, and the necessity of considering the cultural elements that influence learning.

3. Literature Review

3.1 Importance of Physical Science in South African Schools

Physical Science, which encompasses fields such as physics, chemistry, astronomy, and Earth sciences, plays a crucial role in facilitating scientific literacy because it provides the basic scientific knowledge and skills needed to understand and engage with scientific concepts and issues (Mitrevski, 2019). The economic development because of the learning of Physical Science is tied to advancements in science and technology. By fostering a strong foundation in Physical Science, schools contribute to producing a workforce capable of driving innovation and supporting industries such as mining, manufacturing, and technology (Sibanda & Mukeredzi, 2018).

In addition, Physical Science education enables students to understand and find solutions to pressing local and global challenges, such as energy production, environmental sustainability, water scarcity, and climate change. This knowledge is crucial for developing strategies that address South Africa's specific needs. In the field of STEM, Physical Science opens numerous career opportunities which are essential for South Africa's growth and competitiveness in the global economy. Similarly, Physical Science helps learners to think critically, and analytically. These skills are essential for success in various fields and everyday life, enabling students to approach problems systematically and find effective solutions (Ramnarain & Fortus, 2013).

The technological advancement and innovation because of Physical Science education allow students to contribute to the development of new technologies that can benefit society. The knowledge of Physical Science helps individuals make informed decisions about health, safety, and environmental issues. This is particularly important in a country like South Africa, where many communities face challenges related to health and environmental sustainability. Physical Science ensures access to quality education also helps bridge educational gaps and promotes equity and inclusion. It provides all students, regardless of their background, with the opportunity to succeed in science-related fields. The integration of Physical Science with other subjects, such as mathematics, biology, and geography brings about an interdisciplinary approach (Tagutanazvo & Bhagwandeen, 2022).

3.2 Teaching Strategies Physical Science Teachers Use to Teach in Schools

Teaching strategies are influenced by the content of the curriculum, learners' grade level, and teaching environment. Research has revealed the following teaching strategies for teaching Physical Science. Inquiry-Based Learning Strategy encourages learners to ask questions, conduct experiments, and explore scientific concepts through hands-on activities. This approach fosters curiosity and deepens understanding, this is supported by group work and peer-to-peer interaction. Students work together to solve problems, conduct experiments, and discuss concepts, promoting teamwork and communication skills. The use of technology is another strategy Physical Science teachers can use to teach, this includes the incorporation of digital tools such as simulations, virtual labs, and interactive software to enhance learning. Technology can make complex scientific concepts more accessible and engaging (Oke & Fernandes, 2020). The use of flipped classrooms is very imperative for teachers to use for reviewing materials and content at home through videos or readings, and classroom time is dedicated to hands-on activities, discussions, and problem-solving. Differentiated instruction is another teaching strategy to meet the diverse needs of students. This can include varying the pace of instruction, providing additional support, or offering enrichment activities (Jamil et al., 2021).

For Physical Science teachers to develop content knowledge and delivery, there is a need for teachers to use real-world applications that connect scientific concepts to real-world situations and problems. This approach helps learners see the relevance of what they are learning and how it applies to their lives. The use of a project-based learning strategy is also very important since learners engage in projects that require them to apply scientific principles to solve problems or create products. This method promotes critical thinking, creativity, and practical application of knowledge. Using regular informal assessments to monitor student progress and understanding helps teachers adjust their instruction to better meet student needs. Use of Models and Visuals aids to represent scientific concepts. These tools can help students grasp abstract ideas and visualize complex processes. The Socratic Method is another method that encourages dialogue and critical thinking through questioning. Teachers ask open-ended questions that prompt students to think deeply and articulate their understanding (Pradana et al., 2020).

Another strategy for problem-solving in Physical Science is scaffolding, in which instructors offer students organised assistance as they progressively build on their existing knowledge and acquire new abilities. As pupils improve, this assistance is gradually reduced. Hands-on experiments and Labs also engage students in practical experiments and laboratory activities. Hands-on experiences are crucial for understanding scientific methods and concepts, similarly, using real-life case studies and problem-solving activities to apply scientific concepts approach helps students develop analytical and critical thinking skills. Interactive Demonstrations conducts live demonstrations to illustrate scientific principles and phenomena. Demonstrations can capture student interest and make abstract concepts more tangible. Cross-disciplinary integration integrates Physical Science with other subjects such as mathematics, engineering, and technology. This interdisciplinary approach enriches student learning and shows the interconnectedness of knowledge (Butler-Adam, 2018; Prayogi et al., 2018).

One of the most crucial real-life skills is the ability to think critically, which is something that must be encouraged in the instructional tactics employed. According to Mutakinati et al. (2018), students need to be proficient in communication and critical thinking for the future. In other words, thinking critically is self-monitored and disciplined that is, thinking that is analysed and evaluated to make it better (Patra et al., 2021). According to Patra et al. (2021) and Tanak (2020), thinking critically is the process of analysing information, determining its application, and then interpreting it to resolve problems. Employing effective teaching techniques necessitates higher-order thinking and includes the steps of analysis, appraisal, rationality, and reflection (McFadden & Roehrig, 2018).

3.3 The Use of Teachers' Content Knowledge to Teach Physical Science in Schools

Teachers' content knowledge can be influenced by teachers' teaching experiences (McFadden & Roehrig, 2018; Tanak, 2020). On the contrary, according to Patra et al. (2021), there is a need for both teachers' knowledge and teaching experiences to achieve desirable outcomes. Having a deep understanding of concepts, teachers with a strong grasp of Physical Science concepts can explain topics clearly and accurately, ensuring that students develop a solid understanding. This deep knowledge allows teachers to answer student questions effectively and address misconceptions. Moreover, designing effective lesson content knowledge enables teachers to design lessons that are logically structured and build upon prior knowledge. They can create a coherent progression of topics that makes complex concepts more accessible to students (Putra et al., 2021). Teachers use their content knowledge to relate scientific principles to real-world phenomena and applications. This helps students see the relevance of what they are learning and how it applies to everyday life and future careers (McFadden & Roehrig, 2018). In Physical Science creating engaging experiments and activities knowledgeable teachers can design and implement experiments and hands-on activities that reinforce theoretical concepts (Mutakinati et al.,2018).

Furthermore, for content knowledge (CK) to produce the desired goals, there should be technology-enriched science lesson plans prepared and implemented by the teachers. This also determines how teachers apply innovative teaching methods and strategies to their teaching practices (Tanak, 2020). By adapting instruction to student needs with a thorough understanding of the subject matter, teachers can adapt their instruction to meet the diverse needs of their students. They can modify explanations, provide additional resources, and offer alternative approaches to suit different learning styles and levels of understanding (Mutakinati et al., 2018; Putra et al., 2021). Utilizing various teaching strategies and content knowledge allows teachers to employ a variety of teaching strategies, such as inquiry-based learning, problem-solving, and project-based learning. They can choose the most appropriate methods to facilitate student understanding and engagement (McFadden & Roehrig, 2018).

In assessing student understanding, knowledgeable teachers can design assessments that accurately measure students' understanding of physical science concepts. They can create questions that test not only factual knowledge but also the ability to apply and analyze scientific principles and provide feedback support teachers use their content expertise to provide meaningful feedback on student work. They can identify areas where students are struggling and offer targeted support to help them improve (Mutakinati et al., 2018; Putra et al., 2021). By staying updated with scientific advancements, teachers with strong content knowledge are more likely to stay informed about discoveries and advancements in Physical Science (Tanak, 2020). They can incorporate current scientific developments into their teaching, keeping the curriculum relevant and exciting (Putra et al., 2021). In mentoring and professional development, experienced teachers with deep content knowledge can mentor less experienced colleagues and contribute to professional development activities. They can share effective teaching practices and help raise the overall quality of Physical Science education.

4. Research Methodology

4.1 Paradigm

The positivist paradigm, which is adopted in this paper, believes that true knowledge is derived from sensory experience and can only be advanced by experimentation and observation (Adu & Duku, 2020a; Wellington, 2015:164) It supports the idea that the only way to determine the truth is for a scientist to be an observer of an objective world. The scientific paradigm aims to provide a scientific response to the proposed study questions (Adu & Duku, 2020b).

4.2 Research Approach

The present study employed a quantitative method intending to generate accurate and broadly applicable results. This study investigated teachers' content knowledge and strategies used in teaching physical science in selected schools at Buffalo City Municipality, South Africa. As a result of its ability to measure trends and yield numerical, verifiable outcomes, the quantitative method is thought to be more objective (Adu & Duku, 2021a).

4.3 Research Design

The paper adopted a descriptive survey research design which outlines a setup that guides choices made during the collection of data, analysis, and supports the study's findings' applicability given the goals of the paper (Adu & Duku, 2021a). The goal of descriptive research is to give a legitimate and accurate summary of the variables or characteristics that are significant to or related to the research questions (Siedlecki, 2020).

4.4 Population/Sample and Sampling Technique

All the Physical Science teachers (52) in Buffalo City Municipality, East London, South Africa, are the study's population. The method of random sampling was applied. The idea behind this sampling strategy is to guarantee that every member of the population has an equal chance of being chosen for the study (Adu, 2020). Knowing the precise size of the population is necessary when employing this sampling approach. For this paper, a total of forty-two Physical Science teachers were sampled representing more than 85% of the total population to make it more representative and generalizable according to the sample guideline (Stoker, 1985, cited in Adu 2020).

4.5 Instrument, validity, and reliability

The samples were questioned using a standardised questionnaire that included a modified Likert scale titled Physical Science Teachers' Content Knowledge and Strategies Questionnaire (PSTCKSQ). The extent to which a research technique choice explores the subject matter it is meant to explore is known as its validity. The measure was validated using content validity, and reliability was assessed using Cronbach Alpha. According to Adefioye (2015) and Adu (2020), reliability is the capacity of an instrument to produce consistent results each time it is used and to be unaffected by fluctuations other than when the variable being monitored varies. With a coefficient value of 0.89, the dependability is high.

4.6 Data Analysis

The data were analysed using descriptive statistics. The characteristics of the data were described using descriptive statistics of mean, and standard deviation. This gives readers an understanding of the typical or average value within the dataset and provides a basis for comparing new data with existing data or norms, (Adu, 2020).

5. Results and Discussion

The results are analysed based on research questions using descriptive statistics.

5.1 What is the Importance of Physical Science in schools?

Table 1 presents survey data on the importance and impact of teaching Physical Science. Each item is analysed with a mean (average) score and a standard deviation to measure the variation in responses.

Table 1: Importance of physical science

Item	SA	A	D	SD	Mean ($\bar{x}$)	Std. dev.
Physical Science is very important for scientific literacy	21	21	0	0	3.50	0.506
Physical Science allows my learners to know the economic development	0	38	0	4	2.81	0.594
My learners understand how to address local and global challenges through the knowledge of Physical Science	20	22	0	0	3.48	0.505
Physical Science helps my learners enhance their understanding of career opportunities and STEM fields	14	28	0	0	3.33	0.477
Physical Science helps my learners to develop critical thinking and problem-solving skills	21	21	0	0	3.50	0.506
My learners use the information they acquire in learning Physical Science for technological literacy and innovation	16	21	5	0	3.38	0.697
Physical Science teaching continues to be relevant in addressing equity and inclusion	14	28	0	0	3.33	0.477
Grand mean = 3.33						

On how very important Physical Science is for scientific literacy, the high mean score ($\bar{x}$ = 3.50) indicates strong agreement that Physical Science is crucial for scientific literacy. The low standard deviation (0.506) suggests that there is little variation in responses, meaning most respondents strongly agree or agree with this statement this is in line with Mitrevski (2019) who believe Physical Science is important for scientific literacy. On how Physical Science allows learners to know economic development, the lower mean score ($\bar{x}$ = 2.81) indicates moderate agreement on this statement support (Tagutanazvo & Bhagwandeen, 2022). The standard deviation (0.594) shows a bit more variation in responses, with some disagreement. Learners understand how to address local and global challenges through the knowledge of Physical Science, the mean score ($\bar{x}$ = 3.48) indicating a strong agreement that Physical Science helps learners address challenges. The low standard deviation (0.505) suggests consistency in responses.

Also, regarding how Physical Science helps learners enhance their understanding of career opportunities and STEM fields, **t**he mean score ($\bar{x}$ = 3.33) suggests agreement that Physical Science aids in understanding career opportunities in STEM, Sibanda and Mukeredzi's (2018) study was in support of this. The low standard deviation (0.477) indicates little variability in responses. Physical Science helps learners develop critical thinking and problem-solving skills, like the first item, this high mean ($\bar{x}$ = 3.50) indicates strong agreement, and the low standard deviation (0.506) shows consistency among responses. On how learners use the information they acquire in learning Physical Science for technological literacy and innovation, the mean score ($\bar{x}$ = 3.38) shows agreement, but the higher standard deviation (0.697) indicates more variability, with some respondents disagreeing. On the relevance of how Physical Science teaching continues to address equity and inclusion, the mean ($\bar{x}$ = 3.33) suggests agreement on the relevance of Physical Science in equity and inclusion (Ramnarain & Fortus, 2013). The low standard deviation (0.477) indicates consistent responses.

The Grand Mean ($\bar{x}$) of 3.33 shows a general agreement across all items about the positive impact and importance of Physical Science education. The consistency in the standard deviations suggests that the respondents' views are generally in agreement, with minimal variation.

5.2 What Teaching Strategies do Physical Science Teachers Use to Teach in Schools?

Table 2 presents survey data on the teaching strategies used for teaching Physical Science. Each item is analysed with a mean (average) score and a standard deviation to measure the variation in responses.

Table 2: Teaching strategies used to teach physical science

Item	SA	A	D	SD	Mean ($\bar{x}$)	Std. dev
I use different pedagogical approaches to teach Physical Science	6	36	0	0	3.14	0.354
My teaching pedagogies yield the desired outcome	5	28	9	0	2.90	0.576
I integrate Information and Communication Technology (ICT) as a strategy to enhance the teaching of Physical Science	14	28	0	0	3.33	0.477
I evaluate my teaching pedagogies in my classes to ensure the desired outcomes	14	21	7	0	3.17	0.696
Grand mean = 3.14						

How most of the respondents use different pedagogical approaches to teach Physical Science, the mean score ($\bar{x}$ =3.14) indicates agreement that different pedagogical approaches are used. The low standard deviation (0.354) suggests consistency in responses, with most respondents agreeing. For how respondents, teach pedagogies to yield the desired outcome, the mean score ($\bar{x}$ = 2.90) indicates moderate agreement that teaching pedagogies yields desired outcomes. The higher standard deviation (0.576) shows more variability in responses, with some disagreement. The use of different pedagogies is very essential and should be determined by the content, grade level, and prior knowledge of the learners (Tanak, 2020).

Furthermore, integrating Information and Communication Technology (ICT) as a strategy to enhance the teaching of Physical Science, the high mean score ($\bar{x}$ = 3.33) indicates strong agreement on integrating ICT in the teaching of Physical Science and teachers need to identify areas where students are struggling and offer targeted support to help them improve by using ICT and other strategies (Mutakinati et al., 2018; Putra et al., 2021). The low standard deviation (0.477) suggests consistent responses with most respondents agreeing. On evaluating respondents' teaching pedagogies in my classes to ensure desired outcomes, the mean score ($\bar{x}$ = 3.17) indicates agreement on evaluating teaching pedagogies. The higher standard deviation (0.696) indicates some variability in responses, with a few respondents disagreeing. The Grand Mean ($\bar{x}$) of 3.14 shows a general agreement across all items about the effectiveness and use of different teaching strategies in Physical Science education. The consistency in the standard deviations, with a few higher values, suggests that while most respondents agree on the effectiveness and use of these strategies, there is some variation in their opinions, particularly regarding the desired outcomes of their pedagogies. In agreement with Pradana et al. (2020) and Jamil et al. (2021), the mixture of technology and traditional approaches to the teaching of Physical Science will suffice to the achievement of the desired learning outcome.

5.3 How Do Teachers Use Their Content Knowledge to Teach Physical Science in Schools?

Table 3 presents survey data on content knowledge in teaching Physical Science. Each item is analysed with a mean (average) score and a standard deviation to measure the response variation.

Table 3: The content knowledge in teaching physical science

Item	SA	A	D	SD	Mean ($\bar{x}$)	Std. dev.
I have the content knowledge of Physical Science	12	30	0	0	3.29	0.457
My qualification is related to Physical Science	22	20	0	0	3.52	0.505
I use the content of Physical Science to teach my learners	12	30	0	0	3.29	0.457
I believe teachers are trained adequately on the contents of Physical Science before teaching	6	21	15	0	2.79	0.682
Curriculum Assessment Policy Statement (CAPS) give a clear guide on what needs to be taught and how it can be taught (pedagogy)	0	26	16	0	2.62	0.492
Grand mean = 3.10						

The content knowledge of Physical Science by respondents, the mean score ($\bar{x}$ = 3.29) indicates agreement that respondents believe they possess content knowledge in Physical Science. The low standard deviation (0.457) suggests consistency in responses, with most respondents agreeing. Qualifications related to Physical Science, the high mean score ($\bar{x}$ = 3.52) indicates strong agreement that respondents' qualifications are related to Physical Science. The utilisation of various teaching strategies and content knowledge allows teachers to employ various teaching strategies to facilitate student understanding and engagement (McFadden & Roehrig, 2018). The low standard deviation (0.505) indicates consistent responses.

In addition, the use of the content of Physical Science to teach learners by respondents, like the first item, the mean score ($\bar{x}$ = 3.29) suggests agreement that respondents use their content knowledge to teach. The low standard deviation (0.457) indicates little variation in responses. Most of the respondents believe teachers are trained adequately in the contents of Physical Science before teaching and this is because the mean score ($\bar{x}$ = 2.79) indicates moderate agreement on the adequacy of teacher training in Physical Science content. The higher standard deviation (0.682) shows more variability in responses, with some disagreement. On how the Curriculum Assessment Policy Statement (CAPS) gives a clear guide on what needs to be taught and how it can be taught (pedagogy), the mean score ($\bar{x}$ = 2.62) indicates moderate agreement on the clarity of CAPS guidelines. Teachers need to keep the curriculum relevant and exciting by incorporating scientific development (Putra et al., 2021). The low standard deviation (0.492) suggests that while there is some agreement, there is also notable disagreement.

The Grand Mean ($\bar{x}$) of 3.10 shows a general agreement across all items about the content knowledge in teaching Physical Science and also the consistency in the standard deviations, with a few higher values, suggests that while most respondents agree on the importance and relevance of their content knowledge and qualifications, there is some variation in opinions, particularly regarding the adequacy of teacher training and clarity of curriculum guidelines.

6. Conclusion and Recommendations

One of the findings indicates that respondents believe Physical Science is vital for various aspects of education, including scientific literacy, understanding of career opportunities, and developing critical thinking skills. There is moderate agreement on its role in economic development and technological literacy, with some variability in responses. Another finding indicates that respondents generally agree on the use of different pedagogical approaches, the integration of ICT, and the evaluation of teaching strategies to ensure desired outcomes in Physical Science education. However, there is moderate agreement on whether these pedagogies yield the desired outcomes, with some respondents expressing different views. The last finding indicates that respondents generally agree on their content knowledge and qualifications in Physical Science, and they use this knowledge in their teaching. However, there is moderate agreement on the adequacy of teacher training and the clarity of curriculum guidelines, with some respondents expressing differing views. To address local and global concerns, assist economic development, promote scientific literacy, create employment possibilities, and encourage critical thinking and well-informed decision-making, Physical Science education is essential in South African schools. It is essential to the advancement of the nation and to educating students for the future. The paper recommends among others that.

- Physical Science teachers can establish a dynamic and productive learning environment that meets the different requirements and learning styles of their students by utilising these varied teaching tactics.
- Teachers of Physical Science can establish a stimulating and productive learning environment that encourages students' curiosity, comprehension, and admiration of the topic by utilising their content expertise.

- Teachers should use learner-centred strategies like collaborative learning, inquiry-based learning, use of technology, and hands-on experiential learning to mention a few.
- The education officers in the Department of Education in South Africa, the curriculum planners, and school management teams should take into consideration the revelation of this paper and act accordingly in terms of producing a practical and relevant curriculum, conducive learning environment, capacitate the teachers, and provision of resources for teaching

7. Limitations and Suggested Areas for Future Research

This paper is limited to the Physical Science teachers at Buffalo City Metropolitan in East London, the Eastern part (Eastern Cape) of South Africa. Another study can be carried out in another province and a comparative study of two provinces can also be done in the future.

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