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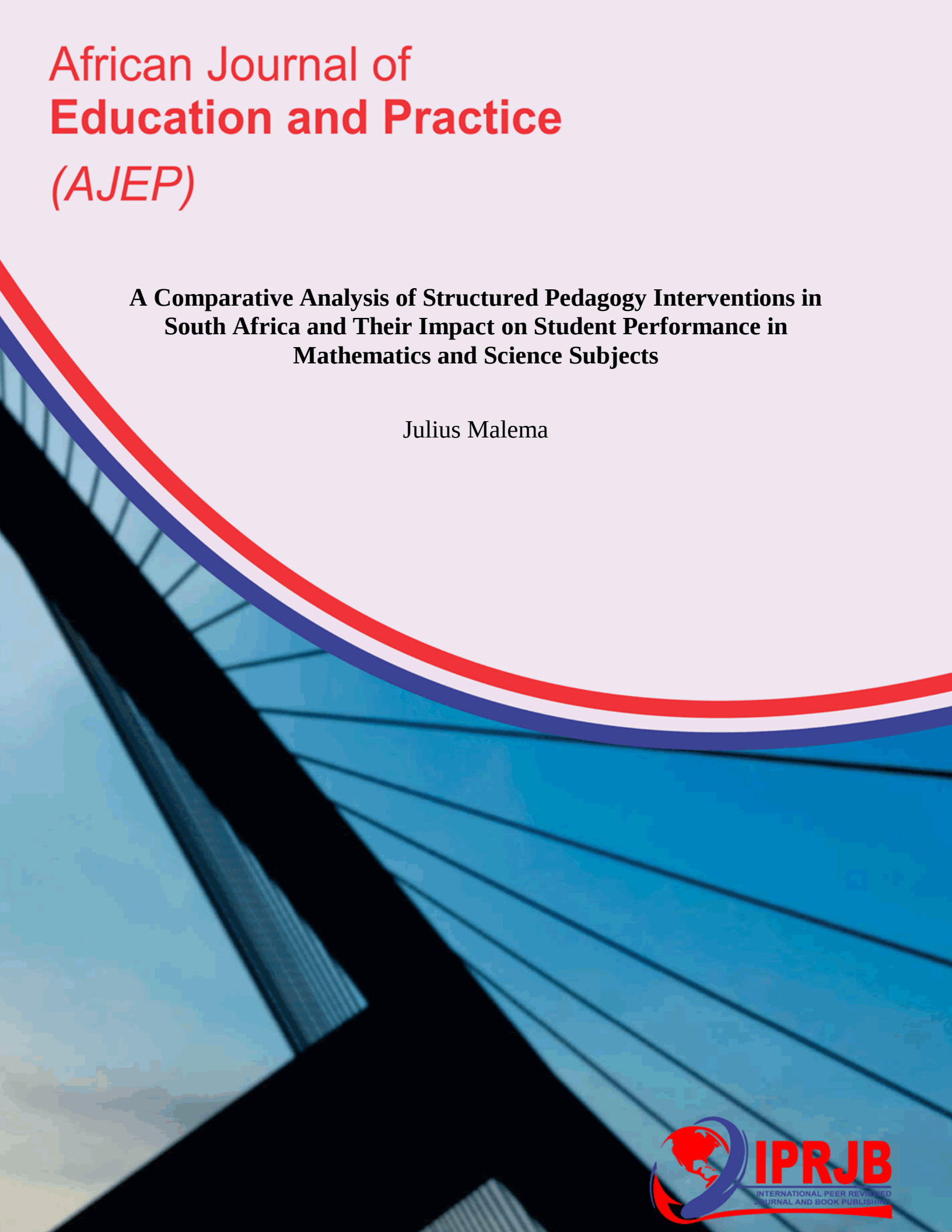

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Abstract

Purpose: The aim of the study was to analyze the comparative analysis of structured pedagogy interventions in South Africa and their impact on student performance in mathematics and science subjects.

Methodology: This study adopted a desk methodology. A desk study research design is commonly known as secondary data collection. This is basically collecting data from existing resources preferably because of its low cost advantage as compared to a field research. Our current study looked into already published studies and reports as the data was easily accessed through online journals and libraries.

Findings: A comparative analysis of structured pedagogy interventions in South Africa reveals that these targeted educational approaches have positively impacted student performance in mathematics and science subjects. Studies show that interventions such as curriculum-aligned teaching materials, teacher training, and standardized assessments significantly improved students' understanding and achievement in these areas.

Unique Contribution to Theory, Practice and Policy: Constructivist learning theory, bloom's taxonomy of educational objectives & sociocultural theory may be used to anchor future studies on the analyzing the comparative analysis of structured pedagogy interventions in South Africa and their impact on student performance in mathematics and science subjects. Schools should integrate structured lesson plans and data-driven instruction into everyday practice to enhance teacher efficacy and student performance. Policymakers should implement nationwide curriculum reforms that standardize content delivery across all schools, ensuring consistency in teaching quality, particularly in mathematics and science.

Keywords: *Structured Pedagogy Interventions, Student Performance, Mathematics, Science Subjects*

INTRODUCTION

Student performance in mathematics and science subjects in developed economies shows significant variability influenced by education systems and policies. In the United States, for example, results from the 2019 Programme for International Student Assessment (PISA) indicate that American 15-year-olds scored an average of 478 in mathematics, below the Organisation for Economic Co-operation and Development (OECD) average of 489, but scored above average in science with a score of 502 (OECD, 2020). Similarly, in Japan, students performed well above average, with PISA 2019 scores of 527 in mathematics and 529 in science, placing the country among the top performers globally. The United Kingdom demonstrated moderate performance, with an average score of 504 in mathematics and 505 in science, aligning with the OECD averages (OECD, 2020). These figures reflect consistent emphasis on education quality in these countries, although challenges remain in addressing achievement gaps within certain demographics.

In Germany, student performance in mathematics and science has shown steady improvement over the years. According to the 2019 PISA results, German students scored 500 in mathematics and 503 in science, both slightly above the OECD average (OECD, 2020). South Korea consistently ranks among the top performers globally, with PISA 2019 scores of 526 in mathematics and 519 in science, reflecting the country's rigorous academic culture (OECD, 2020). Finland, known for its progressive education system, scored 507 in mathematics and 522 in science in 2019, continuing its trend of strong educational outcomes. While each of these countries faces unique challenges, such as student stress in South Korea and a growing performance gap in Germany, their overall performance reflects the high priority given to education. Finland's relatively egalitarian system, which minimizes disparities between students, has been particularly successful in producing consistently high academic outcomes.

In Canada, student performance in mathematics and science remains strong, although challenges persist in closing achievement gaps among different socioeconomic groups. In the 2018 PISA results, Canadian students scored 512 in mathematics and 518 in science, both well above the OECD averages (OECD, 2019). Australia also performs above average, with PISA 2018 scores of 491 in mathematics and 503 in science. However, Australia has seen a slight decline in performance in recent years, particularly in mathematics, which has sparked debate over curriculum reform (OECD, 2019). The Netherlands, known for its robust education system, scored 519 in mathematics and 503 in science in PISA 2018, reflecting its emphasis on both equity and quality in education (OECD, 2019). Although these countries perform well overall, they continue to address internal disparities and the need to enhance STEM education to prepare students for future challenges.

In Sweden, student performance in mathematics and science has shown signs of improvement after a period of decline in the early 2000s. In the 2018 PISA assessment, Swedish students scored 502 in mathematics and 499 in science, aligning with OECD averages (OECD, 2019). This recovery is attributed to education reforms focused on teacher quality and curriculum updates. In Switzerland, the education system continues to rank highly, with Swiss students scoring 515 in mathematics and 506 in science in PISA 2018, reflecting the country's strong emphasis on vocational training alongside academic education (OECD, 2019). New Zealand, while historically a high performer, has seen a gradual decline in recent years. In PISA 2018, New Zealand students scored 494 in mathematics and 508 in science, still above OECD averages but showing a need for

stronger intervention, particularly to address growing inequalities between student groups (OECD, 2019). Each of these countries maintains a strong commitment to educational quality but faces challenges related to equity and maintaining consistently high performance.

In developing economies, student performance in mathematics and science often trails behind that of developed nations due to factors such as limited resources and teacher quality. For instance, in Brazil, PISA 2018 results showed an average score of 384 in mathematics and 404 in science, significantly below the OECD average (OECD, 2019). Similarly, Indonesia's students scored an average of 379 in mathematics and 396 in science, reflecting persistent challenges in both areas (OECD, 2019). Despite ongoing efforts to reform educational systems, many developing countries face hurdles such as insufficient infrastructure, low teacher qualifications, and socioeconomic disparities. However, reforms in curriculum and increased investment in teacher training have shown promise in gradually improving student outcomes in these subjects. The continued focus on education reform is crucial for sustained progress in academic performance.

In Mexico, student performance in mathematics and science has remained below the OECD average, with PISA 2018 scores of 409 in mathematics and 419 in science (OECD, 2019). Despite improvements in access to education, Mexico continues to face challenges such as resource shortages and socioeconomic inequality, which significantly affect learning outcomes. Thailand, another developing economy, scored 419 in mathematics and 426 in science, reflecting similar trends in educational disparities and access to quality instruction (OECD, 2019). However, Turkey stands out as a developing economy that has made notable improvements. In PISA 2018, Turkish students scored 454 in mathematics and 468 in science, reflecting a steady upward trend due to recent education reforms aimed at improving teacher quality and curriculum design (OECD, 2019). Continued investment in teacher training and efforts to reduce inequality are essential for sustained improvement in these countries.

In Argentina, the performance of students in mathematics and science has been a consistent concern. According to the 2018 PISA results, Argentinian students scored 379 in mathematics and 404 in science, significantly below the OECD average (OECD, 2019). Despite government efforts to reform the education system, challenges such as high dropout rates and inequality persist. In the Philippines, performance is similarly low, with PISA 2018 results showing an average score of 353 in mathematics and 357 in science, ranking the country among the lowest globally (OECD, 2019). The Egyptian education system has also struggled with low performance in mathematics and science, although recent reforms aim to address these issues. In 2018, Egypt’s scores in the TIMSS were 387 in mathematics and 398 in science, reflecting deep-rooted challenges like inadequate teacher training and resource scarcity (Mullis et al., 2020). Despite these hurdles, Egypt has been making strides through initiatives such as improving STEM programs and investing in teacher quality.

Vietnam stands out as a developing economy with remarkably high student performance in mathematics and science. In the 2018 PISA assessment, Vietnamese students scored 496 in mathematics and 543 in science, outperforming many developed nations and reflecting the country’s focus on education as a key driver of development (OECD, 2019). Peru, on the other hand, has faced ongoing challenges in improving educational outcomes. In PISA 2018, Peruvian students scored 400 in mathematics and 404 in science, below the OECD averages, though recent reforms aimed at decentralizing education and improving teacher training have shown some

promise (OECD, 2019). Pakistan, with its diverse and challenging educational landscape, has also struggled with low performance in mathematics and science. According to national assessments, the average scores in mathematics and science for secondary students remain significantly below global benchmarks, with rural areas especially affected by teacher shortages and lack of resources (ASER Pakistan, 2018). However, there have been efforts to improve STEM education, particularly through public-private partnerships and curriculum development initiatives.

In sub-Saharan Africa, student performance in mathematics and science remains a significant concern, with many countries ranking near the bottom in international assessments. For example, South Africa's Grade 9 students scored an average of 372 in mathematics and 386 in science in the 2019 Trends in International Mathematics and Science Study (TIMSS), placing the country among the lowest in global rankings (Mullis et al., 2020). Similarly, Botswana, which participated in TIMSS 2019, scored an average of 367 in mathematics and 383 in science (Mullis et al., 2020). Key challenges include inadequate access to quality educational resources, teacher shortages, and high dropout rates, all of which impede student achievement. Despite these barriers, several countries in the region, such as Kenya and Rwanda, have made notable improvements through targeted investments in teacher training and curriculum reform. The implementation of policies focused on improving both the quality and equity of education is essential for long-term academic growth in the region.

In sub-Saharan Africa, performance in mathematics and science remains a significant challenge, but some countries have made notable progress. Kenya, for example, has seen improvements in recent years due to reforms in education, teacher training, and the introduction of technology in classrooms. In the Southern and Eastern Africa Consortium for Monitoring Educational Quality (SACMEQ) study, Kenyan students performed better than their regional counterparts, with higher average scores in both mathematics and science (SACMEQ, 2017). Ghana, on the other hand, has struggled with poor outcomes in these subjects, reflected in their 2019 TIMSS scores of 353 in mathematics and 356 in science, ranking near the bottom globally (Mullis et al., 2020). Uganda has similarly low performance, with significant challenges in terms of teacher quality and educational resources. Despite these challenges, countries like Kenya have shown that strategic investments in education can lead to gradual improvements in student performance, though sustained efforts are necessary for widespread success.

In sub-Saharan Africa, countries like Nigeria, Zimbabwe, and Tanzania continue to face difficulties in achieving strong performance in mathematics and science. Nigeria's education system, while growing in access, has been plagued by underfunding and poor infrastructure, contributing to low scores in international assessments. In the 2019 West African Senior School Certificate Examination (WASSCE), fewer than 40% of Nigerian students passed mathematics and science subjects, reflecting persistent challenges (Aigbavboa, 2021). Zimbabwe, despite its economic struggles, has made some progress in education, though it still lags behind global averages. According to the 2019 Southern Africa Consortium for Monitoring Educational Quality (SACMEQ) results, Zimbabwean students achieved average scores in mathematics and science, with limited access to quality materials and teaching hampering further improvement (SACMEQ, 2017). Tanzania has also faced similar issues, with SACMEQ 2017 data revealing low proficiency levels in mathematics and science, particularly in rural areas where resources are scarce. However,

Tanzania has made efforts to address these issues through policy changes and curriculum updates, though significant work remains to close the gap in student outcomes.

Senegal, similarly, faces challenges in student performance in mathematics and science. In the 2017 PASEC (Programme for the Analysis of Education Systems) assessment, Senegalese students scored below average, reflecting deep-rooted issues such as under-resourced schools and high dropout rates (PASEC, 2017). Zambia, participating in the 2019 TIMSS, reported low scores of 322 in mathematics and 335 in science, placing it among the lowest performers globally (Mullis et al., 2020). Efforts to improve outcomes in Zambia include investments in teacher training and curriculum reform, but progress has been slow due to funding constraints and systemic challenges in the education system.

Structured pedagogy interventions are systematic approaches to teaching that focus on improving instructional quality and learning outcomes through targeted methods and practices. One common intervention is teacher professional development, which enhances teacher content knowledge and pedagogical skills. Research shows that teachers trained in effective instructional strategies significantly improve student performance in mathematics and science (Ganimian & Murnane, 2016). Another method is curriculum reform, where instructional materials are standardized and aligned with learning goals, ensuring consistent quality across schools. For instance, students exposed to well-structured, rigorous curricula tend to outperform their peers in both math and science (Pritchett & Beatty, 2015).

A third intervention is data-driven instruction, where student progress is regularly assessed, and teaching is adjusted based on performance data. Studies show that this approach leads to improvements in student outcomes, particularly in STEM subjects (Black & Wiliam, 2018). Lastly, technology integration—using digital tools to enhance learning—has been shown to improve engagement and understanding in math and science. Educational technology, when paired with effective pedagogy, significantly boosts test scores and critical thinking skills (Cheung & Slavin, 2013). Together, these interventions create a structured learning environment that is conducive to better student outcomes in mathematics and science.

Problem Statement

Despite ongoing educational reforms, student performance in mathematics and science in South Africa remains below international benchmarks, with many students struggling to achieve proficiency in these critical subjects. Various structured pedagogy interventions, such as teacher professional development, curriculum reform, and data-driven instruction, have been implemented to address these challenges. However, there is limited comparative analysis of the effectiveness of these interventions on improving student outcomes in mathematics and science. Understanding the specific impact of structured pedagogy interventions on student performance in South Africa is crucial for tailoring future educational policies and resource allocation. This study seeks to examine the effectiveness of these interventions, drawing on recent studies that highlight persistent gaps in student achievement in South Africa (Spaull & Taylor, 2015; Van der Berg et al., 2020).

Theoretical Framework

Constructivist Learning Theory

Originated by Jean Piaget and Lev Vygotsky, the constructivist theory posits that learners actively construct their own understanding and knowledge through experiences and interactions with their environment. In the context of structured pedagogy interventions, this theory is relevant because it supports teaching approaches that allow students to engage in problem-solving, experimentation, and collaborative learning, particularly in subjects like mathematics and science. By aligning interventions with constructivist principles, educators can create more engaging and effective learning environments that foster deeper understanding. Constructivist approaches have been shown to improve student performance in STEM subjects (Pritchard, 2020).

Bloom's Taxonomy of Educational Objectives

Developed by Benjamin Bloom, Bloom's Taxonomy classifies educational goals into cognitive levels, ranging from basic knowledge to higher-order thinking skills such as analysis and evaluation. This theory is crucial for structured pedagogy as it guides the development of curriculum and assessments that progressively build student skills in mathematics and science. Structured interventions designed with Bloom's framework ensure that students not only grasp fundamental concepts but also develop critical thinking and problem-solving abilities, essential for success in these subjects (Forehand, 2021).

Sociocultural Theory

Lev Vygotsky's sociocultural theory emphasizes the importance of social interactions and cultural context in learning. This theory is relevant to the study of structured pedagogy interventions in South Africa, where the diverse cultural backgrounds of students must be considered when designing effective teaching strategies. Pedagogical approaches that leverage peer collaboration, guided learning, and culturally relevant teaching can significantly improve student engagement and performance in mathematics and science (Daniels, 2019).

Empirical Review

Spaull and Kotze (2019) assessed the effectiveness of structured pedagogy interventions on early-grade reading and mathematics in South Africa. Their research focused on whether teacher training and curriculum reforms could lead to significant improvements in student performance, especially in mathematics. Using a quasi-experimental design, the researchers gathered data from multiple schools that had implemented structured pedagogy interventions. The findings revealed substantial improvements in mathematics outcomes, with early-grade students performing better due to more effective teaching practices. Teachers who underwent training were able to deliver content more consistently and efficiently, leading to better student understanding of mathematical concepts. The research also highlighted that curriculum reforms helped standardize learning, ensuring that students across different schools received similar levels of education quality. Spaull and Kotze noted that while these interventions had a positive impact on mathematics, similar structured pedagogy interventions could be applied to other subjects, such as science, to further enhance learning outcomes. The authors concluded that the success of structured interventions lies in their ability to standardize education and provide teachers with the necessary tools to improve instruction. They also emphasized the importance of expanding these interventions nationwide. In

their recommendations, Spaull and Kotze urged policymakers to continue investing in teacher professional development and curriculum reforms to maintain and enhance the gains in student performance. They suggested that more research should be conducted on the long-term impact of these interventions, particularly in higher grade levels. The study provided a strong foundation for understanding how structured pedagogy can address educational challenges in South Africa. The findings also underscored the role of well-designed teaching interventions in closing performance gaps. This research contributes to the broader discussion on improving educational outcomes in low- and middle-income countries. The study is a critical resource for policymakers and educators seeking to enhance student performance through structured approaches.

Van der Berg (2020) examined the effectiveness of data-driven pedagogy interventions on improving student performance in mathematics and science. The purpose of the research was to analyze how regularly using student performance data to inform teaching could lead to better academic outcomes in South Africa. The study employed a mixed-methods approach, collecting both quantitative performance data and qualitative insights from teachers involved in data-driven interventions. Results indicated a significant positive impact on student test scores in mathematics and science, as teachers were able to adjust their teaching strategies based on real-time feedback from student assessments. By tailoring instruction to address areas where students struggled, teachers were able to target learning gaps more effectively, resulting in improved academic outcomes. The study also found that schools that integrated data-driven instruction consistently outperformed those that did not, highlighting the importance of evidence-based teaching practices. The authors recommended the wider adoption of data-driven pedagogy across South Africa, particularly in underperforming schools where learning gaps are more pronounced. One key takeaway from the study was that empowering teachers with the tools to assess and adapt their instruction based on student needs is crucial for improving performance in challenging subjects like mathematics and science. The researchers also suggested that further training for teachers on how to interpret and use data effectively would be beneficial in scaling this intervention. The study highlighted the need for ongoing support and resources to help teachers fully implement data-driven teaching methods. While the research focused primarily on mathematics and science, the findings have broader implications for the education system as a whole. Van der Berg et al. concluded that data-driven pedagogy is a promising approach for addressing South Africa's educational challenges, particularly in STEM subjects. This study offers valuable insights into how evidence-based teaching can be scaled to improve educational outcomes across the country.

Cilliers (2019) evaluated the long-term effects of structured lesson plans and teacher coaching on student performance in rural South African schools. The study aimed to understand whether providing teachers with structured lesson plans and ongoing professional development could enhance student outcomes in mathematics, particularly in underperforming schools. The researchers used a randomized controlled trial to compare the performance of students in schools that implemented structured pedagogy interventions with those that did not. Results showed that students in schools using structured lesson plans and receiving teacher coaching performed significantly better in mathematics compared to those in the control group. The intervention was particularly effective in improving the performance of lower-achieving students, suggesting that structured pedagogy can help close achievement gaps. The study also found that teachers who participated in coaching were more likely to implement the lesson plans effectively, leading to better student engagement and understanding of mathematical concepts. Cilliers et al. concluded

that structured pedagogy interventions, when combined with professional development, have the potential to transform teaching practices and improve student learning outcomes. The authors recommended that structured lesson plans be integrated into the national curriculum, particularly in rural areas where teacher quality is often lower. They also suggested that teacher coaching should be made a permanent feature of the education system to ensure that teachers are continuously improving their instructional techniques. The study emphasized the importance of providing ongoing support to teachers to sustain the positive effects of structured pedagogy interventions. In addition, the researchers highlighted the need for more research on how these interventions impact other subjects, such as science, in both rural and urban schools. Overall, the study provides valuable insights into the effectiveness of structured pedagogy in improving mathematics outcomes and offers practical recommendations for policymakers and educators.

Taylor and Coetzee (2021) examined the effectiveness of scripted lesson plans on student performance in mathematics and science. The study aimed to assess whether providing teachers with detailed, scripted lesson plans could improve instructional quality and student outcomes over time. The researchers followed a group of South African schools that implemented scripted pedagogy interventions, tracking student performance over several years. Findings revealed that schools using scripted lesson plans saw significant improvements in both mathematics and science test scores, particularly in schools with initially low performance levels. The authors noted that scripted lessons provided a structured framework that helped teachers deliver content more effectively, especially in schools with less experienced teachers. The study also found that students in these schools demonstrated higher levels of engagement and understanding, leading to sustained improvements in academic performance. Taylor and Coetzee recommended that scripted pedagogy interventions be expanded to more schools, particularly those in disadvantaged areas where teacher quality is often a concern. They also emphasized the importance of adapting scripted lesson plans to suit the specific needs of different school environments, as the one-size-fits-all approach may not be effective in every context. The researchers suggested that continuous monitoring and adjustments to the lesson plans would be necessary to ensure their long-term effectiveness. In addition, they called for more research into the impact of scripted pedagogy on other subjects, such as language and social studies, to provide a comprehensive understanding of its benefits. The study offers valuable insights into how structured teaching interventions can be used to improve student performance in challenging subjects.

Hoadley (2018) explored the impact of curriculum standardization on student performance in mathematics in South African schools. The study sought to determine whether standardizing the mathematics curriculum across schools could reduce disparities in educational outcomes. Hoadley employed a comparative case study approach, analyzing schools that had implemented a standardized curriculum alongside those that had not. The results indicated that students in schools with a standardized curriculum performed better in mathematics due to the consistency in content delivery. However, the study also found that teacher quality played a crucial role in the success of the curriculum, as schools with well-trained teachers saw more significant gains in student performance. Hoadley concluded that while curriculum standardization is beneficial, it must be accompanied by investments in teacher training to ensure its effectiveness. The author recommended that policymakers focus on both curriculum reforms and teacher development to improve educational outcomes across the country. In particular, the study highlighted the need for targeted interventions in schools with lower teacher quality to maximize the benefits of a

standardized curriculum. Hoadley also suggested that future research should explore the impact of curriculum standardization on other subjects, such as science, to provide a more holistic view of its effectiveness. The study contributes to the ongoing debate on how best to improve student performance in South Africa's education system.

Mbatha and Dlamini (2022) investigated the effectiveness of peer-assisted learning as a structured pedagogy intervention in improving student performance in mathematics and science. The study aimed to assess whether collaborative learning techniques, where students assist each other in learning, could enhance academic outcomes in rural South African schools. The researchers used an experimental design, comparing the performance of students engaged in peer-assisted learning with those in traditional, teacher-centered classrooms. The findings showed that students involved in peer-assisted learning significantly improved their test scores in both mathematics and science, particularly those who initially struggled with these subjects. The authors noted that peer-assisted learning created a supportive learning environment that encouraged student participation and collaboration. Mbatha and Dlamini recommended that peer-assisted learning be integrated into the national curriculum as a cost-effective strategy for improving educational outcomes in resource-constrained schools. They also suggested that teachers should receive training on how to facilitate peer learning to maximize its benefits. The study highlighted the potential of peer-assisted learning to address educational challenges in rural areas, where teacher quality and resources are often limited. The authors concluded that peer learning is an effective method for improving student performance in mathematics and science, particularly in disadvantaged communities.

Gustafsson and Nuga Deliwe (2020) evaluated the impact of structured teacher development interventions on student performance in mathematics and science. The study focused on whether providing teachers with intensive professional development and ongoing support could improve their instructional practices and, in turn, enhance student outcomes. Using national assessment data, the researchers compared the performance of students in schools where teachers participated in structured development programs with those in schools that did not implement such interventions. The results indicated that students in schools with structured teacher development programs performed significantly better in both mathematics and science. The study found that teachers who received training were more likely to adopt innovative teaching practices, leading to higher levels of student engagement and understanding. Gustafsson and Nuga Deliwe concluded that structured teacher development is a key factor in improving student outcomes in challenging subjects like mathematics and science. They recommended that professional development programs be institutionalized and continuously updated to keep pace with educational demands. The study also emphasized the importance of providing ongoing support to teachers, as one-time training interventions may not be sufficient to sustain improvements in student performance.

METHODOLOGY

This study adopted a desk methodology. A desk study research design is commonly known as secondary data collection. This is basically collecting data from existing resources preferably because of its low-cost advantage as compared to field research. Our current study looked into already published studies and reports as the data was easily accessed through online journals and libraries.

FINDINGS

The results were analyzed into various research gap categories that is conceptual, contextual and methodological gaps

Conceptual Gap: There is a need for more research on the long-term impact of structured pedagogy interventions beyond early-grade mathematics, particularly in other subjects like science. While studies like Spaull and Kotze (2019) and Van der Berg et al. (2020) highlight the positive effects of structured interventions on early mathematics outcomes, fewer studies examine the application of these interventions to science education, or how such programs impact students in higher grades. Additionally, the focus on curriculum reform and data-driven teaching is well-documented, but there is less research on how peer-assisted learning, as explored by Mbatha and Dlamini (2022), compares with other structured interventions across subjects and contexts.

Contextual Gap: Many of the studies focus predominantly on rural or underperforming schools (Cilliers et al., 2019; Mbatha & Dlamini, 2022), with less attention given to urban or more resource-rich environments. This creates a contextual gap, as the effects of structured pedagogy may vary across different educational settings. Moreover, while most studies address the short-term effects of these interventions, there is limited exploration of how structured pedagogy might influence long-term learning trajectories, particularly in terms of student retention and future academic success.

Geographical Gap: The studies reviewed focus primarily on South Africa, with limited comparative analyses between different regions in sub-Saharan Africa or between other developing and developed countries. For example, studies like those by Hoadley (2018) and Gustafsson and Nuga Deliwe (2020) concentrate solely on South Africa's educational system, leaving a gap in understanding how structured pedagogy interventions might perform in similar socio-economic environments in neighboring countries like Botswana or Namibia. Additionally, few studies investigate how the same interventions could be adapted and scaled in other global contexts.

CONCLUSION AND RECOMMENDATIONS

Conclusions

A comparative analysis of structured pedagogy interventions in South Africa reveals that these methods can significantly improve student performance in mathematics and science. Interventions such as teacher professional development, curriculum standardization, data-driven instruction, and peer-assisted learning have shown positive outcomes, particularly in underperforming and rural schools. Studies demonstrate that structured pedagogies help close achievement gaps, enhance instructional quality, and lead to better student engagement and understanding in STEM subjects. However, to maximize the impact, these interventions need to be expanded beyond mathematics to other subjects like science, with ongoing support for teachers through continuous training and coaching. Future research should focus on the long-term effects of these interventions across different educational contexts to ensure scalability and sustainability across South Africa and beyond.

Recommendations

Theory

Future research should explore the theoretical frameworks underpinning the success of structured pedagogy interventions across different subjects, not just mathematics. Studies should investigate how interventions like data-driven instruction and peer-assisted learning align with theories such as constructivism and sociocultural learning to provide a deeper understanding of how students learn in diverse contexts. This will contribute to expanding educational theories on how structured pedagogies affect long-term cognitive development in mathematics and science subjects. There is a need for more comparative theoretical analyses between rural and urban environments to understand the contextual adaptability of these interventions in different socio-economic settings.

Practice

Schools should integrate structured lesson plans and data-driven instruction into everyday practice to enhance teacher efficacy and student performance. Regular coaching and professional development must be part of teacher support systems, ensuring educators are equipped to deliver high-quality instruction. Tailoring these structured approaches to specific subjects, such as science, will ensure more consistent improvements in student outcomes. Schools must adopt peer-assisted learning models, particularly in under-resourced areas, as these are cost-effective ways to improve performance in mathematics and science while fostering collaboration and active engagement.

Policy

Schools should integrate structured lesson plans and data-driven instruction into everyday practice to enhance teacher efficacy and student performance. Policymakers should implement nationwide curriculum reforms that standardize content delivery across all schools, ensuring consistency in teaching quality, particularly in mathematics and science. However, these reforms should be flexible enough to allow customization based on specific regional needs. There should be a national focus on teacher development policies that institutionalize ongoing training and coaching, particularly in STEM education. This policy should include incentives for teachers to continually improve their instructional practices and adapt to data-driven methodologies. Government policies should support scaling structured pedagogy interventions in science education, with continuous monitoring to assess long-term impacts. This could be achieved through partnerships with educational research institutions to pilot interventions before scaling them nationally.

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