

International Journal of Learning, Teaching and Educational Research
 Vol. 23, No. 10, pp. 453-474, October 2024
<https://doi.org/10.26803/ijlter.23.10.22>
 Received Aug 12, 2024; Revised Oct 18, 2024; Accepted Oct 21, 2024

Examining the Effect of Resource Constraints on Teaching and Learning of Grade 12 Mathematics in Gauteng Community Learning Centres

Carlit Casey Tibane*^{ID}, Olivia Neo Mafa-Theledi^{ID},
 Tshediso Phanuel Masebe^{ID} and Peter Mathye^{ID}

Department of Mathematics, Science & Business Education
 School of Education, Tshwane University of Technology, South Africa

Abstract. The study focused on the effects of resource constraints on the teaching and learning of Grade 12 Mathematics in Gauteng Community Learning Centres (CLCs) in South Africa. It highlighted the historical and socio-economic context of apartheid and its enduring effects on educational inequalities. The lack of resources in CLCs, including substandard facilities, scarcity of teaching materials, and under-resourced teachers, was identified as a persistent issue. Grade 12 Mathematics is a vital subject for higher education and career paths, and proposed solutions include using deliverology and implementation science to mitigate these challenges. The methodology involved a multiple-case study design, with semi-structured interviews conducted with Grade 12 Mathematics teachers in CLCs in the Gauteng North region. Thematic analysis was used to analyze the qualitative data gathered from the interviews. The findings highlighted a severe lack of resources in CLCs, reliance on out-dated and borrowed materials, and a heavy burden on teachers to supply resources. Challenges included limited access to basic materials, financial and logistical strains on teachers, and a negative impact on teaching quality. Furthermore, the implications of these findings suggest that addressing resource constraints through these frameworks could significantly enhance the quality of Mathematics education in CLCs. The study recommends a strategic approach using deliverology and implementation science, focusing on structured goal setting, capacity building, stakeholder engagement, continuous improvement, policy advocacy, and technology integration to improve Grade 12 Mathematics delivery. These recommendations are aimed at mitigating the adverse effects of resource constraints and improving the teaching and learning of Grade 12 Mathematics in CLCs.

Keywords: community learning centres; deliverology; implementation science; mathematics; resource constraints; teachers

* Corresponding author: *Carlit Casey Tibane*, caseyct.tibane@gmail.com

1. Introduction

Resource constraints within Community Learning Centres (CLCs) in South Africa are intrinsically linked to the country's socio-economic and historical context, particularly the enduring legacy of apartheid. Green (2015) articulates that apartheid not only shaped the broader societal inequalities but also entrenched disparities within the education system. These disparities are most acutely felt in CLCs located in historically marginalized communities, where lack of resources has been a persistent issue. These centres, intended to provide educational opportunities to underserved populations, often operate with substandard facilities, a scarcity of essential teaching materials, and a significant number of under-qualified teachers, all of which impede the effective delivery of education (Houchen, 2020). Furthermore, research by Ahmadi (2023) delved into the ongoing impact of systemic injustices, emphasizing that these factors continue to obstruct learning in disadvantaged neighbourhoods, thereby perpetuating educational inequalities. The economic challenges faced by these communities, as highlighted by Desjardins (2015) and Legotlo (2014), further compound the issue. Economic disparities mean that some regions are disproportionately affected, with high levels of poverty limiting access to financial resources necessary for maintaining and improving educational facilities. These economic constraints, coupled with inadequate government support, create a scenario where CLCs struggle to provide even the most basic educational services.

While existing literature provides a broad overview of the challenges faced by CLCs, there is a noticeable gap in research, specifically addressing how these resource constraints impact the teaching and learning of Grade 12 Mathematics. Mathematics at the Grade 12 level is a pivotal subject, not only because it is a gateway to higher education and various career paths, but also because it is a subject that often requires more substantial resources - such as qualified teachers, textbooks, and technological tools - than other subjects. Despite this, the specific ways in which resource shortages affect the teaching of Mathematics in CLCs have not been sufficiently explored. Previous studies have generally discussed the inadequacies in infrastructure, teaching materials and teacher qualifications across CLCs (Belete et al., 2022; Rakoma & Schulze, 2015). However, they have not delved deeply into the subject-specific challenges, particularly for Mathematics, where the absence of resources can severely limit the scope of instruction and the ability to engage students effectively. Moreover, while some attention has been given to the lack of technological resources in these centres (Baloyi, 2014), there is a need for more detailed analysis on how this lack affects the teaching and learning process in Mathematics, especially in the digital age where technology plays a crucial role in education. Furthermore, a critical review of the literature reveals a distinct lack of targeted research on resource constraints within CLCs.

Research studies by Chen and Horn (2022) and Melhuish et al. (2022) emphasize the need for more focused investigations into how resource limitations uniquely affect the learning environment in these centres, yet few studies specifically analyze the implications for Mathematics education. Additionally, although

Cevikbas and Kaiser (2023) touch on the lack of technological resources, there remains an urgent need for a comprehensive examination of how these deficits hinder the teaching and learning process in Mathematics, especially in the digital age where technology plays a crucial role in education. The primary objective of this study was to comprehensively assess the impact of resource constraints on the teaching and learning of Grade 12 Mathematics in South Africa's CLCs. Specifically, the research aimed to evaluate how the lack of essential resources, such as textbooks and proper classroom infrastructure, hindered the effective delivery of Mathematics education. It also sought to identify the challenges teachers face in these resource-constrained environments, such as managing large class sizes with limited materials, and adapting curriculum requirements to fit the available resources.

2. Literature Review

Well-resourced teachers play a critical role in the effective implementation of the Grade 12 Mathematics curriculum in CLCs, especially in resource-constrained settings. Teachers' attitudes towards textbooks and other instructional materials can greatly influence how these resources are utilized in the classroom. Positive perceptions often lead to the effective integration of available materials into teaching practices, which is essential in environments where resources are limited (Borg, 2017). Conversely, negative perceptions may result in the underutilization or avoidance of these resources, thereby hindering curriculum implementation. To address these challenges, it is vital to understand and support teachers' beliefs and practices through targeted professional development, enabling them to make the most of the scarce resources available (Margot & Kettler, 2019).

Moreover, the use of supplemental resources, particularly technology, offers significant potential to enhance the teaching and learning of Grade 12 Mathematics in CLCs. Technology can transform traditional instruction into a more interactive and participatory experience, which many teachers view favorably (Pepin et al., 2015). However, the integration of technology in CLCs is often hampered by inadequate infrastructure, lack of training, and insufficient technological tools (Tibane et al., 2024). Addressing these challenges through systematic professional development and resource planning is essential for leveraging technology, to improve curriculum delivery (Powell & Bodur, 2019). In resource-constrained environments, it is crucial to provide teachers with the necessary support to integrate supplemental resources effectively, ensuring that all students benefit from a comprehensive mathematics education (Trantopoulos et al., 2017).

Equity and access to resources are major concerns in the context of CLCs, where financial disparities often prevent students from obtaining essential learning materials like textbooks. Bischoff and Owens (2019) and Darling-Hammond (2018) suggest that addressing such issues requires a combination of government policies, partnerships and donor initiatives to ensure that all students have equal access to educational resources. Open educational resources (OER) and digital platforms offer promising solutions by making high-quality

educational content more accessible and affordable, helping to bridge the gap between students from different socio-economic backgrounds (Bali et al., 2020). Additionally, the integration of technology in CLCs can promote equity by providing interactive and engaging learning experiences, although this requires overcoming significant infrastructural and training challenges (Heflin et al., 2017). Collaborative efforts between governments, NGOs, and the private sector are critical in ensuring that all students have the tools they need to succeed in their education, particularly in resource-constrained settings like CLCs (Steiner-Khamsi & Draxler, 2018; Tandon & Chakrabarty, 2018).

3. Theoretical Framework

The complex challenges associated with curriculum implementation of Grade 12 Mathematics in resource-constrained CLCs necessitated the adoption of two complementary theoretical frameworks, namely, Deliverology and the Implementation Science Framework. The latter provide structured approaches to enhance educational delivery and effectively address barriers to resource availability and utilization. These frameworks were chosen for their distinct yet interrelated strengths, which together provide a comprehensive strategy for addressing the multifaceted issues encountered in CLCs. Figure 1 below serves as a visual synthesis of how these frameworks were integrated to optimize curriculum implementation and resource management in CLCs. Deliverology, as developed by Sir Michael Barber, is recognized for its structured approach to performance management, particularly in the context of government and organizational policy implementation (Mouton, 2021; Nilsen & Bernhardsson, 2019). In this study, Deliverology was applied to establish clear goals, monitor progress, and ensure data-driven decision-making - key elements necessary for managing the limited resources available in CLCs. The emphasis on these components, as illustrated in the diagram, reflects Deliverology's strength in providing a systematic approach to achieving educational objectives within constrained environments. However, Deliverology's traditional focus on broader policy implementation, as noted by Birch and Jacob (2019), limits its direct applicability to the specific and nuanced challenges of curriculum delivery at the CLC level. Thus, while its principles are invaluable for setting the overarching strategy, they require contextual adaptation to be fully effective in CLCs. To address the limitations of Deliverology, the Implementation Science Framework was incorporated into the study. This framework is particularly well-suited to analyzing and improving educational interventions in complex, resource-limited environments like CLCs (Cook et al., 2019).

As depicted in the diagram, the implementation science framework provides a more nuanced and context-specific approach by considering critical factors such as organizational culture, resource availability, stakeholder engagement, and the beliefs and attitudes of teachers (Davies et al., 2024; Williams et al., 2021). These factors are crucial in environments where resources are scarce, as they directly impact the feasibility and sustainability of curriculum implementation efforts. The Implementation Science Framework emphasizes the importance of continuous improvement and adaptation, which allows for on-going adjustments to the curriculum implementation process in response to real-time

feedback and changing conditions (Youn et al., 2024). This flexibility is vital in CLCs, where external factors such as community needs, resource fluctuations, and teacher turnover can significantly influence educational outcomes. The diagram illustrates how this framework ensures that curriculum implementation is not only effective, but also resilient and adaptable to the unique challenges faced by CLCs.

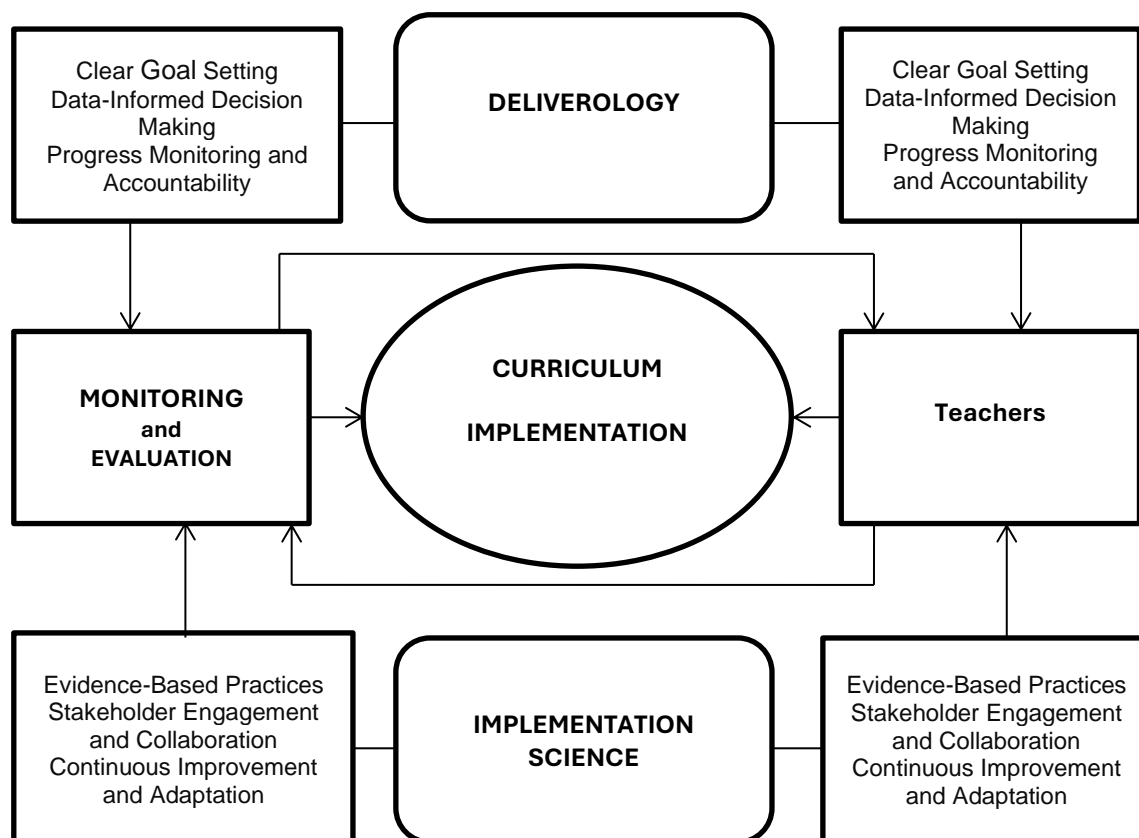


Figure 1: Framework integrating deliverology and the implementation science framework in curriculum implementation (Nilsen & Bernhardsson, 2019; Williams et al., 2021)

The integration of Deliverology and the Implementation Science Framework, as represented in Figure 1, creates a synergistic approach that combines the strengths of both frameworks. While Deliverology provides the necessary structure and accountability through goal setting and progress monitoring (Birch & Jacob, 2019), the Implementation Science Framework offers the flexibility and contextual sensitivity needed to address the specific challenges of CLCs (Youn et al., 2024). This combination ensures that curriculum implementation of Grade 12 Mathematics in CLCs is strategically sound and practically feasible, even in the face of resource constraints. By applying this integrated approach, the study was able to develop strategies that optimized resource utilization, enhanced stakeholder engagement, and promoted sustainable improvement in teaching practices within CLCs. The literature review, which involved a critical analysis of sources such as Barber et al. (2015),

Birch and Jacob (2019), and Williams et al. (2021), identified several benefits of applying these frameworks to CLCs. These include enhanced collaboration and stakeholder engagement, capacity building, and the establishment of processes for continuous improvement and adaptation. The integration of Deliverology and the Implementation Science Framework, as depicted in the diagram, was instrumental in guiding the study's efforts to improve teaching methods and student outcomes in resource-constrained CLC environments.

4. Research Question

What are the effects of resource constraints on teaching and learning of Grade 12 mathematics in community learning centres?

5. Methodology

5.1 Research Design

The study employed a multiple case study design, which is a qualitative research approach involving the exploration of several individual cases within a certain context, to understand a specific phenomenon in-depth (Tumele, 2015). Qualitative data was chosen over quantitative methods to allow for a deeper exploration of teachers' personal experiences and perspectives on the effects of resource constraints, which quantitative methods may not capture in sufficient detail (Knott et al., 2022). This approach provided rich, contextual insights into the specific challenges faced in implementing the Grade 12 Mathematics curriculum in under-resourced CLCs. However, a limitation of this method is that the findings may not be fully generalizable, and the subjective nature of interviews could introduce potential bias and/or inconsistencies in how participants interpret and share their experiences (Karunarathna et al., 2024). The focus of this study was centered on the effects of resource constraints on the teaching and learning of Grade 12 Mathematics in CLCs located in the Gauteng North region. In this context, the multiple-case study design was selected because it allowed for the comparison of various cases, such as teacher experiences regarding resource constraints and infrastructure limitations, which led to different implementations of the curriculum in Gauteng North region CLCs.

This research specifically targeted Gauteng North region CLCs that have a long history of underperformance in Grade 12 Mathematics. To select cases, a purposive sampling technique was employed based on the following criteria: demographics, geographical environment, and the offering of Grade 12 Mathematics (Bell, 2014; Creswell & Poth, 2018). Semi-structured interviews were conducted with one Grade 12 Mathematics teacher from each of the 12 CLCs in the Gauteng North region. The interviews were guided by semi-structured questions, which provided an opportunity for participants to share their perspectives and experiences freely. This approach enabled the researcher to gain comprehensive knowledge concerning this inquiry, facilitating a deeper understanding of the challenges faced by these educators.

5.2 Participants

This study comprised twelve Grade 12 Mathematics teachers from CLCs altogether. To ensure a variety of participation, the researchers used stratified and purposive random sampling (Creswell & Poth, 2018). According to Davis (2015), stratified random sampling is a type of probability sampling in which some characteristics of the entire population are used to divide them in groups. A power analysis was performed in order to determine the minimum sampling requirements in the ratio of twelve (12) teachers and it was found that this ratio will provide enough power to be able to identify any significant differences and patterns in the problems of curriculum implementation that teachers face (Kang, 2021). This strategy enhanced the protection of the integrity and the credibility of the results based on the scope of the study. The typical criteria for including or excluding the participants were, however, pouring in from different quarters and to some extent even negatively impacting the studies as appeared to be suggested by Trafimow and Earp (2017) including a power analysis which considers effect size such as, out of the 18 subjects earmarked for the study only 12 were finally interviewed. To ensure teachers' participation was voluntary, the researcher informed the teachers of research aims and clear benefits, guarantee of confidentiality. Before their enrolment, formal invitations and information sessions were used to obtain informed consent (Eeckhout et al., 2023). The researcher later addressed the CLCs identified during this phase utilizing purposive sampling techniques, purposely seeking out participants with knowledge and experience relevant to the aspect of the study (Adeoye, 2023). This way the information gathered was more intensive and appropriate.

To gather diverse perspectives on the issues faced by teachers regarding Grade 12 Mathematics implementation, the twelve participants were recruited from CLCs located in different areas within the Tshwane region. The study employed stratified random sampling to recruit a sample of teachers from each of the chosen CLCs. This method ensured that the sample accurately reflected the population in terms of specific factors such as teachers' issues, experiences, viewpoints, and impressions (Davis, 2015). Two groups were formed from the sample based on elements such as the environment of the CLCs, including geographical dynamics, mathematical performance, and the tenure of teachers in the CLCs. Following stratified random sampling methods, participants were selected at random from each stratum (Dhivyadeepa, 2015). Based on a computation that helped ascertain the minimum sample size for the research, a power analysis was conducted to determine the sample size. This analysis took into account factors such as the desired level of impact size (Rust, 2013). Furthermore, the selected sampling technique ensured that participants possessed the necessary knowledge, direct experience, and insightful analysis related to the research goals (Setia, 2016).

5.3 Data Collection Procedure

In this study, semi-structured interviews were used to completely capture teacher's issues, experience, viewpoint, and perspectives in using the Grade 12 Mathematics curriculum. A pilot study was carried out to validate the instrument to investigate a broad spectrum of pertinent issues related to the Grade 12 Mathematics curriculum implementation. The structured interviews

used in the study were valid since they were carefully designed and adopted (Husband, 2020). Data was gathered, based on semi-structured interviews carried out with participants. A set of open-ended questions (Slade & Sergent, 2023) directed the interviews, meant to probe difficulties teachers encountered using Grade 12 Mathematics' curriculum application. The semi-structured interviews guaranteed thorough understanding of the the effect of resource constraints on teaching and learning of Grade 12 Mathematics in Gauteng CLCs.

5.4 Data Analysis

The information gathered from the semi-structured interviews were analyzed using a thematic approach to interpret qualitative data. In this manner, the data was examined by carefully coding any patterns or themes and organizing them into categories of key insights (Slade & Sergent, 2023). The analytic process consisted of several steps among which were getting acquainted with the data, determining and coding themes, looking for concepts in the material, and making conclusions. In a constantly evolving effort to analyze the data, resources problems and their influence on teaching and learning Grade 12 Mathematics were identified as a theme and discussed. In order to enhance the reliability of the findings, the author used peer debriefing (Sabnis & Wolgemuth, 2024), in which subjects examined and gave feedback on the findings for reliability of the interpretations.

5.5 Ethical Considerations

This study on the effects of resource constraints on the Grade 12 mathematics teaching and learning process in Gauteng CLCs is designed with due consideration to Tshwane University of Technology's (TUT) ethical guidelines, which uphold human dignity, rights and well being of the subjects. Approval by ethical standards was sought in terms of explaining the purpose of the research and the possible risks and benefits of partaking in it. Reports did not reveal any identifying information about the participants and confidentiality and anonymity were observed. It was noticed that the participants' participation was voluntary and participants were free to exit the study without penalty at any stage of the research. To improve the credibility of the research, the researchers maintained the focus of the study and refrained from being biased in any manner.

6. Findings

Table 1 outlines the diverse resource constraints faced by various CLCs in Gauteng, focusing on the availability and sufficiency of resources for teaching Grade 12 Mathematics. The responses highlighted significant disparities in resource provision across the CLCs. Some centres relied heavily on borrowing textbooks from nearby schools (Case 1) or using outdated materials such as previous question papers (Case 10), while others had access to more stable resources, including textbooks and computer labs (Cases 3 and 4). However, even in centres with better resource availability, challenges persist, such as the need for more manipulatives, professional development, and dedicated teaching spaces. The table also reflects the burden placed on teachers to supply their own

resources or ensure students procure necessary materials (Case 6), underscoring the systemic inadequacies in resource provision.

Table 1: Themes on resource constraints in Gauteng CLCs

Answer A - Case 1 - CLC 1
According to the respondent, mathematics learning materials are lacking at the CLC. They then had to get textbooks and guidelines from the neighbouring institutions as there were no resources provided. However, due to the unavailability of any resources, the respondent was not in a position to address their adequacy. As it stands, no support is available from the management of the CLC in terms of teaching mathematics. The situation of lack of support also includes no class visits or any kind of support given by the management. The respondent indicated that there was a demand for workshops, textbooks and curriculum guidelines in order to improve the mathematics subject of the CLC.
Answer B - Case 2 - CLC 2
Respondent B also reported utilizing textbooks and papers as well as social media for the purpose of imparting mathematics to the learners at CLC. These resources are relied upon for teaching materials and extra exercises. The current resources were inadequate as per the mathematics curriculum requirements in the CLC. Some issues like scarcity of printing supplies including paper and ink, and having few textbooks available for students' use, were pointed out as major problems. Respondent B also feels it is necessary to convene with the subject advisor for more resources and improvement of the mathematics curriculum.
Answer C - Case 3 - CLC 3
Respondent C states that Textbooks, some online material, and a computer lab are also available for the mathematics teaching at the CLC. The respondent noted that he has the support of the management of the CLC in terms of necessary materials and training sessions sometimes. Respondent C has pointed out that more funds need to be allocated for material resources, especially manipulatives that enhance practical learning in Mathematics.
Answer D - Case 4 - CLC 4
According to Respondent D , there are textbooks, some internet materials and even a computer room which is useful for the teaching of mathematics in colleges D indicated that. Resources are currently available that respondents said are competent enough so as to be used in fulfilling the objectives of the mathematics curriculum in CLC . This respondent stated that he has been able to rely on the management of CLC who will give him necessary materials when needed and allow him to enhance his skills professionally on occasions.
Answer E - Case 5 - CLC 5
Respondent E mentions chalkboards, student copies without the textbook and textbooks such other materials as available at the CLC for the teaching of mathematics. Resources available at the CLC at the moment are not enough to address all the requirements of the mathematics curriculum. One of the reasons why resources are inadequate is the absence of diagrams and other visual aids for the formulas.
Answer F - Case 6 - CLC 6
A significant issue was that teachers faced the onus of sourcing for their own materials and there was an added expectation that students would find the necessary materials themselves. We can also see here the failure of the system in providing the needed resources within the institutions. Respondent F noted " <i>Textbooks, chalkboard, copies for all students who don't have textbooks</i> ". Resources which teachers are made to

<p>shoulder signify their responsibility but also underline the deficiencies of the institutions in extending support. Businesses, specifically teacher unemployment and retention notwithstanding, cannot afford this in the long run.</p>
<p>Answer G - Case 7 - CLC 7</p>
<p>Few respondents claimed the existence of at least minimal supplies in the form of such items as textbooks, chalkboards and writing tools. Although these resources are basic, their inadequacy presents major challenges. Respondent G mentioned, "<i>Textbooks and study guides.</i>" Constructionists have observed that sometimes having only elementary resources at hand acts as a constraint to the variety of methods and materials that can be employed by the students, thereby restricting what they are able to learn or achieve.</p>
<p>Answer H - Case 8 - CLC 8</p>
<p>The respondent replied that the only resources available for teaching mathematics in the CLC include teachers' guidelines and old papers. As he/she claimed, these current resources are however not up to the requirements of the mathematics curriculum. Other aids are required in order to fulfill instruction and learning activities more completely including: pupil's and teacher's books, additional workout books and other learning materials. In order to make the mathematics curriculum more effective there is belief from the respondent that sufficient practice time is generally needed by the learners for their work.</p>
<p>Answer I - Case 9 - CLC 9</p>
<p>Respondent H acknowledged that teachers are provided with textbooks, while students have to buy their own materials. With the view of Respondent H, the materials that are available may be adequate to meet the demands of the mathematics curriculum depending on if the students have bought the necessary resources. Respondent H, for his part, pointed out the lack of workshops oriented to mathematics as one of the factors inhibiting teaching. Such instruction is viewed as critical in strengthening teachers' competence and learning the best practices of other teachers.</p>
<p>Answer J - Case 10 - CLC 10</p>
<p>The respondent pointed out that there is not much material ever provided by the college, as only previous question papers are current. The resources policy of the university is not effective as the resources are only available with the lecturers and students are not able to access the resources. The respondent indicated that he received no assistance from the management of the CLC while teaching math. There are no such trainings offered and there seems to be a lack of innovation as far as standard 12 is concerned.</p>
<p>Answer K - Case 11 - CLC 11</p>
<p>The respondent mentioned having and sharing classes with adjoining secondary schools with access to chalks, textbooks and mentor assistance from the senior lecturers and management. Now the available resources are inadequate to cater for the needs of the study of mathematics. The CLC was catering for students preparing for the NSC and the ASC, but the number of classes are not sufficient. To enhance the mathematics curriculum, the respondent highlights the importance of spending more time with the students. In such a scenario intensive periods would help, meaning teachers could cover the whole syllabus to completion instead of increasing the hours per week in the classroom, by utilizing separate periods for every day.</p>
<p>Answer L - Case 12 - CLC 12</p>
<p>The respondent reports being furnished with books and other study materials for the purpose of teaching mathematics in the CLC. The respondents believe that the existing resources are not enough for the requests of the mathematics program. Yet</p>

many students do not access these resources, which may affect their ability to study well away from classes. To enhance the mathematics curriculum further, the respondent emphasized that Internet access is very important.

Table 2 highlights the major findings of a study on resource constraints in CLCs and their effect on the teaching of Grade 12 Mathematics. The findings revealed a severe lack of resources, with teachers often forced to rely on outdated, borrowed, or minimal materials, which significantly hampers the effectiveness of their teaching.

Table 2: Major findings of the study

Framework category	Major findings
<p>Severe lack of resources (Darling-Hammond, 2018)</p>	<p>A critical issue identified in the study was the severe lack of resources in community learning centres, which significantly hampers the teaching and learning process. Respondent A stated, <i>“No resources and we are forced to go to a nearby school to borrow textbooks and even mathematical guidelines.”</i> Respondent D noted, <i>“There are no resources at the centre. As the teacher, I make sure my students buy the correct study materials for themselves.”</i> Respondent I added, <i>“No resources at all from the college, only previous question studies.”</i> This lack of resources highlights a systemic issue within the community learning centres, forcing teachers to seek unreliable and unsustainable external support.</p>
<p>Reliance on outdated and borrowed materials (Amadi & Nwogu, 2023; Ihebom & Uko, 2020)</p>	<p>Teachers often have to depend on outdated or borrowed materials, which limits the effectiveness of their teaching. Respondent B stated, <i>“We use previous textbooks, studies, and social media.”</i> Respondent N added, <i>“We are using previous textbooks and handout notes, also previous question studies.”</i> The use of outdated textbooks and borrowed materials can result in students learning outdated methods and content, and the availability of these materials can be inconsistent.</p>
<p>Burden on teachers to supply resources (Barcelona et al., 2023)</p>	<p>Teachers frequently bear the responsibility of providing their own resources or ensuring that students purchase necessary materials. Respondent H stated, <i>“We have textbooks as teachers but students are not provided with resources; they have to buy.”</i> Respondent M noted, <i>“Textbooks only per the teacher.”</i> Respondent E added, <i>“Textbooks, chalkboard, copies for all students who don’t have textbooks.”</i> This practice, while demonstrating teachers’ commitment, is not sustainable and places significant financial and logistical strain on teachers.</p>
<p>Availability of basic and minimal resources (UNESCO, 2015)</p>	<p>In some instances, only basic resources like textbooks, chalkboards, and writing utensils are available, which still pose significant challenges due to their limited quantity. Respondent G mentioned, <i>“Textbooks and study guides.”</i> Respondent K added, <i>“Textbooks, study guide.”</i> Respondent O stated, <i>“Books and writing utensils.”</i> The limited availability of these fundamental resources restricts the scope of teaching methods and materials available to students, potentially hindering their learning experiences and outcomes.</p>

<p>Challenges in acquiring and utilizing resources (Meier & West, 2020)</p>	<p>Teachers face multiple challenges in acquiring and effectively utilizing resources, which impacts their teaching quality and consistency. Participant A stated, “Challenges I have to make sure that I also acquire solutions or tools to these resources to make sure that I don’t make up my own solutions. Sometimes getting those tools is challenging, and it impacts because I will find myself sometimes not fully utilizing the resources.” These challenges lead to inconsistencies in teaching, and prevent teachers from fully leveraging the available resources.</p>
<p>Financial and logistical burdens on teachers (Cahilog et al., 2023; Placencia, 2021; Singh, 2024)</p>	<p>Teachers often bear the financial and logistical burdens of procuring and providing resources, which is unsustainable and adds significant stress. Participant B described this challenge: “There are a lot of challenges because most students don’t have materials. Yes, us teachers, we have a lot of materials we can download; we do have data, but for some students, it’s still a challenge. They don’t have materials or data, even the study guide. Sometimes I share my data with students even though it is self-funded. The cell phones and gadgets are mine. This challenge has a negative impact because you find you are teaching somebody who doesn’t have anything, not even a study guide or a textbook, so it becomes a big concern.” This self-funding model is unsustainable and places additional stress on teachers, detracting from their primary focus on teaching.</p>
<p>Impact on teaching quality (Anthony & Walshaw, 2009; Saloviita, 2020)</p>	<p>The lack of resources and associated challenges significantly impact the quality of teaching and learning outcomes. Teachers find it difficult to deliver comprehensive and effective lessons without proper materials. Participant A noted, “Sometimes getting those tools is challenging, and it impacts because I will find myself sometimes not fully utilizing the resources.” Participant B added, “This challenge has a negative impact because you find you are teaching somebody who doesn’t have anything, not even a study guide or a textbook, so it becomes a big concern.” These challenges result in a compromised educational experience for students, as teachers are unable to provide consistent and thorough education.</p>

7. Discussion

7.1 Severe Lack of Resources

A critical issue identified in the study was the severe lack of resources in CLCs, which significantly hampers the teaching and learning process. Respondents highlighted the absence of basic educational materials, which placed a considerable burden on both teachers and students. **Respondent A** stated, “No resources and we are forced to go to a nearby school to borrow textbooks and even mathematical guidelines.” This situation illustrates the desperation and the extent to which teachers must go to provide basic educational needs, relying on external institutions for materials that should be readily available within their own centres.

Thus, this lack of resources signifies a systemic issue within the CLCs, forcing teachers to seek unreliable and unsustainable external support. **Respondent D** noted, “There are no resources at the centre. As the teacher, I make sure my students buy the correct study materials for themselves.” This response indicated the financial

burden placed on students and their families, exacerbating educational inequities. Students from less affluent backgrounds are particularly disadvantaged, as they may struggle to afford necessary materials, leading to gaps in their learning.

This finding aligns with the existing literature on the importance of resource adequacy in education. Darling-Hammond (2018) emphasizes that resource adequacy is a precondition for educational success. Inadequate resources undermine teaching and learning, and disproportionately affect students from disadvantaged backgrounds. The situation described by **Respondent I**, who mentioned, *“No resources at all from the college, only previous question studies,”* reflects this broader issue. The reliance on out-dated or inadequate resources limits the effectiveness of teaching and learning, preventing students from accessing current and relevant educational content. Moreover, the reliance on borrowed or out-dated materials, as reported by the respondents, was another critical issue. This dependence on external sources is not only unsustainable, but also limits the ability of teachers to provide a consistent and comprehensive education. **Respondent A’s** reliance on borrowing from nearby schools and **Respondent D’s** strategy of having students purchase their own materials, highlight the systemic inadequacies within the community learning centres. These approaches are temporary solutions that do not address the root cause of the problem. This situation is further compounded by the financial and logistical burdens placed on teachers. Singh (2024) notes that the inequitable distribution of educational resources is a major factor contributing to the achievement gap between students from different socio-economic backgrounds. The lack of resources in community learning centres, therefore, not only hampers the educational process but also perpetuates existing inequalities, as students from disadvantaged backgrounds are less likely to have the means to acquire necessary materials on their own.

7.2 Reliance on Out-dated and Borrowed Materials

The study revealed a significant reliance on out-dated and borrowed materials among teachers in CLCs. This dependence severely limits the effectiveness of teaching and the quality of education that students receive. **Respondent B** highlighted this issue by stating, *“We use previous textbooks, studies, and social media.”* Similarly, **Respondent N** mentioned, *“We are using previous textbooks and handout notes, also previous question studies.”* These responses indicate a common challenge faced by teachers in these centres; the scarcity of up-to-date and comprehensive educational resources. Using outdated textbooks and borrowed materials means that students are often exposed to obsolete methods and content. This situation is problematic because it prevents students from accessing the latest information and educational advancements, which are crucial for their academic development and future competitiveness. According to Amadi and Nwogu (2023), the use of outdated resources in schools significantly hampers the quality of education, leading to poorer educational outcomes for students in underfunded schools as compared to their peers in better-resourced institutions. Ihebom and Uko (2020) highlighted: *“In schools where resources are scarce, students are often deprived of the opportunity to learn with*

up-to-date materials, which puts them at a disadvantage compared to their peers in better-funded schools."

Moreover, the inconsistency in the availability of borrowed materials adds another layer of complexity to the problem. Teachers may not always have access to these borrowed resources, which can disrupt the continuity of their teaching. **Respondent B's** reliance on social media and previous studies indicates a makeshift approach to resource acquisition, which is neither sustainable nor reliable. This inconsistency can lead to gaps in the curriculum and an uneven learning experience for students. The literature supports these findings by emphasizing the negative impact of inadequate and outdated resources on educational quality. Yang and Lee (2022) state, *"The inequitable distribution of educational resources is a major factor contributing to the achievement gap between students from different socio-economic backgrounds."* In the context of community learning centres, this inequity is starkly evident as teachers and students struggle with insufficient and outdated materials. Furthermore, relying on outdated materials can perpetuate educational inequalities. Students who do not have access to current textbooks and resources are at a distinct disadvantage, compared to those who do. This gap can lead to lower academic performance and reduced opportunities for higher education and employment. The UNESCO Education for All Global Monitoring Report (Desjardins, 2015) highlights the importance of equitable resource allocation to ensure all students receive a quality education. The report notes: *"Equitable resource allocation is critical for ensuring that all children, regardless of their socio-economic background, have access to quality education"* (Desjardins, 2015, p. 396).

7.3 Burden on Teachers to Supply Resources

A significant issue identified in the study was the burden placed on teachers to supply their own resources, or ensure that students procure necessary materials themselves. This practice, while demonstrating the teachers' commitment to their students' education, is unsustainable and places considerable financial and logistical strain on teachers (Placencia, 2021). **Respondent H** noted, *"We have textbooks as teachers but students are not provided with resources; they have to buy."* Similarly, **Respondent M** mentioned, *"Textbooks only per the teacher,"* indicating that teachers are often left to provide resources out of their own pockets or ensure students acquire them. **Respondent E** added, *"Textbooks, chalkboard, copies for all students who don't have textbooks,"* further highlighting the lengths to which teachers go to mitigate the lack of institutional support.

The literature supports these findings by emphasizing the unsustainability of expecting teachers to bear the cost of educational materials. According to Placencia (2021), teachers in under-resourced schools frequently face financial burdens that can detract from their primary teaching responsibilities and contribute to burnout. Barcelona et al. (2023) highlighted that teachers in schools with limited resources often have to supplement materials out of their own pockets, which can lead to significant financial strain and decreased job satisfaction.

This situation not only impacts the teachers but also exacerbates educational inequalities. Students from lower socio-economic backgrounds may struggle to afford the necessary materials, placing them at a disadvantage compared to their peers. Leithwood (2021) highlights the importance of equitable resource distribution, noting that the inequitable distribution of educational resources is a major factor contributing to the achievement gap between students from different socio-economic backgrounds.

7.4 Availability of Basic and Minimal Resources

In some instances, only basic resources such as textbooks, chalkboards, and writing utensils are available in CLCs. While these resources are fundamental, their limited quantity poses significant challenges to effective teaching and learning. **Respondent G** mentioned, *"Textbooks and study guides,"* indicating that even the most essential materials are often in short supply. **Respondent K** noted the availability of *"Textbooks, study guide,"* while **Respondent O** highlighted, *"Books and writing utensils."* These responses illustrate the scarcity of basic teaching tools, which restricts the scope of instructional methods and materials available to students. Thus, the limited availability of these fundamental resources restricts the scope of teaching methods and materials available to students, potentially hindering their learning experiences and outcomes. As Darling-Hammond (2018) points out, the adequacy of basic educational resources is crucial for effective teaching and learning. The lack of these resources can lead to suboptimal educational experiences, where teachers are unable to implement diverse teaching strategies, and students miss out on comprehensive learning opportunities.

Moreover, the availability of only basic resources often means that teachers must prioritize which materials to use, potentially leaving out important aspects of the curriculum. This situation can lead to a fragmented educational experience for students, where they do not receive a well-rounded education. The UNESCO Education for All Global Monitoring Report (Desjardins, 2015) emphasizes the need for sufficient educational resources to ensure all students receive a quality education. The report notes that equitable resource allocation is critical for ensuring that all children, regardless of their socio-economic background, have access to quality education.

7.5 Challenges in Acquiring and Utilizing Resources

In Gauteng CLCs, teachers faced multiple challenges in acquiring and effectively utilizing resources, which impacts their teaching quality and consistency. **Participant A** highlighted this issue by stating, *"Challenges I have to make sure that I also acquire solutions or tools to these resources to make sure that I don't make up my own solutions. Sometimes getting those tools is challenging, and it impacts because I will find myself sometimes not fully utilizing the resources."* This statement indicates the difficulties teachers encounter in securing adequate materials and the subsequent impact on their ability to deliver consistent and effective teaching. The literature corroborates these findings, emphasizing that the lack of adequate resources can lead to significant inconsistencies in teaching. According to Meier and West (2020), teachers in under-resourced schools often struggle to maintain consistent teaching practices due to the scarcity of necessary materials. This

inconsistency can hinder students' learning experiences and outcomes, as teachers are unable to fully leverage available resources to enhance their instruction.

7.6 Financial and Logistical Burdens on Teachers

Teachers often bear the financial and logistical burdens of procuring and providing resources, which is unsustainable and adds significant stress. **Participant B** described this burden by saying, *"Yes, us teachers, we have a lot of materials we can download; we do have data, but for some students, it's still a challenge. The cell phones and gadgets are mine. This challenge has a negative impact because you find you are teaching somebody who doesn't have anything, not even a study guide or a textbook, so it becomes a big concern."* This self-funding model is unsustainable and places additional stress on teachers, detracting from their primary focus on teaching. The financial burden on teachers to supply their own resources is a well-documented issue in educational research. Cahilog et al. (2023) note that teachers in underfunded schools often have to spend their own money on classroom supplies, which can lead to significant financial strain and decreased job satisfaction.

7.7 Impact on Teaching Quality

The lack of resources and associated challenges significantly impact the quality of teaching and learning outcomes in CLCs. Teachers find it difficult to deliver comprehensive and effective lessons without proper materials. **Participant A** mentioned, *"Sometimes getting those tools is challenging, and it impacts because I will find myself sometimes not fully utilizing the resources."* Similarly, **Participant B** stated, *"This challenge has a negative impact because you find you are teaching somebody who doesn't have anything, not even a study guide or a textbook, so it becomes a big concern."* These challenges result in a compromised educational experience for students, as teachers are unable to provide a consistent and thorough education. The literature supports this finding, emphasizing that resource inadequacy can severely limit the scope and quality of instruction. Anthony and Walshaw (2009) and Saloviita (2020) highlight the critical role of adequate resources in ensuring effective teaching and learning. Without these resources, teachers cannot implement diverse instructional strategies, leading to suboptimal educational outcomes.

8. Conclusions

This study has concluded that resource constraints in Gauteng CLCs in South Africa, especially in historically marginalized communities, have a profound impact on the teaching and learning of Grade 12 Mathematics. The severe lack of essential resources, such as textbooks and proper classroom infrastructure, significantly hindered the effective delivery of Mathematics education. Teachers are often forced to rely on outdated and borrowed materials, and many teachers bear the burden of providing their own resources and ensuring that students purchase necessary materials, which is unsustainable and detrimental to educational outcomes (Darling-Hammond, 2018). The limited availability of basic resources like textbooks and writing utensils further restricts the range of teaching methods and materials available to students, negatively affecting the quality and consistency of instruction (Amadi & Nwogu, 2023; Ihebom & Uko,

2020). To address these challenges, the study recommends a strategic approach that integrates Deliverology and Implementation Science frameworks. This approach includes structured goal setting and data-driven decision-making to optimize resource allocation and utilization, along with capacity building and stakeholder engagement to empower teachers, and enhance resource availability (Birch & Jacob, 2019; Mouton, 2021). Continuous improvement, policy advocacy, and the integration of technology are also essential for creating a more resilient educational environment in CLCs, enabling consistent and equitable access to high-quality educational materials and learning opportunities. At a broader, systemic level, these findings highlight the urgent need for government policies to prioritize equitable resource distribution, specifically within CLCs. This includes ensuring that funding mechanisms are adjusted to target the most under-resourced CLCs, which often serve historically marginalized communities. Policymakers should also focus on creating long-term investment strategies for teacher development and digital infrastructure within CLCs to sustainably address these resource constraints.

9. Recommendations

To effectively mitigate the severe resource constraints in CLCs, this study recommends a strategic approach that integrates Deliverology and Implementation Science Frameworks. First, by employing structured goal setting and data-driven decision-making, CLCs can significantly enhance the allocation and utilization of their limited resources. Deliverology, a performance management approach, is instrumental in setting clear, measurable goals and monitoring progress through data-informed strategies. This approach ensures that resources are allocated efficiently based on actual needs, helping to address shortages and optimize the distribution of educational materials. These can be achieved by continuous tracking of resource availability and usage; CLCs can make informed decisions that prioritize the most underserved areas, thereby enhancing the overall quality of education provided in these centres (Barber et al., 2015; Williams et al., 2021).

In addition to structured goal setting, the study emphasizes the importance of capacity building and stakeholder engagement. Professional development programs tailored to the unique challenges of resource-constrained environments should be implemented to equip teachers with innovative strategies for maximizing the use of limited resources. For instance, training on the integration of digital tools and alternative teaching methods can empower teachers to deliver effective instruction even with minimal physical resources. Furthermore, fostering collaboration between CLC management, teachers, and external stakeholders, such as nearby schools and community organizations, can create a network for resource sharing and knowledge exchange. This collaborative approach not only enhances resource availability, but also strengthens the sustainability of resource provision by distributing responsibility among all stakeholders involved (Cook et al., 2019; Gewirtz et al., 2021).

The context of this study underscores the need for continuous improvement, policy advocacy, and the integration of technology as essential strategies for creating a more resilient educational environment in CLCs. Establishing a regular feedback loop will help CLCs remain flexible and responsive to changing needs and circumstances. This ongoing evaluation process allows for the refinement of resource strategies, ensuring that they remain effective over time. Additionally, advocating for consistent and equitable funding is crucial for addressing the systemic issues that contribute to resource constraints in CLCs. The integration of technology, such as online learning platforms and virtual classrooms, offers a viable solution to physical resource limitations by providing students and teachers with access to a wealth of educational materials and interactive learning opportunities. These combined efforts are aimed at building a sustainable and well-supported educational framework that enables CLCs to deliver high-quality education, despite the challenges posed by limited resources (Birch & Jacob, 2019; Mouton, 2021).

10. References

- Adeoye, M. A. (2023). Review of sampling techniques for education. *ASEAN Journal for Science Education*, 2(2), 87–94.
https://www.researchgate.net/publication/370358209_Review_of_Sampling_Techniques_for_Education
- Ahmadi, M. (2023). *The state of social justice in academia in Quebec: A literature-based exploratory exploration* (Doctoral dissertation, Concordia University).
- Amadi, U. V., & Nwogu, U. J. (2023). The impact of funding on educational development in Nigeria. *Journal of Education in Developing Areas*, 31(3), 61–82.
<https://journals.journalsplace.org/index.php/JEDA/article/view/383>
- Anthony, G., & Walshaw, M. (2009). *Effective pedagogy in mathematics* (Vol. 19). Belley, France: International Academy of Education.
https://doi.org/10.1163/9789087905019_011
- Bali, M., Cronin, C., & Jhangiani, R. S. (2020). Framing open educational practices from a social justice perspective. *Journal of Interactive Media in Education*, 2020(1).
<https://doi.org/10.5334/jime.565>
- Baloyi, G. (2013). Students support in context of open distance and e-learning for adult students using new technologies. In *Proceedings of the International Conference on e-Learning* (pp. 31-37).
- Barber, M., Rodriguez, N., & Artis, E. (2015). *Deliverology in practice: How education leaders are improving student outcomes*. Corwin Press.
<https://doi.org/10.4135/9781071800621>
- Barcelona, K. E. P., Daling, B. A. J., Doria, P., Balangiao, S. J., Mailes, M. J., Chiang, P. M., & Ubatay, D. (2023). Challenges and opportunities of TLE teachers in Philippine public schools: An inquiry. *British Journal of Multidisciplinary and Advanced Studies*, 4(4), 44–60. <https://doi.org/10.37745/bjmas.2022.0247>
- Belete, S., Duke, C., Hinzen, H., Owusu-Boampong, A., & Khau, H. P. (2022). Community learning centres (CLCs) for adult learning and education (ALE): Development in and by communities. *International Review of Education*, 68(2), 259–290. <https://doi.org/10.1007/s11159-022-09954-w>
- Bell, H. (2014). *Becoming a successful student in pre-registration nurse education: A qualitative multiple case study* (Doctoral dissertation, University of East Anglia).

- Birch, L., & Jacob, S. (2019). "Deliverology" and evaluation: A tale of two worlds. *Canadian Journal of Program Evaluation*, 34(2), 303–328. <https://doi.org/10.3138/cjpe.53365>
- Bischoff, K., & Owens, A. (2019). The segregation of opportunity: Social and financial resources in the educational contexts of lower-and higher-income children, 1990–2014. *Demography*, 56(5), 1635–1664. <https://doi.org/10.1007/s13524-019-00817-y>
- Borg, S. (2017). Teachers' beliefs and classroom practices. In P. Garrett, & J. M. Cots (Eds.), *The Routledge handbook of language awareness* (pp. 75–91). Routledge. <https://doi.org/10.4324/9781315676494-5>
- Cahilog, D. T., Sarong, J. S., & Arcilla Jr, F. E. (2023). Exploring the motivations and challenges of teachers leaving DepEd for overseas opportunities. *Randwick International of Education and Linguistics Science Journal*, 4(3), 516–534. <https://doi.org/10.47175/rielsj.v4i3.754>
- Cevikbas, M., & Kaiser, G. (2023). Can flipped classroom pedagogy offer promising perspectives for mathematics education on pandemic-related issues? A systematic literature review. *ZDM—Mathematics Education*, 55(1), 177–191. <https://doi.org/10.1007/s11858-022-01388-w>
- Chen, G. A., & Horn, I. S. (2022). A call for critical bifocality: Research on marginalization in mathematics education. *Review of Educational Research*, 92(5), 786–828. <https://doi.org/10.3102/00346543211070050>
- Cook, C. R., Lyon, A. R., Locke, J., Waltz, T., & Powell, B. J. (2019). Adapting a compilation of implementation strategies to advance school-based implementation research and practice. *Prevention Science*, 20, 914–935. <https://doi.org/10.1007/s11121-019-01017-1>
- Creswell, J. W., & Poth, C. N. (2018). *Qualitative inquiry and research design: Choosing among five approaches* (4th ed.). Sage Publications.
- Darling-Hammond, L. (2018). From "separate but equal" to "No Child Left Behind": The collision of new standards and old inequalities. In E. B. Hilty (Ed.), *Thinking about schools* (pp. 419–437). Routledge. <https://doi.org/10.4324/9780429495670-34>
- Davies, C., O'Donnell, D., Radomska, A., Shé, N. E., O'Shea, M., Devaney, C., Donnelly, S., O'Donoghue, G., de Bruin, A., Whitty, H., Harnett, P., Lang, D., Harrison, R., McAuliffe, E., & Ahern, E. (2024). Sustaining health and public services in an uncertain future: What role for implementation science? *Implementation Science*, 19(1), Article 21. <https://doi.org/10.1186/s13012-024-01341-3>
- Davis, J. M. (2015). Sampling and what it means. In J. D. Brown (Ed.), *The Cambridge guide to research in language teaching and learning* (pp. 198–205). Cambridge University Press.
- Desjardins, R. (2015). Participation in adult education opportunities: Evidence from PIAAC and policy trends in selected countries, background paper for the Education for All Global Monitoring Report 2015. UNESCO. https://unesdoc.unesco.org/ark:/48223/pf000_232_396
- Dhivyadeepa, E. (2015). *Sampling techniques in educational research*. Lulu.com.
- Eckhout, D., Aelbrecht, K., & van der Straeten, C. (2023). Informed consent: Research staff's perspectives and practical recommendations to improve research staff-participant communication. *Journal of Empirical Research on Human Research Ethics*, 18(1–2), 3–12. <https://doi.org/10.1177/15562646221146043>
- Gewirtz, S., Maguire, M., Neumann, E., & Towers, E. (2021). What's wrong with 'deliverology'? Performance measurement, accountability and quality

- improvement in English secondary education. *Journal of Education Policy*, 36(4), 504–529. <https://doi.org/10.1080/02680939.2019.1706103>
- Green, L. N. (2015). *Investigating adult learning centre performance in the General Education and Training Certificate in relation to district socio-economic profiles in KwaZulu-Natal* (Doctoral dissertation, University of KwaZulu-Natal).
- Heflin, H., Shewmaker, J., & Nguyen, J. (2017). Impact of mobile technology on student attitudes, engagement, and learning. *Computers & Education*, 107, 91–99. <https://doi.org/10.1016/j.compedu.2017.01.006>
- Houchen, D. F. (2020). An “organized body of intelligent agents,” Black teacher activism during de jure segregation: A historical case study of the Florida State Teachers Association. *Journal of Negro Education*, 89(3), 267–281. <https://www.jstor.org/stable/10.7709/jnegroeducation.89.3.0267>
- Husband, G. (2020). Ethical data collection and recognizing the impact of semi-structured interviews on research respondents. *Education Sciences*, 10(8), Article 206. <https://doi.org/10.3390/educsci10080206>
- Ihebom, B., & Uko, J. O. (2020). Challenges and prospects of secondary education in Nigeria. *International Journal of Scientific Research in Education*, 13(4), 670–688. [https://ijsre.com.ng/assets/vol.%2c-13\(4\)-bartholomew-ihebom.pdf](https://ijsre.com.ng/assets/vol.%2c-13(4)-bartholomew-ihebom.pdf)
- Kang, H. (2021). Sample size determination and power analysis using the G*Power software. *Journal of Educational Evaluation for Health Professions*, 18. <https://doi.org/10.3352/jeehp.2021.18.17>
- Karunaratna, I., Gunasena, P., Hapuarachchi, T., Ekanayake, U., Rajapaksha, S., Gunawardana, K., Aluthge, P., Bandara, S., Jayawardana, A., de Alvis, K., & Gunathilake, S. (2024). The crucial role of data collection in research: Techniques, challenges, and best practices. *Uva Clinical Research*, 1–24. <https://www.researchgate.net/publication/383155720>
- Knott, E., Rao, A. H., Summers, K., & Teeger, C. (2022). Interviews in the social sciences. *Nature Reviews Methods Primers*, 2(1), Article 73. <https://doi.org/10.1038/s43586-022-00150-6>
- Legotlo, M. W. (Ed.). (2014). *Challenges and issues facing the education system in South Africa*. Africa Institute of South Africa. <https://doi.org/10.2307/j.ctvh8r1tk>
- Leithwood, K. (2021). A review of evidence about equitable school leadership. *Education Sciences*, 11(8), Article 377. <https://doi.org/10.3390/educsci11080377>
- Margot, K. C., & Kettler, T. (2019). Teachers’ perception of STEM integration and education: A systematic literature review. *International Journal of STEM Education*, 6(1), Article 2. <https://doi.org/10.1186/s40594-018-0151-2>
- Meier, C., & West, J. (2020). Overcrowded classrooms—the Achilles heel of South African education?. *South African Journal of Childhood Education*, 10(1), 1–10. <https://doi.org/10.4102/sajce.v10i1.617>
- Melhuish, K., Fukawa-Connelly, T., Dawkins, P. C., Woods, C., & Weber, K. (2022). Collegiate mathematics teaching in proof-based courses: What we now know and what we have yet to learn. *The Journal of Mathematical Behavior*, 67, Article 100986. <https://doi.org/10.1016/j.jmathb.2022.100986>
- Mouton, C. (2021). *Performance measurement of policy priorities: Tracking government performance* (Doctoral dissertation, Stellenbosch University).
- Nilsen, P., & Bernhardsson, S. (2019). Context matters in implementation science: A scoping review of determinant frameworks that describe contextual determinants for implementation outcomes. *BMC Health Services Research*, 19, Article 189. <https://doi.org/10.1186/s12913-019-4015-3>

- Pepin, B., Gueudet, G., Yerushalmy, M., Trouche, L., & Chazan, D. I. (2015). E-textbooks in/for teaching and learning mathematics: A potentially transformative educational technology. In L. English, & D. Kirshner (Eds.), *Handbook of international research in mathematics education* (pp. 636–661). Taylor and Francis. <https://doi.org/10.4324/9780203448946-37>
- Placencia, A. A. (2021). *Teacher effectiveness in underserved, underfunded, and under-resourced elementary schools* (Bachelor's thesis, College of Community Innovation and Education, Orlando, FL, USA).
- Powell, C. G., & Bodur, Y. (2019). Teachers' perceptions of an online professional development experience: Implications for a design and implementation framework. *Teaching and Teacher Education, 77*, 19–30. <https://doi.org/10.1016/j.tate.2018.09.004>
- Rakoma, M., & Schulze, S. (2015). Challenges in adult education in the rural areas of limpopo province in South Africa. *Studies of Tribes and Tribals, 13*(2), 163-171. <https://doi.org/10.1080/0972639x.2015.11886723>
- Rust, K. (2013). Sampling, weighting, and variance estimation in international large-scale assessments. In L. Rutkowski, M. von Davier, & D. Rutkowski (Eds.), *Handbook of international large-scale assessment: Background, technical issues, and methods of data analysis* (pp. 117–153). Chapman and Hall/CRC. <https://doi.org/10.1201/b16061-11>
- Sabnis, S. V., & Wolgemuth, J. R. (2024). Validity practices in qualitative research in school psychology. *School Psychology International, 45*(2), 87–114. <https://doi.org/10.1177/01430343231194731>
- Saloviita, T. (2020). Teacher attitudes towards the inclusion of students with support needs. *Journal of Research in Special Educational Needs, 20*(1), 64–73. <https://doi.org/10.1111/1471-3802.12466>
- Setia, M. S. (2016). Methodology series module 5: Sampling strategies. *Indian Journal of Dermatology, 61*(5), 505–509. <https://doi.org/10.4103/0019-5154.190118>
- Singh, R. B. (2024). *Challenges and coping strategies of teaching English in an under-resourced context: A narrative inquiry* (Doctoral dissertation, Kathmandu University).
- Slade, S., & Sergent, S. R. (2023). Interview Techniques. In *StatPearls [Internet]*. StatPearls Publishing.
- Steiner-Khamsi, G., & Draxler, A. (Eds.). (2018). *The state, business and education: Public-private partnerships revisited*. Edward Elgar Publishing.
- Tandon, R., & Chakrabarty, K. (2018). Partnering with higher education institutions for SDG 17: The role of higher education in multi-stakeholder partnerships *Approaches to SDG, 17*, 75–85.
- Tibane, C. C., Mafa-Theledi, O. M., Masebe, T. P., & Peter, M. (2024). Challenges experienced by mathematics teachers in the implementation of Grade 12 mathematics curriculum in community learning centres: South African perspective. *International Journal of Learning, Teaching and Educational Research, 23*(7), 141–166. <https://doi.org/10.26803/ijlter.23.7.8>
- Trafimow, D., & Earp, B. D. (2017). Null hypothesis significance testing and Type I error: The domain problem. *New Ideas in Psychology, 45*, 19–27. <https://doi.org/10.1016/j.newideapsych.2017.01.002>
- Trantopoulos, K., von Krogh, G., Wallin, M. W., & Woerter, M. (2017). External knowledge and information technology. *MIS Quarterly, 41*(1), 287–300. <https://doi.org/10.25300/misq/2017/41.1.15>
- Tumele, S. (2015). Case study research. *International Journal of Sales, Retailing & Marketing, 4*(9), 68–78.

- UNESCO. (2015). *Education 2030: Incheon Declaration (ID) and Framework for Action for the implementation of Sustainable Development Goal 4: Ensure inclusive and equitable quality education and promote lifelong learning opportunities for all* [Document code ED-2016/WS/28]. UNESCO.
- Williams, M. J., Leaver, C., Mansoor, Z., Qarout, D., Bilous, A., Mundy, K., Asim, M., & Bell, S. (2021). *Delivery approaches to improving policy implementation: A conceptual framework* [DeliverEd Initiative Working paper]. Education Commission and Blavatnik School of Government.
- Yang, M., & Lee, H. J. (2022). Do school resources reduce socioeconomic achievement gap? Evidence from PISA 2015. *International Journal of Educational Development, 88*, Article 102528. <https://doi.org/10.1016/j.ijedudev.2021.102528>
- Youn, S. J., Boswell, J. F., Douglas, S., Harris, B. A., Aajmain, S., Arnold, K. T., Creed, T. A., Gutner, C. A., Orengo-Aguayo, R., Oswald, J. M., & Stirman, W. (2024). Implementation science and practice-oriented research: Convergence and complementarity. *Administration and Policy in Mental Health and Mental Health Services Research, 51*(3), 336-347. <https://doi.org/10.1007/s10488-023-01296-5>