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Empowering Intermediate Teachers with Self-Engineering Problem-Solving Techniques to Improve their Performance in Mathematics in Chris Hani East District, South Africa

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ABSTRACT

This qualitative research empowers intermediate teachers on students' problem-solving abilities and engagement with mathematical concepts by integrating goal setting, self-regulation, and metacognitive approaches. A student-centered theory served as the foundation for the investigation. Data collection involved semi-structured interviews with participants, while thematic analysis was utilized to interpret the data and capture participants' perspectives. The methodology was rooted in an interpretive paradigm using a case study approach. The findings revealed that self-engineering techniques cultivate a growth mindset, promote learner confidence, and enhance resilience in confronting complex mathematical problems. However, inadequate teacher training and time constraints hinder effective implementation. This study identified the need for professional development programs that equip teachers with essential skills, thereby paving the way for innovativeness and improvements in mathematics education within primary schools. Recommendations include establishing structured development programs tailored to varying teacher experience levels, mentorship initiatives that encourage collaboration, integration of interdisciplinary teaching methods, targeted training for technology incorporation, and fostering a culture of continuous feedback and assessment. Furthermore, schools should nurture collaborative learning environments that focus on group projects, contextualized lessons linked to real-world applications, and mechanisms for consistent feedback for educators. Ongoing research is suggested to assess the impact of these strategies alongside community engagement to strengthen support for enhanced mathematics education.

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INTRODUCTION

Student-centered learning, a theoretical framework that focuses on the individual needs and interests of learners and stresses active involvement, has gained attention in the constantly changing field of education.[1] The foundation of this pedagogical approach is creating an atmosphere in which students take charge of their educational paths in addition to absorbing knowledge. This fosters critical thinking, teamwork, and intrinsic motivation qualities that are frequently absent from conventional teacher-centered approaches.[2] Even though student-centered learning is becoming more and more popular, there is still a lot we don't know about how these ideas might be used specifically to support primary math teachers. In particular, little study has been done on how self-engineering problem-solving strategies might be included into teaching methods. By investigating how these methods may be applied to increase teaching effectiveness and raise student achievement in mathematics, this study seeks to close this knowledge gap.

This study's main goals are to (1) investigate efficient self-engineering problem-solving techniques in the context of intermediate mathematics and (2) increase awareness and encourage the use of these self-engineering strategies among teachers in the intermediate stage of mathematics instruction. In order to accomplish these goals, this study will first offer a thorough analysis of pertinent research on self-engineering techniques and student-centered learning. A framework for putting these tactics into practice in the classroom will then be presented, and their effects on learning outcomes and student engagement will be examined. The study will culminate with useful suggestions for math teachers looking to incorporate self-engineering problem-solving into their teaching methods.

LITERATURE REVIEW

Empowering teachers with self-engineering problem-solving techniques aligns with student-centered learning by promoting active engagement. Moreover, these techniques encourage a shift from traditional lectures to interactive sessions, including discussions and group work (Author, Year). By embracing inquiry-based learning, teachers can guide students to ask questions and investigate real-world mathematical problems, nurturing curiosity and critical thinking. Brooks and Roy highlighted that incorporating technology into instruction allows for tailoring learning activities to diverse student needs, promoting personalized learning pathways.

The impact on learners is significant, as students develop a sense of ownership and intrinsic motivation, leading to a positive attitude toward mathematics and improved performance.[3] Collaborative problem-solving enhances critical thinking and analytical skills, which are beneficial across disciplines. The shift to student-centered instruction encourages a deeper understanding of mathematical concepts as students connect abstract ideas to real-life situations. The overall quality of instruction and student performance is enhanced by integrating a student-centered framework and empowering primary mathematics teachers with self-engineering problem-solving techniques. According to Brooks and Roy this approach fosters engagement, cultivates essential skills, and promotes a positive attitude toward mathematics, leading to better outcomes in primary education.[4] Ultimately, such alignment promises to create a dynamic learning atmosphere that prioritizes student agency and fosters a love for learning, establishing a foundation for lifelong mathematical understanding and application. The study employed a constructivism theory to guide this study.

Self-Engineering Problem-solving Strategies in Intermediate Mathematics

Brooks and Roy indicated that self-engineering problem-solving strategies in intermediate mathematics are being effectively implemented across various regions, including the USA, UK, Japan, Africa, and South Africa, each adapting the practice to their cultural and educational contexts.[5] In the USA, educators emphasize project-based learning and real-world applications through technology integration, while the UK focuses on collaborative learning and contextualized word problems to foster student engagement. Naz, Brooks, and Roy highlighted that Japan's lesson study model promotes continuous teacher

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[1] Sam Brooks and Rajkumar Roy, "Complexity of Self-Engineering Systems across the Life Cycle–Biological and Engineering Systems," *Procedia CIRP* 98 (2021): 121–26.

[2] Brooks and Roy, "Complexity of Self-Engineering Systems across the Life Cycle–Biological and Engineering Systems."

[3] Brooks and Roy, "Complexity of Self-Engineering Systems across the Life Cycle–Biological and Engineering Systems."

[4] Brooks and Roy, "Complexity of Self-Engineering Systems across the Life Cycle–Biological and Engineering Systems."

[5] Brooks and Roy, "Complexity of Self-Engineering Systems across the Life Cycle–Biological and Engineering Systems."

collaboration to refine instructional methods, encouraging students to problem-solve innovatively.[6] Yu et al., established that in Africa, community engagement initiatives empower students to apply mathematics to local challenges, and professional development programs enhance teaching practices.[7] South Africa's educational reforms emphasize interactive learning and community mathematics opportunities, making the curriculum more relevant and engaging.[8] These strategies may enhance critical thinking, collaboration, and real-life applications, preparing students to become proficient, confident problem solvers.

In intermediate primary school mathematics, the effectiveness of teaching practices directly correlates to student performance. Yu et al. alluded that mathematics often poses challenges for students due to its abstract concepts and problem-solving requirements, making it crucial for educators to implement effective teaching strategies.[9] Brooks and Roy asserted that empowering primary mathematics teachers with self-engineering problem-solving techniques has become pivotal to enhancing instructional methods and elevating learner outcomes.[10] This empowerment allows teachers to refine their skills and develop innovative ways to engage their students in learning. Manders, Pantelic, Milisavljević, and Martinetti, argued that teachers equipped with effective problem-solving techniques can foster a learning environment that promotes critical thinking, creativity, and a deeper understanding of mathematical concepts.[11] This paper examines the effectiveness of this empowering strategy, focusing on two main dimensions: the impact on teachers' instructional practices and the consequent performance of their learners. Empowering teachers with self-engineering problem-solving techniques profoundly affects their instructional practices. Brooks and Roy posit that it increases teacher confidence and competence.[12] Teaching, particularly in a subject as challenging as mathematics, can often be daunting, and teachers may feel limited in their capabilities. However, when educators are trained in self-engineering problem-solving techniques, they gain a sense of mastery over their teaching methodologies. This self-efficacy translates into a willingness to experiment with new strategies and to trust their ability to teach complex concepts effectively. Consequently, when teachers feel adept at using these strategies, they are more likely to adopt them in the classroom, shifting from traditional rote learning to more dynamic and interactive methods.

Gharib established that empowerment self-engineering techniques would promote the adoption of inquiry-based learning environments, which are crucial in mathematics education. [13]In perceived that such environments, students are encouraged to ask questions, explore various solutions to problems, and engage in discussions that challenge their thinking. Teachers become better equipped to pose open-ended questions that stimulate curiosity and creativity, encouraging critical thinking for surface-level understanding and more resounding, analytical engagement. They guide students in independently discovering solutions, enhancing student engagement and ownership of their learning.[14] This shift from passive to active learning dramatically changes the classroom dynamic, as students are no longer mere recipients of information but active participants in their educational journey. Additionally, many self-engineering problem-solving techniques involve the use of technology. Manders et al. highlighted that with the advancing role of technology in education, teachers trained in these methods are more likely to

[6] Ayesha Tahir Naz, Sam Brooks, and Rajkumar Roy, "Investigation of Future Applications of Self-Engineering Using Drones," *Materials Today: Proceedings* 64 (2022): 1255–60.

[7] Feng Yu et al., "Sustainable Production of Value-Added N-Heterocycles from Biomass-Derived Carbohydrates via Spontaneous Self-Engineering," *National Science Open* 2, no. 6 (2023): 20230019.

[8] Brooks and Roy, "Complexity of Self-Engineering Systems across the Life Cycle–Biological and Engineering Systems."

[9] Xinjie Deng and Zhonggen Yu, "A Meta-Analysis and Systematic Review of the Effect of Chatbot Technology Use in Sustainable Education," *Sustainability* 15, no. 4 (February 6, 2023): 2940, https://doi.org/10.3390/su15042940.

[10] Brooks and Roy, "Complexity of Self-Engineering Systems across the Life Cycle–Biological and Engineering Systems."

[11] Steven Manders et al., "Self-Engineering: Possibilities for Maintenance Operations in the Mining Machines Industry," in *10th International Conference on Through-Life Engineering Service, TESCONF 2021*, 2021.

[12] Brooks and Roy, "Complexity of Self-Engineering Systems across the Life Cycle–Biological and Engineering Systems."

[13] Enas Gharib, "هندسة الذات لدى طالبات المرحلة الثانوية بمنطقة القصيم Self-Engineering among Secondary School Students in the Qassim Region," *International Journal of Learning Management Systems* 11, no. 3 (2023): 93–107.

[14] Kholoud Imhammad Al-Mseidin, "Post Pandemic Readjustment to Traditional Education System: Analyzing Difficulties of University Students and Recommendations," *International Journal of Childhood, Counselling and Special Education* 5, no. 1 (June 2023): 1–7, https://doi.org/10.31559/CCSE2023.5.1.1.

integrate digital tools into their teaching practices.[15] Whether using interactive software, educational apps, or online resources, these technologies can enhance student interaction and provide diverse learning pathways tailored to various learning styles. The infusion of technology not only aids in the visualization of mathematical concepts but also allows for more personalized learning experiences that can cater to the unique needs of each student.

Awareness and Application of Self-Engineering Techniques in Teaching Mathematics in the Intermediate Phase

Empowering primary mathematics teachers in self-engineering is crucial for enhancing learners' performance, particularly in a world that increasingly values critical thinking and problem-solving skills. Manders et al. assert that self-engineering problem-solving techniques provide teachers with the tools to facilitate student-centered learning environments, enabling students to take ownership of their learning processes.[16] This approach aligns with contemporary educational reform movements that advocate for active engagement, collaboration, and inquiry-based learning across various regions, including the USA, UK, Japan, Africa, and South Africa. In the USA, educational reforms have focused on developing teachers' capacity to integrate problem-solving techniques into their instruction. The National Council of Teachers of Mathematics (NCTM) emphasizes the importance of a problem-solving approach in mathematics education, advocating for professional development that equips teachers with the necessary pedagogical skills.[17] Teachers who utilize self-engineered problem-solving strategies significantly may improve students' engagement and achievement in mathematics through tailored instruction that fosters critical thinking.

Goos and Beswick established that in the United Kingdom (UK), the rise of the Mathematics Mastery movement has focused on empowering teachers to build a deep conceptual understanding of mathematics.[18] According to recent studies, training teachers in problem-solving and inquiry-based learning methodologies enhances teacher confidence and student performance Goos and Beswick.[19] The effectiveness of collaborative and practical problem-solving strategies can foster mathematics skills among primary students. Japan's approach to mathematics education, exemplified by its Lesson Study model, fosters teacher collaboration to refine instructional practices, including problem-solving techniques.[20] Studies show that teachers engage in continuous self-improvement and actively create problem-solving tasks that promote student inquiry, leading to substantial gains in learner performance. This model illustrates professional development's effectiveness in enhancing teaching strategies and student outcomes.

In Africa, the challenges faced by primary mathematics teachers often relate to inadequate resources and training. Nevertheless, initiatives like the African Institute for Mathematical Sciences (AIMS) promote innovative teaching practices that empower educators through workshops and collaborative learning environments.[21] Research highlights that teachers with self-engineering problem-solving techniques can effectively motivate students and improve performance, addressing significant disparities in mathematics education on the continent.[22] South Africa's education system has undergone significant reforms to improve mathematics education, focusing on empowering teachers through

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[15] Manders et al., "Self-Engineering: Possibilities for Maintenance Operations in the Mining Machines Industry."

[16] Manders et al., "Self-Engineering: Possibilities for Maintenance Operations in the Mining Machines Industry."

[17] Amy Brass, *Mathematics, Mathematics Education, and Citizenship: Mathematics Teacher Educators' Conceptions and Views* (The Pennsylvania State University, 2024).

[18] Merrilyn Goos and Kim Beswick, *Learning and Development of Mathematics Teacher Educators* (Springer, 2021).

[19] Goos and Beswick, *Learning and Development of Mathematics Teacher Educators*.

[20] M. L. McCormick, "Teacher Perceptions of the Opportunities and Constraints When Integrating Problem Solving in Student-Centred Mathematics Teaching and Learning" (Monash University, 2022).

[21] F. A. Y. Mullick-Martinez, "Teaching Metacognitive Strategies to Optimize Mathematical Problem Solving in Fourth Grade Students" (Barry University, 2020).

[22] Mullick-Martinez, "Teaching Metacognitive Strategies to Optimize Mathematical Problem Solving in Fourth Grade Students."

professional development.[23] Studies indicate that teachers who apply self-engineered problem-solving approaches can create more engaging learning environments, leading to improved learner outcomes.[24]

Across these global contexts, the literature disclosed that empowering primary mathematics teachers through self-engineering problem-solving techniques enhances teaching practices and improves learner performance.[25] As educational systems evolve, teachers increasingly recognize the importance of equipping students with self-engineering techniques in the intermediate phase of their education.[26] These techniques may foster learners' independence and motivation and enhance their engagement with mathematical concepts. Self-engineering techniques empower students to take charge of their learning by promoting self-awareness, goal setting, self-assessment, and reflection. In the context of intermediate mathematics education, these techniques effectively enhance learner autonomy and deepen their understanding of mathematical concepts.

Chang, Baelen, Ramburn, and Purandare argue that goal setting is a foundational self-engineering technique, encouraging students to establish specific, measurable, achievable, relevant, and time-bound (SMART) goals regarding their mathematical learning.[27] Self-assessment tools, such as reflection journals or rubrics, enable students to evaluate their understanding of mathematical concepts, fostering ownership of their learning journey.[28] Reflective exercises allow students to analyse challenges and successes, while peer assessment encourages collaboration and critical thinking. Despite recognizing the importance of self-engineering techniques, awareness and understanding can vary among educators teaching mathematics in the intermediate phase. Chang et al. notes that factors influencing this awareness include access to professional development opportunities, individual educational philosophy, and peer influence.[29] Some teachers are familiar with these approaches, having learned about them in professional development workshops or teacher training.[30] Workshops, online courses, and collaborative learning communities raise awareness among teachers about self-engineering techniques. At the same time, a student-centered educational philosophy may foster integrating these practices into their teaching.

Nesbeth observes that self-engineering techniques can lead to transformative changes in mathematics teaching within the intermediate phase.[31] These techniques promote student ownership, resulting in increased engagement and motivation. As students set their learning goals and reflect on their progress, they become more invested in their success. Additionally, self-assessment and reflective practices enhance critical thinking, essential in mathematics, where learners analyse problems from multiple perspectives.[32] In the interest of this study, personalization of learning experiences driven by self-engineering techniques can meet the diverse needs within the intermediate mathematics classroom.

Despite the potential benefits, several challenges may hinder the effective implementation of self-engineering techniques in teaching mathematics. Edan, Haider, and Sultan note that time constraints often present a significant barrier, as educators face rigorous curricula and may find it challenging to

[23] Nwacoye Gladness Mpya and Marubini Christinah Sadiki, “Inclusive Basic Education in South Africa: Highlights and Lowlights,” in *Handbook of Research on Inclusive and Accessible Education* (IGI Global Scientific Publishing, 2024), 244–61.

[24] Surinder Kaur Sandhu, “Effective Instructional Practices: Secondary School Teachers View About Teaching Secondary Mathematics With Technology” (Oakland University, 2024).

[25] Jemmeta DeMay Nesbeth, “Teacher-Efficacy with Standards-Based Education for Eighth-Grade Mathematics in a 21st-Century-Skill Framework: A Case Study,” 2021.

[26] Nazar Habeeb Abbas, Alaa Muhsin Khafeef AL-Ghuriabawi, and Omar F Hassan Al-obaidy, “The Effect Of Self-Engineering In Promoting Entrepreneurial Behavior Of The Organization’s Employees Applied Study at ZSCO Group International Auto Trading,” المجلة الاقتصادية للعلوم العراقية 22, no. 80. S (2024): 1189–1203.

[27] Tracy F H Chang et al., “Developing Positive Self-Leadership through ‘Inner Engineering,’” *Journal of Management Development* 41, no. 7/8 (2022): 405–16.

[28] Abbas, AL-Ghuriabawi, and Al-obaidy, “The Effect Of Self-Engineering In Promoting Entrepreneurial Behavior Of The Organization’s Employees Applied Study at ZSCO Group International Auto Trading.”

[29] Chang et al., “Developing Positive Self-Leadership through ‘Inner Engineering.’”

[30] Nargol Ghazian and Christopher J Lortie, “A Review of the Roots of Ecological Engineering and Its Principles,” *Journal of Ecological Engineering* 25, no. 1 (2024).

[31] Nesbeth, “Teacher-Efficacy with Standards-Based Education for Eighth-Grade Mathematics in a 21st-Century-Skill Framework: A Case Study.”

[32] C B Adams et al., “Axion Dark Matter,” *ArXiv Preprint ArXiv:2203.14923*, 2022.

incorporate practices requiring additional reflection or self-assessment time.[33] Additionally, some educators may lack the necessary training or resources to implement these techniques effectively, highlighting the importance of professional development opportunities.[34] Students accustomed to traditional teaching methods may also resist changes in their learning approaches, necessitating patience and guidance to establish a culture of self-direction.[35] Finally, aligning conventional assessment methods with self-engineering techniques poses challenges, requiring educators to balance standardized evaluation with formative assessments that encourage self-directed learning.[36]

Nesbeth argues that the awareness and use of self-engineering techniques in teaching mathematics during the intermediate phase can transform educational experiences for both students and educators.[37] These techniques can significantly enhance students' mathematical understanding and overall academic success in mathematics by fostering independence, critical thinking, and personalized learning. To maximize their effectiveness, ongoing professional development, tailored strategies, and supportive learning environments are supposedly essential in overcoming implementation challenges.

THEORETICAL FRAMEWORK

The study employed Student-Centered and Constructivism Theory. The Student-Centered Theory is not attributed to a single individual. However, it is rooted in various educational philosophies and psychological frameworks prioritizing the learner's needs, interests, and active participation in the learning process.[38] This theory emphasises the importance of active student engagement in the learning process, prioritising learners' needs, interests, and experiences. Tang highlighted that under this framework, teaching encourages students to take ownership of their learning, fostering critical thinking, collaboration, and intrinsic motivation.[39] Hoidn and Reusser asserted that this approach contrasts with traditional teacher-centered methodologies, where the educator is the primary source of knowledge and students are passive receivers of information.[40] In empowering primary mathematics teachers with self-engineering problem-solving techniques, the student-centered learning framework is pivotal in shaping effective instructional practices and enhancing student outcomes. Tang highlighted that when teachers adopt techniques that encourage student involvement and agency, they create an environment conducive to learning where students feel empowered to explore, question, and engage with mathematical concepts meaningfully.[41]

Constructivism posits that learners construct knowledge through experiences and interactions. In this case, intermediate teachers can benefit from hands-on experiences that allow them to discover and apply problem-solving techniques in mathematics. This framework encourages teachers to engage with the material actively, promoting more profound understanding and retention. Research on empowering primary mathematics teachers with self-engineering problem-solving techniques is limited. Although goal setting and self-monitoring enhance learner engagement and outcomes, their integration into mathematics education remains underexplored. Existing literature tends to focus on cognitive challenges without providing practical frameworks for teachers. Given the abstract nature of primary mathematics and the need for innovative strategies, this study examines how equipping teachers with these techniques

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[33] Takwa Sadeq Edan, Adawiya J Haider, and Fatima I Sultan, "Core–Shell Nanostructures in Self-Cleaning Surface Technology: A Mini Review," *Plasmonics*, 2025, 1–20.

[34] Ghazian and Lortie, "A Review of the Roots of Ecological Engineering and Its Principles."

[35] Cassandra Carels et al., "Youths' Perceptions Of The Relation Between Alcohol Consumption And Risky Sexual Behaviour in the Western Cape, South Africa: A Qualitative Study," *Child Indicators Research* 15, no. 4 (August 20, 2022): 1269–93, https://doi.org/10.1007/s12187-022-09913-9.

[36] Michele Lynn Norton, "A Narrative Inquiry into Design-Based Learning Experiences, Transversal Skills, and Flourishing as Your Best-Loved Self" (Texas A&M University, 2020).

[37] Nesbeth, "Teacher-Efficacy with Standards-Based Education for Eighth-Grade Mathematics in a 21st-Century-Skill Framework: A Case Study."

[38] Sabine Hoidn and Kurt Reusser, "Foundations of Student-Centered Learning and Teaching," in *The Routledge International Handbook of Student-Centered Learning and Teaching in Higher Education* (Routledge, 2020), 17–46.

[39] Kuok Ho Daniel Tang, "Student-Centered Approach in Teaching and Learning: What Does It Really Mean?," *Acta Pedagogia Asiana* 2, no. 2 (2023): 72–83.

[40] Hoidn and Reusser, "Foundations of Student-Centered Learning and Teaching."

[41] Tang, "Student-Centered Approach in Teaching and Learning: What Does It Really Mean?"

can foster student performance in Chris Hani East District. The research will identify challenges and opportunities for implementing effective, inclusive mathematics instruction by gathering teacher perspectives.

METHODOLOGY

Paradigm

The study utilised an interpretive paradigm that emphasised grasping individuals' lived experiences and viewpoints about their social and cultural settings. According to Buonaguro, Ascierto, Morse, Buonaguro, Puzanov, Tornesello, and Gallo this approach highlights how teachers perceive and ascribe significance to self-engineering problem-solving techniques and their impact on teaching practices and student performance.[42] Additionally, it considers the unique socio-educational factors, such as resource availability and community dynamics, that influence the adoption and implementation of these techniques. Interpretivism highlights the importance of individual perspectives and the subjective meanings individuals attach to their experiences. This study aimed to understand how intermediate teachers interpret and experience the implementation of self-engineering problem-solving techniques in their teaching practice. By employing this paradigm, researchers could delve into the complexities of teachers' thoughts, feelings, and reflections on how these techniques impact their performance and students' learning outcomes.

Research Design

The study employed a qualitative case study design to explore the adoption and implementation of self-engineering problem-solving techniques by primary mathematics teachers in the Chris Hani East District and their impact on teaching practices and learner performance. This design was chosen for its ability to provide an in-depth understanding of complex phenomena within real-life contexts, emphasizing the unique socio-educational dynamics of the district.[43] A qualitative design was employed in the study for several important reasons aligned closely with the research objectives. Qualitative research is well-suited for exploring and understanding complex human experiences and behaviors. The study explored how intermediate teachers experience, interpret, and integrate self-engineering problem-solving techniques in their teaching practices.

Approach

In this study, a qualitative approach was adopted to delve into individuals' beliefs, experiences, attitudes, behaviors, and interactions. This method aims to establish connections between community engagement, climate change, and sustainable development. By focusing on non-numerical data, qualitative research is becoming increasingly prevalent across various fields, especially in intervention studies like the one at hand. Through interviews and observations, researchers can collect, synthesize, and develop insightful knowledge from participants about their everyday realities.[44]

Research Design

The study implemented a case study research design, which allows for a thorough and detailed exploration of specific phenomena, situations, or individuals. This design provides a deep understanding of the context, processes, and dynamics at play. By investigating a case in its entirety, researchers can uncover rich insights and subtle aspects that might be overlooked with alternative research methodologies.

Sampling

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[42] David S. Yeager et al., “A National Experiment Reveals Where a Growth Mindset Improves Achievement,” *Nature* 573, no. 7774 (September 7, 2019): 364–69, https://doi.org/10.1038/s41586-019-1466-y.

[43] Stijn Baert et al., “Student Internships and Employment Opportunities after Graduation: A Field Experiment,” *Economics of Education Review* 83 (2021): 102141.

[44] John Mhandu and Vivian Ojong, “Covid-19 and the South African Pentecostal Landscape: Historic Shift from Offline Liturgical Practice to Online Platforms,” *Journal for the Study of Religion* 34, no. 2 (January 21, 2021): 1–25, https://doi.org/10.17159/2413-3027/2021/v34n2a5.

To facilitate this research, a purposive sampling technique was employed, selecting eight university lecturers, three community leaders, and four community members as participants. According to Pollock et al. purposive sampling is effective in identifying and choosing instances that hold valuable information relevant to the study.[45] In total, the research included fifteen participants.

Data Gathering Instruments

The primary method of data collection was through one-on-one interviews. The sessions involved eight university lecturers, three community leaders, and four community members, each lasting a minimum of 30 minutes. With participants' consent, the interviews were recorded to accurately capture the dialogue and ensure clarity for both researchers and participants. Throughout the interviews, participants were reminded of their rights, including the choice to decline to answer questions or withdraw from the study at any point.

Data Analysis

The data collected was analyzed using thematic analysis, which is the process of reviewing, cleansing, transforming, and modeling information to extract valuable insights, draw conclusions, and assist in decision-making.[46] The data was organized thematically, and the findings were presented and discussed in detail.

Ethical Considerations

Ethical concerns were carefully weighed throughout the research process. To protect participants' identities, pseudonyms were used to ensure confidentiality. The researchers were committed to treating both the research environment and the subjects involved with respect. Participants signed informed consent forms before the interviews commenced and were clearly informed about their right to withdraw from the study or decline to participate at any time.

PRESENTATION OF RESULTS /FINDINGS

Theme 1: Self-Engineering Problem-Solving Strategies in Intermediate Mathematics

Variety in Experience Levels: The participants range from new teachers to veteran educators, which reflects a spectrum of experiences in teaching mathematics. For instance, Participant A has been teaching for 15 years, while Participant B is relatively new, with only two years in the field. This variety suggests that employing self-engineering allows different perspectives to shape learning approaches and philosophies.

Findings from the study revealed that the participants' extensive experience suggests a solid understanding of intermediate school mathematics. However, adapting self-engineering teaching methods to fit evolving student needs is critical. Participant C said, *"I have been teaching mathematics for 15 years, mainly in the intermediate phase, focusing on grades 6 to 8. Over the years, I have engineered my approach to better meet my students' diverse needs."* The findings from this quotation suggest engaging teachers in professional development opportunities that focus on integrating self-engineering teaching methodologies, especially ones that incorporate technology and self-directed learning, to ensure lessons remain relevant.

Findings from the study also revealed that teaching at the same school allows for the development of self-engineering in student relationships and understanding of the school culture. Leverage this stability to initiate mentorship programs with new teachers, sharing your knowledge about curriculum and effective teaching strategies. Teacher Participant D argued: *"I am a new teacher with about two years of experience teaching mathematics to 8th graders. My time in the classroom has been a journey of discovery for me and my students."* This insight highlights the potential for collaboration and mentorship within schools to strengthen teaching practices and support educators in effectively

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[45] Robin Bronen et al., "Usteq: Integrating Indigenous Knowledge and Social and Physical Sciences to Coproduce Knowledge and Support Community-Based Adaptation," *Polar Geography* 43, no. 2–3 (2020): 188–205.

[46] Faezeh Fathi et al., "Emerging Drying Techniques for Food Safety and Quality: A Review," *Comprehensive Reviews in Food Science and Food Safety* 21, no. 2 (2022): 1125–60.

integrating self-engineering techniques, thereby enriching teacher development and student learning outcomes.

Teaching at the same school allows for the development of student relationships and understanding of the school culture. Teacher Participant E said: *"I mostly teach 7th grade math and have been at this school for five years. Before this, I taught high school math, giving me a broader perspective on the learning continuum."* The quotation indicated the stability of initiating mentorship programs with new teachers and sharing your knowledge about curriculum and effective teaching strategies.

Interdisciplinary Connections: Participants like F and G highlight their dual focus on mathematics and other subjects, which allows for more prosperous, more connected learning experiences. This multidisciplinary approach enriches student understanding by relating math to real-life scenarios, such as science or the arts.

Findings from the study indicated their dual focus on teaching math and science. It highlighted the benefits from an interdisciplinary perspective. Also, the teacher's background in educational psychology enhances their ability to adapt strategies effectively to varied self-engineering learning styles. Teacher Participant H disclosed: *"I have been in education for over 12 years, having taught both math and science. My main focus has been on grades 5 through 7. This dual background helps me create interdisciplinary connections that enrich the learning experience."* As the quotation above indicates, consider developing integrated lesson plans that explicitly connect mathematical concepts to scientific experiments. For example, exploring mathematical data analysis through real-world experiments could solidify understanding across subjects.

Many participants emphasised integrating technology into their teaching (e.g., interactive math software and real-world applications). This indicates an awareness of technology's critical role in modern classrooms and the necessity of adapting teaching methods to stay relevant and engaging. Teacher Participant A mentioned: *"I use a combination of inquiry-based learning and direct instruction, supplemented with technology like interactive math software. This blend helps accommodate different learning styles in my classroom."* Findings from the quotation revealed that integrating technology into their teaching practices highlights a progressive shift toward creating dynamic and inclusive learning environments. By leveraging tools like interactive math software and aligning lessons with real-world applications, educators are committed to enhancing student engagement and catering to diverse learning needs. This approach underscores the importance of equipping teachers with innovative pedagogical strategies and technological skills to ensure that mathematics education remains relevant, effective, and accessible in a rapidly evolving educational landscape.

Findings from this study stressed the need for collaboration and hands-on learning, which involves self-engineering techniques. Participants B and C particularly stress the importance of group projects and collaborative learning environments, highlighting a belief that students grasp concepts better through teamwork and shared experiences.

The study findings disclosed that a self-engineering approach may foster communication skills and peer learning, which are essential to holistic education. Participant D said: *"I gather feedback through class discussions and quizzes to see if my students grasp the concepts. Continuous feedback allows me to adjust my teaching in real-time to address any misunderstandings."* This quotation disclosed that using self-engineering tactics to facilitate continuous feedback fosters student understanding through engineering tactics like class discussions and quizzes, where educators can identify gaps in learning and make timely adjustments to their instruction. This iterative process may support student success and reflects a learner-centered approach to prioritise active engagement and meaningful comprehension in mathematics education.

Collaborative learning emerged as a key theme among participants, emphasizing the importance of group projects and hands-on activities in fostering peer-to-peer learning and engagement. Teacher Participant E mentioned: *"I incorporate group projects and hands-on activities, as students learn best through collaboration. Creating a cooperative atmosphere encourages them to learn from one another."* This approach highlights how collaboration builds a supportive classroom culture and serves as a foundation for refining teaching methods. By analysing test scores and student reflections, educators can tailor self-engineering strategies to meet learners' evolving needs and optimize instructional effectiveness.

Participants underscored the value of connecting mathematics to real-world contexts, aligning lessons with students' interests to make learning more relatable and enjoyable. Teacher Participant F revealed: *"Right now, I rely heavily on real-world applications; I love using math in the context of sports or music to make it relatable. Connecting lessons to their interests makes math more appealing."* The quotation highlighted that using real-world applications as part of self-engineering tactics provides immediate feedback on student comprehension. This enables teachers to adjust their lesson plans dynamically, ensuring that future instruction resonates with students and enhances their engagement with mathematics.

Integrating traditional and modern teaching strategies and self-engineering tactics in continuous assessment was highlighted as a practical approach to problem-solving in intermediate mathematics. Participants were committed to engaging students and ensuring comprehension through a balanced blend of innovative tools and foundational techniques. Teacher Participant G substantiated: *"I blend traditional problem-solving techniques with modern technology to make the lessons engaging for my students. The fusion of old and new keeps their interest alive and enhances learning."* Findings from the quotation implied that assessment is continuous as it provides daily summaries to check for understanding and retention. Knowing where intermediate mathematics students stand academically allows a teacher to support them effectively.

Participants emphasized the importance of personalized and collaborative teaching strategies to enhance student learning in mathematics. Differentiated instruction and peer assessments emerged as valuable methods for addressing diverse learning needs while fostering community and critical engagement. Teacher Participant H stated: *"I focus on differentiated instruction, giving various options for students to approach problems based on their strengths. This ensures that every student has a pathway to success."* This insight also revealed that self-engineering intermediate primary school teachers might employ peer assessments, enabling students to review each other's work. Such practices promote collaborative learning and encourage students to think critically and deepen their understanding of mathematical concepts.

Theme 2: Awareness and Application of Self-Engineering Techniques in Teaching Mathematics in the Intermediate Phase

Participants' familiarity with self-engineering techniques varied, with some expressing interest in learning more about how these methods could enhance their teaching practices and benefit students. Teacher Participant A stated, *"I am somewhat familiar with self-engineering techniques; I briefly read about them in a workshop but have not fully implemented them. I am eager to explore how these methods can benefit my students."* This statement reflects the need for targeted professional development to help teachers better understand self-engineering strategies. Equipping educators with the necessary skills and knowledge will enable them to effectively implement these techniques, fostering improved student outcomes in mathematics.

Participants expressed varying levels of familiarity and application of self-engineering techniques, reflecting curiosity and a desire to explore these strategies further. Teacher Participant B disclosed: *"So far, I have only implemented goal setting; I hope to expand it by incorporating reflective journals. This could encourage students to think critically about their learning process."* The participant's interest in expanding their use of self-engineering techniques, such as reflective journals, highlights the potential for fostering critical thinking and self-awareness in students. Structured support and resources could further enhance this practice.

Teachers identified goal setting and fostering independence as essential components of self-engineering techniques, though maintaining consistency emerged as a challenge. Teacher Participant C asserted: *"I encourage goal setting at the beginning of the year but find it challenging to keep that momentum throughout. I believe that with more structured support, I could integrate these techniques more consistently."* This perspective disclosed the importance of sustained guidance and resources for effectively integrating self-engineering techniques, ensuring long-term student benefits.

Participants with prior knowledge of self-engineering techniques emphasized their potential to foster independence and enhance learning outcomes. Participant B highlighted: *"Definitely familiar; I have read multiple resources on self-engineering techniques and believe they can be valuable. These approaches resonate with my goal of fostering independent learners."* This perspective strongly aligns with self-engineering principles and the participant's educational goals. Leveraging this familiarity can lead to developing more structured and impactful strategies to empower students as independent learners.

Participants aligned self-engineering techniques with their educational philosophies, particularly in promoting student empowerment and engagement. Teacher Participant D alluded: *"I have heard of them but primarily heard how beneficial they are for student empowerment and self-directed learning. It is a fascinating area that aligns with my educational philosophy."* The participant's recognition of self-engineering techniques as tools for empowerment suggests an opportunity to deepen their integration into teaching practices, enhancing student ownership of learning.

Some participants expressed a desire for more explicit guidance on incorporating self-engineering techniques effectively, recognizing their value in promoting reflective practices. Teacher Participant F stated: *"I try including self-assessment forms after each unit, but I think I could improve my approach. Having clear guidance would help me incorporate these methods more effectively."* The participant's use of self-assessment forms demonstrates an initial step toward implementing self-engineering techniques. Providing structured training and resources could enhance their ability to promote student self-awareness and growth.

Teachers noted the importance of autonomy and self-directed learning as critical outcomes of self-engineering techniques, reflecting a shared commitment to long-term student success. Participant G said, *"Yes, I learned about them in my teacher training. They interest me, especially in terms of promoting autonomy. I believe that self-directed learning is key to long-term success."* The participant’s enthusiasm for promoting autonomy through self-engineering techniques highlights their transformative potential. Further exploration and support could help fully realize these benefits in the classroom.

Participants acknowledged the need to adapt their teaching methods by incorporating innovative approaches like self-engineering to address evolving student needs. Participant H asserted: *"I am familiar with self-engineering but have mostly focused on traditional methods until now. I recognize the need to evolve my teaching to serve my students better."* This insight underscores the participant’s awareness of traditional methods' limitations and willingness to embrace self-engineering techniques. Such a shift could enhance their teaching effectiveness and better support student learning in a dynamic educational environment.

The need for actionable strategies emerged as a recurring theme, with participants expressing a desire for practical applications of self-engineering techniques in their teaching practices. Teacher Participant A disclosed: *"I attended a workshop about self-engineering techniques, which was insightful but left me wanting more actionable strategies. I believe there is much more to learn in this area."* This quotation highlights the gap between awareness and implementation, emphasizing the need for workshops and training sessions to offer more hands-on, practical guidance to empower teachers effectively.

Informal learning avenues, such as online forums, have exposed some participants to self-engineering techniques, though formal, structured training remains a priority. Teacher Participant B said: *"I have not had formal training, but I have joined online forums where teachers discuss these techniques. The exchange of ideas has been quite enriching, though I still feel I need more hands-on strategies."* While online forums foster collaborative learning and idea exchange, the participant's insight underscores the need for professional development opportunities focusing on practical, hands-on methods for effectively implementing self-engineering techniques.

Participants recognized the lack of dedicated training on self-engineering in mathematics and emphasized the potential benefits of focused professional development. Teacher Participant C revealed: *"I have participated in several workshops over the years, but none specifically targeted self-engineering in mathematics. I find that dedicated training would be beneficial for my practice."* This perspective reflects the importance of targeted training initiatives, as general workshops may not provide the depth or specificity required to equip teachers with the tools needed to implement self-engineering techniques in mathematics education.

Professional development sessions often touch upon self-engineering techniques, but their lack of depth has left participants seeking more comprehensive insights and tools. Teacher Participant D explained, *"I attended a professional development event that briefly mentioned self-engineering techniques but lacked depth. I left wanting to dive deeper into the subject and learn more."* This highlights a critical need for in-depth, specialized training sessions on self-engineering techniques that go beyond introductory overviews to equip teachers with actionable strategies for improving student performance.

DISCUSSION

Self-Engineering Problem-solving Strategies in Intermediate Mathematics

The diversity in teaching experience among participants highlights the adaptability of self-engineering strategies across different career stages. Teachers with extensive experience, like Participant A, reflect the importance of professional development in evolving their methods to meet diverse student needs. This aligns with Brooks and Roy, who emphasize the role of inner engineering and reflective practices in improving teaching efficacy.[47] Similarly, mentoring programs for new teachers, as suggested by Participant B, resonate with the findings of Nesbeth, who highlights the collaborative potential in engineering-based professional environments.[48]

Teachers' extended tenure at the same school fosters a deeper understanding of its culture and students, enabling the application of tailored self-engineering methods. Participant B's insights about leveraging their broader teaching background to mentor others underscore the value of knowledge sharing. This finding supports Brooks and Roy, who advocate for mentorship and collaborative practices to enhance teaching effectiveness and promote continuous professional learning.[49]

Participants noted the benefits of connecting mathematics to other subjects, enriching learning experiences through real-world applications. For instance, Participant C's dual focus on math and science mirrors findings from Brass, who emphasizes interdisciplinary teaching for holistic student development.[50] As suggested in the findings, developing integrated lesson plans aligns with Tang's call for contextualized learning.[51]

Participant D noted that integrating technology in teaching highlights the progressive shift towards dynamic and inclusive educational practices. This finding aligns with Brooks and Roy who advocate for using self-engineering systems in various disciplines to enhance engagement and learning outcomes.[52] The use of tools like interactive math software underscores the importance of equipping teachers with technological skills, a necessity echoed in Ghazian and Lortie.[53]

Collaboration and group projects were emphasized as critical for fostering peer-to-peer learning and engagement. This approach is consistent with Sandhu, who highlights the value of interactive and cooperative learning in improving student outcomes.[54] The findings also align with Nesbeth, who stresses collaborative frameworks for problem-solving and critical thinking in mathematics education.[55]

Connecting mathematics to real-life contexts emerged as a recurring theme, making learning more relatable and enjoyable. Participant E's emphasis on sports and music as teaching contexts exemplifies

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[47] Sam Brooks and Rajkumar Roy, "An Overview of Self-Engineering Systems," *Journal of Engineering Design* 32, no. 8 (2021): 397–447.

[48] Nesbeth, "Teacher-Efficacy with Standards-Based Education for Eighth-Grade Mathematics in a 21st-Century-Skill Framework: A Case Study."

[49] Brooks and Roy, "Complexity of Self-Engineering Systems across the Life Cycle–Biological and Engineering Systems."

[50] Brass, *Mathematics, Mathematics Education, and Citizenship: Mathematics Teacher Educators' Conceptions and Views*.

[51] Tang, "Student-Centered Approach in Teaching and Learning: What Does It Really Mean?"

[52] Brooks and Roy, "Complexity of Self-Engineering Systems across the Life Cycle–Biological and Engineering Systems."

[53] Ghazian and Lortie, "A Review of the Roots of Ecological Engineering and Its Principles."

[54] Sandhu, "Effective Instructional Practices: Secondary School Teachers View About Teaching Secondary Mathematics With Technology."

[55] Nesbeth, "Teacher-Efficacy with Standards-Based Education for Eighth-Grade Mathematics in a 21st-Century-Skill Framework: A Case Study."

this approach, which aligns with Norton, who emphasizes the importance of designing meaningful learning experiences.[56] Real-world applications support immediate feedback mechanisms, allowing for iterative teaching strategies, as Norton noted.[57]

The balance between traditional problem-solving methods and modern technological tools was highlighted as a way to maintain student engagement. This aligns with Gharib, who emphasised the importance of blending foundational and innovative approaches for effective self-engineering in education.[58] As noted by Participant F, continuous assessment supports adaptive teaching strategies, which are essential for student-centered learning, as Hoidn and Reusser discussed.[59]

Participants emphasized the importance of personalized teaching approaches, such as differentiated instruction and peer assessments, to cater to diverse learning needs. This practice aligns with the findings of Adams et al., who advocate for customized approaches to improve problem-solving skills.[60] As Participant G described, Peer assessments promote collaborative learning and critical thinking, reflecting the principles discussed by.[61]

The findings discovered the transformative potential of self-engineering strategies in intermediate mathematics education. Educators can create engaging, inclusive, and effective learning environments by integrating diverse teaching experiences, interdisciplinary approaches, technology, collaborative learning, and real-world applications. These findings reaffirm the need for professional development, mentorship, and continuous assessment to support teachers in adapting their methods to meet evolving student needs. This approach ultimately aligns with contemporary educational goals of fostering critical thinking, creativity, and lifelong learning among students.

Awareness and Application of Self-Engineering Techniques in Teaching Mathematics in the Intermediate Phase

The findings underscore the varying levels of awareness and application of self-engineering techniques among teachers and their potential impact on mathematics education in the Intermediate Phase. These insights resonate with existing literature, which emphasises the value of empowering teachers with innovative strategies to improve student outcomes.

The participants' varied familiarity with self-engineering techniques highlights the importance of targeted professional development. Literature supports this, suggesting that teacher training programs must include explicit instruction on innovative pedagogies like self-engineering. For instance, Brooks and Roy emphasises the need for teachers to develop adaptive expertise to foster meaningful learning experiences.[62] Professional development tailored to self-engineering can bridge the gap between awareness and practical implementation, as seen in Participant A's call for structured guidance.

Goal setting and reflective practices emerged as foundational self-engineering techniques identified by participants. Research indicates that these methods encourage metacognition and intrinsic motivation in learners.[63] Participants like Teachers B and C, who demonstrated an interest in reflective journals and sustained goal setting, align with findings that self-regulated learning strategies can significantly enhance critical thinking and academic achievement. However, as noted by Participant B identified the need for sustained support and follow-up training.

Participants recognized the potential of self-engineering techniques to promote autonomy and student empowerment, echoing Norton's efficacy theory.[64] Empowering students as independent learners aligns with contemporary educational goals, where autonomy is linked to lifelong learning capabilities.

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[56] Norton, "A Narrative Inquiry into Design-Based Learning Experiences, Transversal Skills, and Flourishing as Your Best-Loved Self."

[57] Norton, "A Narrative Inquiry into Design-Based Learning Experiences, Transversal Skills, and Flourishing as Your Best-Loved Self."

[58] Gharib, "هندسة الذات لدى طالبات المرحلة الثانوية بمنطقة القصيم Self-Engineering among Secondary School Students in the Qassim Region."

[59] Hoidn and Reusser, "Foundations of Student-Centered Learning and Teaching."

[60] Carels et al., "Youths' Perceptions Of The Relation Between Alcohol Consumption And Risky Sexual Behaviour in the Western Cape, South Africa: A Qualitative Study."

[61] Norton, "A Narrative Inquiry into Design-Based Learning Experiences, Transversal Skills, and Flourishing as Your Best-Loved Self."

[62] Brooks and Roy, "Complexity of Self-Engineering Systems across the Life Cycle–Biological and Engineering Systems."

[63] Nesbeth, "Teacher-Efficacy with Standards-Based Education for Eighth-Grade Mathematics in a 21st-Century-Skill Framework: A Case Study."

[64] Norton, "A Narrative Inquiry into Design-Based Learning Experiences, Transversal Skills, and Flourishing as Your Best-Loved Self."

Teacher Participant E's enthusiasm for promoting autonomy and Participant D's alignment with educational philosophies reinforce the importance of integrating self-engineering techniques into teaching practices.

The findings reveal a common theme: Participants expressed a need for actionable strategies and hands-on methods for applying self-engineering techniques effectively. This aligns with Darling-Hammond et al. who argue that effective professional development must be experiential, context-specific, and sustained over time.[65] Teachers' reliance on informal learning avenues like online forums (e.g., Participant F) indicates a formal training gap, highlighting the need for structured learning opportunities.

Participants noted a lack of focused training on applying self-engineering techniques in mathematics, a subject often associated with high levels of anxiety and low self-efficacy among learners.[66] This points to a critical opportunity for developing specialized workshops that contextualize self-engineering principles within mathematics teaching, enhancing their relevance and applicability.

The findings suggest a disparity between teachers' awareness of self-engineering techniques and their practical application in classrooms. This gap aligns with research by Norton which highlights that effective professional development must move beyond theory to provide teachers with concrete, actionable strategies. Participant B's desire for more actionable insights and Participant G's acknowledgment of insufficient training specifically for mathematics reflect this ongoing challenge.

The findings align with the literature in identifying self-engineering techniques as promising for enhancing student engagement, autonomy, and critical thinking in mathematics education. However, the need for targeted professional development, actionable strategies, and sustained support is evident. By addressing these gaps, educators can better integrate self-engineering principles into their practices, improving learner outcomes and teaching efficacy.

RECOMMENDATIONS

To enhance the effectiveness of self-engineering problem-solving strategies in intermediate mathematics education, it is essential to implement structured professional development programs tailored to teachers' varying experience levels, establish mentorship initiatives that foster collaboration and knowledge-sharing, promote interdisciplinary teaching methods, provide targeted training on technology integration, and create a culture of continuous assessment and feedback. Additionally, schools should support collaborative learning environments that emphasize group projects, encourage contextualized lessons connected to real-world interests, establish feedback mechanisms for teachers, conduct ongoing research to evaluate the impact of these strategies, and engage the community to bolster support for mathematics education. These comprehensive measures will empower educators, enrich student learning experiences, and improve overall educational outcomes in mathematics.

CONCLUSION

In conclusion, this study highlights the critical importance of self-engineering problem-solving techniques within intermediate mathematics education. Through an in-depth exploration of current teaching practices and pedagogical strategies, it is evident that fostering an environment that encourages creative thinking, collaboration, and real-world application can significantly enhance students' understanding and engagement in mathematics. The findings identify the need for tailored professional development programs, mentorship opportunities, and supportive teaching frameworks that empower educators to implement these innovative strategies effectively. By prioritising these recommendations, educational institutions can create a more dynamic and enriching learning environment, ultimately equipping students with the problem-solving skills necessary for academic success and effective citizenship in an increasingly complex world. As we move forward, continued research and adaptive practices will be essential in refining our approaches and ensuring that teachers and students can thrive in the evolving landscape of mathematics education.

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[65] Linda Darling-Hammond, Maria E Hyler, and Madelyn Gardner, "Effective Teacher Professional Development.," *Learning Policy Institute*, 2017.

[66] Norton, "A Narrative Inquiry into Design-Based Learning Experiences, Transversal Skills, and Flourishing as Your Best-Loved Self."

BIBLIOGRAPHY

Abbas, Nazar Habeeb, Alaa Muhsin Khafeef AL-Ghuriabawi, and Omar F Hassan Al-obaidy. "The Effect Of Self-Engineering In Promoting Entrepreneurial Behavior Of The Organization's Employees Applied Study at ZSCO Group International Auto Trading." المجلة العراقية للعلوم الاقتصادية 22, no. 80. S (2024): 1189–1203.

Adams, C B, N Aggarwal, A Agrawal, R Balafendiev, C Bartram, M Baryakhtar, H Bekker, P Belov, K K Berggren, and A Berlin. "Axion Dark Matter." *ArXiv Preprint ArXiv:2203.14923*, 2022.

Al-Mseidin, Kholoud Imhammad. "Post Pandemic Readjustment to Traditional Education System: Analyzing Difficulties of University Students and Recommendations." *International Journal of Childhood, Counselling and Special Education* 5, no. 1 (June 2023): 1–7. https://doi.org/10.31559/CCSE2023.5.1.1.

Baert, Stijn, Brecht Neyt, Thomas Siedler, Ilse Tobback, and Dieter Verhaest. "Student Internships and Employment Opportunities after Graduation: A Field Experiment." *Economics of Education Review* 83 (2021): 102141.

Brass, Amy. *Mathematics, Mathematics Education, and Citizenship: Mathematics Teacher Educators' Conceptions and Views*. The Pennsylvania State University, 2024.

Bronen, Robin, Denise Pollock, Jacquelyn Overbeck, DeAnne Stevens, Susan Natali, and Chris Maio. "Usteq: Integrating Indigenous Knowledge and Social and Physical Sciences to Coproduce Knowledge and Support Community-Based Adaptation." *Polar Geography* 43, no. 2–3 (2020): 188–205.

Brooks, Sam, and Rajkumar Roy. "An Overview of Self-Engineering Systems." *Journal of Engineering Design* 32, no. 8 (2021): 397–447.

———. "Complexity of Self-Engineering Systems across the Life Cycle–Biological and Engineering Systems." *Procedia CIRP* 98 (2021): 121–26.

Carels, Cassandra, Maria Florence, Sabirah Adams, Deborah Louise Sinclair, and Shazly Savahl. "Youths' Perceptions Of The Relation Between Alcohol Consumption And Risky Sexual Behaviour in the Western Cape, South Africa: A Qualitative Study." *Child Indicators Research* 15, no. 4 (August 20, 2022): 1269–93. https://doi.org/10.1007/s12187-022-09913-9.

Chang, Tracy F H, Rebecca N Baelen, Triya Tessa Ramburn, and Pradeep Purandare. "Developing Positive Self-Leadership through 'Inner Engineering.'" *Journal of Management Development* 41, no. 7/8 (2022): 405–16.

Darling-Hammond, Linda, Maria E Hyler, and Madelyn Gardner. "Effective Teacher Professional Development." *Learning Policy Institute*, 2017.

Deng, Xinjie, and Zhonggen Yu. "A Meta-Analysis and Systematic Review of the Effect of Chatbot Technology Use in Sustainable Education." *Sustainability* 15, no. 4 (February 6, 2023): 2940. https://doi.org/10.3390/su15042940.

Edan, Takwa Sadeq, Adawiya J Haider, and Fatima I Sultan. "Core–Shell Nanostructures in Self-Cleaning Surface Technology: A Mini Review." *Plasmonics*, 2025, 1–20.

Fathi, Faezeh, Samad N. Ebrahimi, Luís Carlos Matos, M Beatriz PP Oliveira, and Rita C Alves. "Emerging Drying Techniques for Food Safety and Quality: A Review." *Comprehensive Reviews in Food Science and Food Safety* 21, no. 2 (2022): 1125–60.

Gharib, Enas. "هندسة الذات لدى طالبات المرحلة الثانوية بمنطقة القصيم Self-Engineering among Secondary School Students in the Qassim Region." *International Journal of Learning Management Systems* 11, no. 3 (2023): 93–107.

Ghazian, Nargol, and Christopher J Lortie. "A Review of the Roots of Ecological Engineering and Its Principles." *Journal of Ecological Engineering* 25, no. 1 (2024).

Goos, Merrilyn, and Kim Beswick. *Learning and Development of Mathematics Teacher Educators*. Springer, 2021.

Hoidn, Sabine, and Kurt Reusser. "Foundations of Student-Centered Learning and Teaching." In *The Routledge International Handbook of Student-Centered Learning and Teaching in Higher Education*, 17–46. Routledge, 2020.

Manders, Steven, Milorad Pantelic, Vladimir MILISAVLJEVIĆ, and Alberto Martinetti. "Self-Engineering: Possibilities for Maintenance Operations in the Mining Machines Industry." In *10th International Conference on Through-Life Engineering Service, TESCONF 2021*, 2021.

McCormick, M. L. "Teacher Perceptions of the Opportunities and Constraints When Integrating Problem Solving in Student-Centred Mathematics Teaching and Learning." Monash University, 2022.

Mhandu, John, and Vivian Ojong. "Covid-19 and the South African Pentecostal Landscape: Historic Shift from Offline Liturgical Practice to Online Platforms." *Journal for the Study of Religion* 34, no. 2 (January 21, 2021): 1–25. https://doi.org/10.17159/2413-3027/2021/v34n2a5.

Mpya, Nwacoye Gladness, and Marubini Christinah Sadiki. "Inclusive Basic Education in South Africa: Highlights and Lowlights." In *Handbook of Research on Inclusive and Accessible Education*, 244–61. IGI Global Scientific Publishing, 2024.

Mullick-Martinez, F. A. Y. "Teaching Metacognitive Strategies to Optimize Mathematical Problem Solving in Fourth Grade Students." Barry University, 2020.

Naz, Ayesha Tahir, Sam Brooks, and Rajkumar Roy. "Investigation of Future Applications of Self-Engineering Using Drones." *Materials Today: Proceedings* 64 (2022): 1255–60.

Nesbeth, Jemmeta DeMay. "Teacher-Efficacy with Standards-Based Education for Eighth-Grade Mathematics in a 21st-Century-Skill Framework: A Case Study," 2021.

Norton, Michele Lynn. "A Narrative Inquiry into Design-Based Learning Experiences, Transversal Skills, and Flourishing as Your Best-Loved Self." Texas A&M University, 2020.

Sandhu, Surinder Kaur. "Effective Instructional Practices: Secondary School Teachers View About Teaching Secondary Mathematics With Technology." Oakland University, 2024.

Tang, Kuok Ho Daniel. "Student-Centered Approach in Teaching and Learning: What Does It Really Mean?" *Acta Pedagogia Asiana* 2, no. 2 (2023): 72–83.

Yeager, David S., Paul Hanselman, Gregory M. Walton, Jared S. Murray, Robert Crosnoe, Chandra Muller, Elizabeth Tipton, et al. "A National Experiment Reveals Where a Growth Mindset Improves Achievement." *Nature* 573, no. 7774 (September 7, 2019): 364–69. https://doi.org/10.1038/s41586-019-1466-y.

Yu, Feng, Chong Liu, Fenghua Tan, Yuhe Liao, Liang Wang, Yuping Li, and Feng-Shou Xiao. "Sustainable Production of Value-Added N-Heterocycles from Biomass-Derived Carbohydrates via Spontaneous Self-Engineering." *National Science Open* 2, no. 6 (2023): 20230019.

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