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Understanding educators' approaches to teaching mechanical systems and control in grade 8

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ABSTRACT

The quality of instruction in Mechanical Systems and Control significantly impacts learners' grasp of technology concepts in Grade 8. The objectives of the research were: (1) to determine how Grade 8 educators applied pedagogical strategies to teach Mechanical Systems and Control, and (2) to assess the specific practices used in the classroom. Using a qualitative approach, data were collected through non-participant observations, semi-structured interviews and open-ended questionnaires conducted with seven (7) Technology educators across Madibeng schools. Data was transcribed and analysed using the 6 steps of thematic analysis. The findings revealed that while educators used a variety of teaching approaches such as demonstrations, practical tasks and learner-centred discussions, there was a lack of consistency between theory and practical application due to resource constraints and limited professional development. Educators expressed a preference for interactive and hands-on strategies; challenges such as large class sizes and time limitations were reported. The study recommended targeted training workshops and curriculum alignment to enhance teaching effectiveness. These findings contributed to a deeper understanding of pedagogical practices in Technology education. For further research, a mixed-method approach could provide a more comprehensive understanding by using learner performance data to evaluate the effectiveness of various teaching strategies.

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INTRODUCTION

Mechanical Systems and Control is an essential aspect of South Africa's Grade 8 Technology curriculum, as it introduces learners to fundamental engineering principles such as levers, links, pulleys, gears, and mechanical advantage. This content area not only promotes technical knowledge but also stimulates the development of problem-solving, critical thinking, and design skills, all of which are essential in STEM education (Molefe & Ramabenyane, 2019). However, the success of delivering this subject is strongly dependent on educators' pedagogical skills, confidence and classroom techniques.

Regardless of the curriculum's aims, multiple studies show that Technology educators frequently struggle to teach Mechanical Systems and Control effectively. These include a lack of material knowledge, inadequate professional development, limited access to teaching tools and excessive class sizes (Naidoo, 2022). As a result, teaching is usually restricted to textbook-based, educator-centred instruction, limiting learner participation and engagement (Motsamai & Makgato, 2021). This approach opposes the CAPS curriculum's emphasis on hands-on, activity-based learning, in which learners are supposed to explore and generate meaning by designing, creating and assessing assignments.

Research indicates that learners fail to grasp abstract mechanical concepts without hands-on experimentation and visual aids (Maharaj & Moodley, 2023). As a result, learner-centred educational approaches such as inquiry-based learning, collaborative problem-solving and the incorporation of digital simulations have been found to improve retention and understanding in technical courses (Ngobeni & Dlamini, 2023). However, the application of these creative solutions is patchy, particularly in underserved schools.

Pedagogical decisions are likewise significantly influenced by educators' opinions (Ramaligela, 2021). Educators' decisions to embrace innovative approaches or adhere to conventional ways are frequently influenced by their opinions regarding the benefits, viability and results of various teaching methodologies (Makhetha & Wyk, 2021). Some educators recognise the advantages of practical work but are deterred from holding frequent practical sessions due to concerns about classroom management, safety, time limits and limited resources.

The novelty of this study lies in its focused exploration of how Grade 8 Technology educators teach Mechanical Systems and Control, a sub-concept often overshadowed in broader studies of technology education. While several studies explored Grade 8 Technology educators' pedagogical content knowledge generally, there is a gap in understanding how educators specifically teach Mechanical Systems and Control. Little is known about how educators reconcile pedagogical content knowledge and content knowledge during lesson enactment.

Adequate provision of teaching and learning resources, such as tools and instructional models, is essential to support meaningful learning experiences (Rahman & Lestari, 2025). Although numerous studies have explored the concept, limited empirical attention has been given to teaching methods. In the Madibeng context, these challenges are intensified by disparities in resource distribution and limited access to professional development.

METHOD

Type of Research

To understand Educators' approaches to teaching Mechanical Systems and Control in Grade 8, this study employed a qualitative research method. This approach was deemed appropriate because it allowed for an in-depth exploration of educators' pedagogical practices, perceptions and contextual challenges within real classroom settings (Lahiri, 2023).

Time and Place of Research

The study was conducted from June to July 2025. The research was conducted with a purposively sampled group of 07 educators from public schools within the Madibeng sub-district in North West province, South Africa. Purposive sampling was used to select participants who were knowledgeable and experienced in teaching Mechanical Systems and Control (Maree, 2020). Participants included Technology educators with at least 2 years' experience, ensuring insights were drawn from individuals with established classroom practices. The biographical data of the educators based on qualifications and experience can be interpreted as shown in Table 1. This biographical information is relevant because this study used expert purposive sampling. These educators are experts in Technology subjects and have 2 or more years of experience in the field.

Table 1. Biographical Data of Educators

No.	Educators	Qualifications & Experience
1	Educator A	B. Ed Technology - 3 years
2	Educator B	STD Technical - 22 years
3	Educator C	B. Ed Technical - 4 years
4	Educator D	B. Ed Natural Sciences - 6 years

No.	Educators	Qualifications & Experience
5	Educator E	ACE Technology - 4 years
6	Educator F	B. Ed Technology -13 years
7	Educator G	STD Technical - 10 years

Data Collection

Three qualitative methods were used to collect the data: non-participant observations, semi-structured interviews and open-ended questionnaires. Without interfering with the lesson's organic flow, non-participant observations provided the researcher with personal knowledge of teaching strategies, classroom dynamics, and the level of practical participation (Patton, 2022). Educators were able to describe their thinking, experiences, and difficulties through semi-structured interviews, which offered a flexible framework for discussing educational decisions (Bertram & Christiansen, 2019). Participants were allowed to write down their ideas using open-ended questionnaires, resulting in more insightful and detailed data.

Data Analysis

The six-phase model developed served as the guidance for the recording, transcription and thematic analysis of all data, as shown in Figure 1 below. Finding patterns and themes in the various data sources was made possible via thematic coding. To allow themes to arise inductively from the data rather than be imposed beforehand, a grounded theory technique was used (Charmaz, 2020). Triangulation, member checking and audit trails were among the techniques employed to guarantee the reliability of the results (Lincoln & Guba, 2018). Strict adherence to ethical protocols was maintained, including obtaining informed consent from each participant, ensuring anonymity, and obtaining ethical clearance from the appropriate educational authorities.

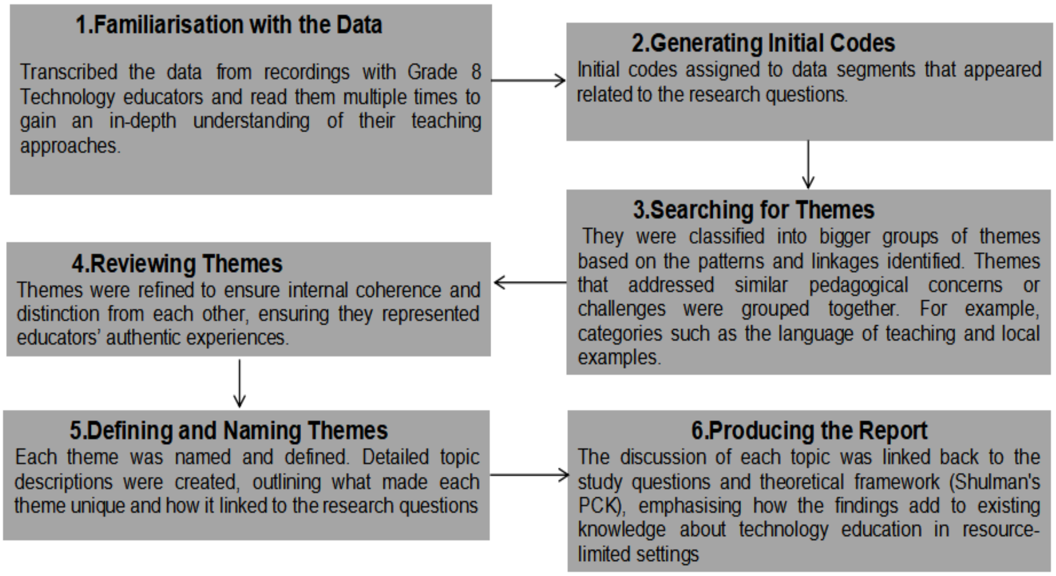

Figure 1. Braun and Clarke Model Chart based on the Research Process

Ethical Approval

Research permission was obtained from the Tshwane University of Technology Institutional Ethics Committees and from the authorities at the Department of Education and the Madibeng sub-district offices. Ethical principles were followed throughout the entire research. Participants were informed about the purpose of the research, their voluntary participation and their right to withdraw at any time without penalty. Written informed consent was obtained from all participants. The Grade 8 technology educators were notified of the study and completed the consent form indicating their voluntary participation. The participants had the right to withdraw at any time without having to specify the reasons.

RESULTS AND DISCUSSION

Results

The analysis of data collected through non-participant observation, semi-structured interviews, and open-ended questionnaires revealed several key themes regarding educators' approaches to teaching Mechanical Systems and Control in Grade 8. The results are presented under the following major themes. (1) Create scenarios for learners in order to enact prior knowledge, (2) Use various methods to prepare for lessons, and (3) Practical work enhances learner knowledge.

To add a comprehensive research instrument table that aligns with the research questions, data collection instruments, applicable frameworks and emerged themes from the study, the following Table 2 can be constructed using the detailed methodology and thematic focus described in the document:

Table 2. Research Instrument Table and Emerged Themes

No.	Research Question	Data Collection Instrument	Applicable Frameworks	Emerged Themes/Focus Areas
1	How do Grade 8 Technology educators apply pedagogical approaches to teach Mechanical Systems and Control?	Document Analysis, Non-participant Observation	Content knowledge and Pedagogical content knowledge	Create scenarios for learners in order to enact prior knowledge
2	Which pedagogical practices do Grade 8 Technology educators use to teach Mechanical Systems and Control?	Semi-structured Interviews, Open-ended Questionnaires	Content knowledge and Pedagogical content knowledge	Use various methods to prepare for lessons. Practical work enhances learner knowledge.

Create Scenarios for Learners in Order to Enact Prior Knowledge

According to the majority of educators, they start their classes by constructing realistic, real-world scenarios that draw on students' past knowledge. For instance, Educator A described how she asked learners to consider how they use equipment like wheelbarrows and bottle openers at home to teach the idea of levers. According to Educator D, learners' engagement and comprehension increase when they can relate abstract mechanical principles to familiar settings through shared experiences. This assertion was corroborated by observations that revealed classes frequently began with brief discussions or real-world problem-solving exercises. Educator G noted that some learners, particularly those with limited exposure to tools or mechanical devices outside the classroom, are unable to connect past experiences to mechanical systems.

Use Various Methods to Prepare for Lessons

Each of the seven educators reported using a variety of methods to get ready to teach mechanical systems and control. While Educator E emphasised the value of creating lesson plans and visual aids in advance, Educator B noted the importance of leveraging online resources and YouTube videos to enhance textbook content. During departmental meetings, educator C saw that working together with colleagues was very beneficial for resource sharing and lesson planning. Despite these initiatives, several educators acknowledged that a barrier to confident lesson preparation was the lack of access to training for educators in mechanical subjects. For example, Educator F mentioned that although he uses the CAPS paper as a reference, he often feels it is too general and lacks concrete examples.

Practical Work Enhances Learner Knowledge

Every participant agreed that hands-on experience is crucial to learners' comprehension of mechanical systems and control. According to observations, learners were more attentive and engaged in class during practical exercises. Using thread and plastic reels, Educator D showed students how to construct basic pulley systems, sparking lively class debates and problem-solving. Educator A stressed that hands-on activities help students "see theory come to life," which increases their engagement and retention. Educators G and F, however, expressed concerns about inadequate supplies and equipment, which frequently limit the quantity and quality of hands-on learning. Educators reported using inexpensive or repurposed materials to adapt in schools with limited resources, but they noted that this required much more preparation time. Moreover, Educator C highlighted that there are inadequate materials for practicals, while utilising the smartboard, to provide learners with at least visual images and worksheet demonstrations. See Figure 2 below.

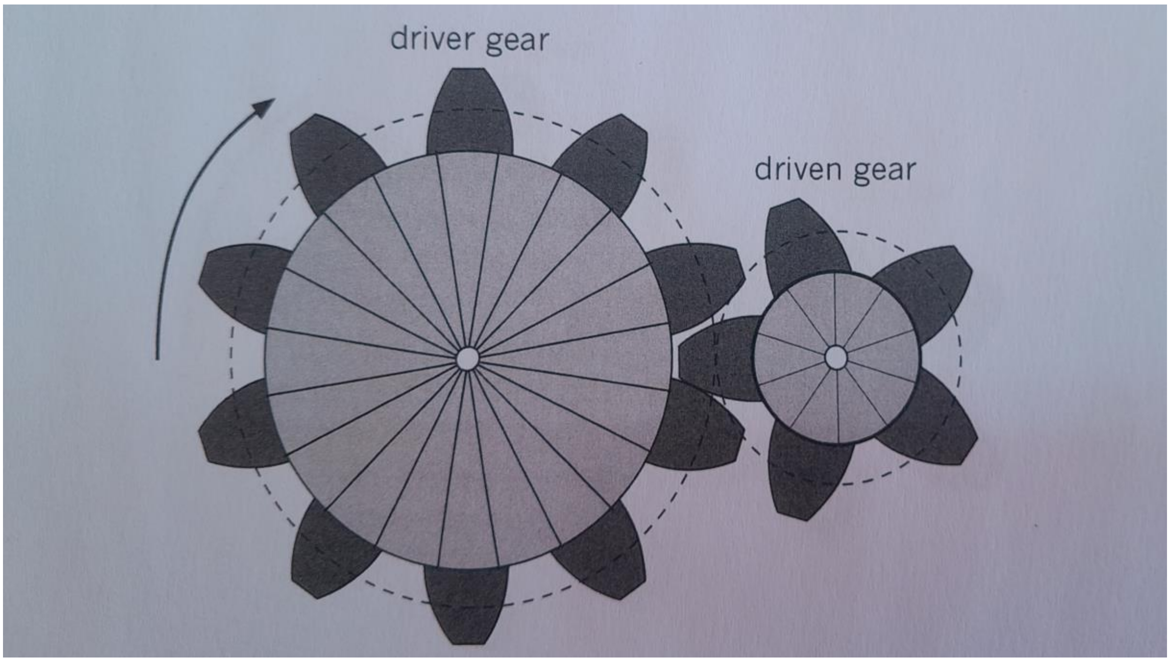

Figure 2. Educator D Worksheet Demonstration of Driver and Driven Gear

Discussion

One tactic frequently employed by participants is the use of real-life scenarios to stimulate learners' prior knowledge. Educators feel that putting lessons in context with familiar items makes it easier for learners to understand abstract mechanical ideas. Constructivist learning theory, which holds that students create new knowledge on the basis of prior experiences, is consistent with this conclusion (Maharaj & Moodley, 2023). According to studies by Motsamai & Makgato (2021), technology educators frequently rely on real-world applications to present mechanical systems and interest learners. Participants noted that not all students, particularly those with limited resources, could readily relate to mechanical instruments. This supports the findings of Letsoalo & Bhebhe (2024), who discovered that socioeconomic background can restrict students' access to mechanical devices, making it more challenging to transfer knowledge.

Lesson Preparation

According to Achmad & Mulyati (2023), educators used a range of lesson preparation techniques, including creating visual aids and diagrams, using web resources, and engaging in peer collaboration. Despite a lack of official training in mechanical systems, these initiatives demonstrate a commitment to improving instruction quality. Nonetheless, several educators acknowledged that they relied primarily on the CAPS document, which they found too general and lacking helpful advice. This aligns with Naidoo (2022) findings, which showed that educators frequently felt unprepared to teach technical material due to deficiencies in their professional development. Additionally, although peer support is seen as helpful, collaboration was often sporadic and informal due to the lack of official professional learning networks.

Practical Work

Although all educators acknowledge the value of practical work in improving learners' comprehension, resource limitations prevented some from putting it into practice. Learner engagement and conceptual knowledge clearly increase in areas where practical activities were carried out. Highlight that practical tasks promote deeper learning and retention in technology education, which validates their earlier findings. As suggested by Molefe & Ramabenyane (2019), the need for a more structured integration of practical components is highlighted by the significant learner responses observed during practical sessions. Time restrictions, packed classrooms, and restricted access to resources were mentioned as the main obstacles.

Educators have positive opinions about the subject and acknowledge its importance in providing students with life and career skills (Ndlovu & Mtshali, 2025). However, their confidence and effectiveness in instruction were weakened by the lack of focused instruction in mechanical systems. This reveals a significant discrepancy between educator readiness and curriculum expectations. The results corroborate those of Makhetha & Wyk (2021), who advocate for frequent professional development workshops explicitly focused on mechanical systems and hands-on teaching methods. These findings highlight the importance of ongoing in-service training, peer collaboration and improved resourcing to support Technology educators.

Limitations

The study is limited to the Madibeng sub-district and focused solely on Grade 8 technology educators. The sample size is limited (seven educators), and the generalizability of the results is limited. Time constraints restrict the number of classroom observations per educator. Furthermore, as a qualitative study, the findings reflect the researcher's subjective views; however, procedures such as triangulation and member verification are used to increase credibility.

CONCLUSION

This study aims to understand how Grade 8 Technology educators approach the teaching of Mechanical Systems and Control, focusing on the pedagogical methods they employ, the practices they use, and their perceptions of these approaches. The findings reveal that educators actively use real-life scenarios to activate prior knowledge, employ various strategies to prepare for lessons and value practical work as essential to learner understanding. However, despite these efforts, many face significant challenges, including limited resources, a lack of structured training, and time constraints, particularly in under-resourced schools. The conclusion drawn from these findings is that while educators demonstrate creativity and commitment, the effectiveness of their teaching is often compromised by systemic barriers. This highlights a misalignment between curriculum expectations and classroom realities. Based on these facts, it is evident that the successful teaching of Mechanical Systems and Control requires more educator effort.

Future research could expand this study by comparing the instructional practices of technology educators across different districts. A mixed-methods approach incorporating learner performance data may offer deeper insights into the effectiveness of various teaching strategies. The study has a limited number of Grade 8 Technology educators and is based around a single district. Additionally, examining how educator training programmes develop CK and PCK, along with evaluating how the CAPS document supports or limits innovative technology teaching, would provide valuable directions for improvement. Future studies should explore scalable professional learning models to strengthen practical teaching in Technology education.

REFERENCES

Achmad, R. K., & Mulyati, Y. (2023). The perceptions of high school teachers and students towards digital interest and literacy. *Jurnal Inovasi Teknologi Pendidikan*, *10*(3), 283–297. https://doi.org/10.21831/jitp.v10i3.58804

Bertram, C., & Christiansen, I. (2019). *Understanding research: An introduction to reading research*. Van Schaik Publishers.

Charmaz, K. (2020). *Constructing grounded theory* (3rd ed.). SAGE Publications.

Chikoko, V., & Shonhiwa, C. (2021). *Practical guide to qualitative research in education*. Oxford University Press Southern Africa.

Lahiri, S. (2023). A qualitative research approach is an inevitable part of research methodology: An overview. *International Journal for Multidisciplinary Research*, *5(*3), 1–13. https://doi.org/10.36948/ijfmr.2023.v05i03.3178

Letsoalo, M., & Bhebhe, S. (2024). Enhancing conceptual understanding in mechanical systems through practical tasks. *African Journal of Technology Education*, *12*(1), 45–59. https://doi.org/10.1234/ajte.v12i1.5678

Lincoln, Y. S., & Guba, E. G. (2018). *Naturalistic inquiry*. SAGE Publications.

Maharaj, A., & Moodley, T. (2023). Using constructivist approaches to teach mechanical systems in secondary schools. *South African Journal of Education*, *43*(2), 112–128. https://doi.org/10.15700/saje.v43n2a5678

Makhetha, M., & Wyk, R. V. (2021). Teacher perceptions on practical work in mechanical systems. *Journal of Technical Education and Training*, *13*(4), 122–136. https://doi.org/10.30880/jtet.2021.13.04.011

Maree, K. (2020). *First steps in research* (3rd ed.). Van Schaik Publishers.

Molefe, M., & Ramabenyane, N. (2019). Practical integration in technology education: A mechanical systems focus. *International Journal of Technology and Design Education*, *29*(4), 789–804. https://doi.org/10.1007/s10798-018-9465-3

Motsamai, M., & Makgato, M. (2021). Contextual teaching approaches in mechanical systems and control. *Journal of Technology Education in Africa*, *8*(2), 66–81. https://doi.org/10.1234/jtea.v8i2.3456

Naidoo, P. (2022). Professional development for technology educators: Addressing pedagogical gaps. *Journal of Education*, *87*(1), 102–118. https://doi.org/10.17159/2520-9868/i87a07

Ndlovu, L. K., & Mtshali, T. I. (2025). Tablet adoption and mobile learning impact in high schools. *Jurnal Inovasi Teknologi Pendidikan*, *12*(3), 287-297. http://doi/10.21831/jitp.v12i3.88985

Ngobeni, S., & Dlamini, N. (2023). Digital simulations in teaching mechanical systems. *Journal of STEM Education Research*, *6*(3), 215–231. https://doi.org/10.1007/s41979-023-00089-4

Patton, M. Q. (2022). *Qualitative research and evaluation methods* (5th ed.). SAGE Publications.

Rahman, S., & Lestari, G. D. (2025), Integrated digital portfolio-based education management in LMS: Strategy to improve learning quality and administration in educational units. *Journal of Educational Technology and Innovation*, *8*(1), 1-5. http://doi.org/10.31537/jeti.v8i1.2321

Ramaligela, S.M. (2021). Exploring pre-service technology teachers' content and instructional knowledge to determine teaching readiness. *International Journal of Technology and Design Education*, *31*, 531-544. https://doi.org/10.1007/s10798-020-09570-5