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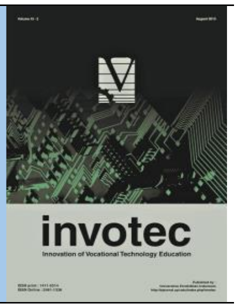


# TEACHING MECHANICAL SYSTEMS AND CONTROL: INSIGHTS FROM GRADE 8 TECHNOLOGY EDUCATORS IN MADIBENG

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**A R T I C L E  I N F O**

*Article history:*
*Received: 06 Aug 2025*
*Received in revised form: 03 Nov 2025*
*Accepted: 22 Dec 2025*
*Available online: 23 Dec 2025*

*Keywords:*
Madibeng, Mechanical Systems and Control, Pedagogical Practices, Technology Education

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**A B S T R A C T**

Mechanical Systems and Control constitute a critical component of the Grade 8 Technology curriculum in South African schools. However, their effective delivery remains uneven, particularly in under-resourced rural contexts. The purpose of this study was to investigate the pedagogical practices of Grade 8 Technology educators within the Madibeng Local Municipality. Employing a qualitative single-case study design, data was collected through non-participant observations, semi-structured interviews, open-ended questionnaires and document analysis. The study purposively sampled seven Grade 8 educators, each representing a different secondary school in close proximity to the researcher's residence. The findings reveal significant gaps in pedagogical content knowledge, particularly in educators' ability to articulate and simplify abstract mechanical concepts for learners. In addition, participants identified the scarcity of instructional resources and insufficient subject-specific training as critical constraints to effective teaching. Drawing on these insights, the study advocates for targeted professional development initiatives tailored to mechanical systems and control, enhanced support from subject advisors and the provision of contextually appropriate teaching aids. Such interventions are essential to strengthening educators’ instructional capacity and improving learner engagement with this technically demanding curricular area.

## 1. Introduction

Mechanical systems and control are essential components of the Grade 8 Technology curriculum in South African schools, as outlined in the Curriculum and Assessment Policy Statement (CAPS). Despite its importance in developing learners’ technological literacy, enabling understanding of levers, gears, pulleys, hydraulic and pneumatic systems the real-world classroom implementation of these topics frequently falls short of both curricular goals and learner needs (DBE, CAPS, 2011). In the Madibeng area, educators face specific contextual problems such as limited resources, diverse learner backgrounds and the need to make abstract mechanical principles accessible and engaging. These constraints impede effective pedagogy and raise serious concerns about how mechanical systems and control are taught in this setting.

This study focuses on how Grade 8 educators in Madibeng interpret and implement the mechanical systems and control curriculum. It tries to shed light on their instructional practices, tools, and approaches for promoting learner comprehension. The study question focuses on the pedagogical strategies used by Grade 8 educators to teach mechanical systems and control and their alignment with CAPS results. A better grasp of this will aid in identifying gaps between legislative aim and classroom reality, as well as highlighting potential for contextualized pedagogical innovations. However, based on a study conducted by Mhlanga et al. (2023) Mechanical Technology learners lack conceptual basics of mechanical knowledge which results in hands-on practical incompetence. According to the above-mentioned authors, the lack of basic mechanical concepts and skills stems from lower grades in the senior phase Technology.

Several studies have highlighted the difficulties educators encounter when teaching mechanical systems and control. For example, Ramaboea, Ramaligela and Mtshali (2023) explored how Grade 8 Technology educators applied the 9E instructional model in delivering practical tasks. Although educators were effective in drawing out learners' prior knowledge, they encountered challenges in clarifying complex mechanical concepts, linking content to real-world contexts and guiding learners through advanced phases such as designing, making and communicating. Similarly, Nkosi and Dlamini (2024) investigated how educators introduced mechanical control components like gears, pulleys and levers. While their study focused on instructional tools and task design, it did not delve into how theoretical lessons were delivered, particularly regarding the explanation of control principles and the handling of learner misconceptions. This omission reveals a critical gap in understanding educators' everyday instructional approaches to teaching Mechanical Systems.

The lack of resources in most schools worsens technology educators' pedagogy as they scrabble with the idea of teaching about mechanisms that work with air (pneumatic) and liquid (hydraulic) in their technological classrooms. This is problematic because learners are expected to choose Mechanical Technology in the FET phase with these concepts as a baseline, meaning that they should have a clear understanding of Mechanical Systems and Control so that they can perform better in mechanical technology. Examining pedagogical practices in Madibeng is valuable for educators, policymakers and curriculum developers. Rural or semi-urban insights differ from metropolitan case studies but are less recorded. This study contributes actual data on educator experiences and classroom practices in Madibeng, filling a gap in the literature on South African technology education. The findings can help to inform contextual professional development, targeted resource allocation and adaptive curriculum assistance adapted to the region's specific educational contexts (Rannikmäe et al., 2020). This study addressed two key research questions: (1) What teaching strategies do Grade 8 educators use for mechanical systems and control? (2) What challenges do educators face in teaching mechanical systems and control?

Also, Nkwanyane and Monyuku, (2025) added that technology education is crucial in preparing learners for future innovation driven economies, emphasizing critical thinking and problem-solving abilities. Mechanical systems and control are essential components of this curriculum because they lay the framework for understanding automation, mechanics in everyday life and industry. Mechanical systems, which include the design and operation of machines and mechanisms, as well as control systems, which ensure that these mechanisms run efficiently and are critical topics for providing learners with 21st-century abilities (Smith & Jones, 2021). Arguably, in the context of technology subjects, PCK remains under-researched and critical when looking at technology education (Ndlovu & Mtshali, 2025; Nilsson & Karlsson, 2019). What we have known since is that when educators are teaching technology, they are mainly influenced by a lack of professional knowledge and out-of- field experience. Thus, the study of Mcambi (2022) proposed a continuous professional development programme for educators to gain knowledge and resources regarding technology. However, literature revealed various challenges which educators experience when dealing with PCK in technology. The challenges thus far are limited knowledge to aid concepts in technology, specifically Mechanical Systems and Control.

### 1.1 Theroretical Framework

To better understand the pedagogical approaches used by Technology educators to teach Mechanical Systems and Control, this study used Shulman's (1987) Pedagogical Content Knowledge (PCK) as its foundation. According to Shulman (1987), PCK is defined as knowing what makes learning specific topics simpler or more difficult. Thus, PCK was employed in this study to help educators understand mechanical systems and control. It also includes information that mixes subject matter and instructional knowledge (Shulman, 2007). This study focuses on the concept of PCK which concentrates on the understanding of subject matter link with appropriate instructional strategies and curriculum needs. Educators must have both conceptual knowledge of mechanical principles and a thorough understanding of how to teach these concepts in age-appropriate, contextually relevant ways. The study focuses on PCK and studies how educators blend content knowledge with practical tactics to make lessons interesting, clear and anchored in learners' real-world experiences (Kind, 2009). In accordance with this framework, the study looked at how educator's classroom decisions, planning, assessment methods and instructional choices reflect their PCK. This approach also allowed the researcher to discover both strengths and weaknesses in educators' knowledge of the relationship between mechanical content and learner cognition. Finally, adopting Shulman's (1987, 2007) PCK paradigm provides an effective instrument for investigating pedagogical methods in technology education. It enables a comprehensive understanding of the professional knowledge base upon which educators draw, which is especially important in STEM subjects such as mechanical systems and control, where conceptual clarity and instructional technique must be tightly intertwined for successful teaching and learning results.

## 2. Methods

This study used a qualitative approach to investigate the educational practices of grade 8 Technology educators who teach Mechanical Systems and Control. According to Cohen et al. (2018), a qualitative research approach is the systematic analysis of a social event in its natural setting, where people's experiences and behaviors are examined. Data were gathered by non-participant observations, semi-structured interviews, open-ended questionnaires and document analysis. To answer the research questions, the study employed an exploratory case study design (single case). Purposive sampling helped locate and choose technology educators in Madibeng Sub-District, Northwest Province, South Africa.

The study employed an exploratory case study, whereby the aim was to explore teaching mechanical systems and control in South African schools. According to Cohen, Manion and Morrison (2018) define an exploratory case as a methodological strategy that considers previously unexplored research difficulties. The exploratory case was used in this study to better understand difficulties that had not been adequately investigated, particularly in Madibeng Sub-District. The case study method enabled an examination of real-world classroom practices and their compatibility with curriculum objectives (Yin, 2021).

### 2.1 Participants

The study was based on (N=07) Grade 8 Technology educators in Madibeng Sub-District, Northwest Province. The schools that were selected fall under the same location where the researcher resides. The researcher chose small sample size and neighboring schools due to the convenient time and resources. Participants are experts who have obtained a Bachelor of Education, Diploma in Teaching, Advanced Certificate in Education with Technology as a major subject and at least two years' experience. The inclusion criteria for the sampled educators were that they should be Grade 8 educators in the Bojanala, Madibeng sub-district. The exclusion criteria were that all educators of technology not teaching Mechanical Systems and Control in Grade 8 were excluded.

**2.2 Data Analysis**

This study used deductive theme analysis as its major method for assessing qualitative data, guided by Azungah (2018) paradigm. Deductive analysis includes coding data using pre-existing theoretical constructs, in this case Pedagogical Content Knowledge (Shulman, 1987) to investigate how educators methods match with specific features of teaching mechanical systems and control. The themes that guided the investigation included instructional tactics, content representation, learner engagement, assessment practices and contextual adaptation. Thematic analysis followed Braun and Clarke (2021) six-phase technique, starting with data familiarization, which required regularly reading field notes, interview transcripts and questionnaire responses to get a thorough knowledge of educators' experiences. This step was crucial for detecting early trends and nuances in the data. The second phase, producing initial codes, involved meticulously structuring data extracts pertinent to the research topics and PCK framework. Coding was done manually, with text segments labelled to capture recurring aspects including instructional approaches, classroom interactions, the usage of examples and allusions to learner problems.

Data was gathered using three qualitative methods: nonparticipant observation, semi-structured interviews and open-ended questionnaires. Non-participant observations allowed the researcher to see authentic classroom interactions and instructional styles while preserving the natural learning environment. Observation notes were categorized for teacher demonstrations, questioning strategies, learner replies, and the usage of teaching aids or mechanical models. This supplied valuable contextual information about how mechanical systems and control were presented in practice. The third and fourth rounds of the investigation involved topic identification and review. These themes were examined and revised to ensure internal coherence and consistency with the research objectives. The fifth and sixth phases were spent developing and naming themes, followed by writing the report, which discussed each subject in connection to current literature and the PCK framework. The triangulation of data sources observations, interviews and questionnaires increased the reliability of findings, ensuring that interpretations were based on various forms of evidence. The thematic structure not only reflected trends in educators' practices, but it also provided explanatory power for comprehending the pedagogical choices that shape the teaching of mechanical systems and control in Madibeng classrooms. Refer to Table 1, on how data from multiple sources were triangulated and coded.

Table 1. Data triangulation and Thematic analysis process

| Data Source | Purpose and Contribution | Triangulation Approach |
|---|---|---|
| Non-participant Observations | Captured educators' real-time instructional practices, resource use and learner engagement | Compared with interview and document data to ensure consistency between enacted and stated pedagogical practices. |
| Semi-Structured Interviews | Explored educators' reflections, reasoning, and justifications for instructional choices. | Cross-checked with observations and documents to verify alignment between beliefs and practices. |
| Open-Ended Questionnaires | Gathered broader perspectives from multiple participants on challenges and approaches in teaching | Used to validate and enrich emerging patterns identified from interviews and observations. |

| Data Source | Purpose and Contribution | Triangulation Approach |
|---|---|---|
| | Mechanical Systems and Control. | |
| Document Analysis (lesson plans) | Examined evidence of educators' planning and assessment alignment with the Technology curriculum. | Integrated with observation and interview data to confirm consistency of planning. |
| Cross-Source Integration | Combined insights from all four sources to form a holistic understanding of teaching practices. | Identified convergence and divergence across data for methodological triangulation. |
| Final Analysis and Reporting | Produced an interpretive narrative linking empirical findings to PCK theory. | Drew on evidence from all triangulated sources to ensure trustworthiness. |

### 2.3 Trustworthiness of the Study

To ensure the reliability of this qualitative study, procedures were implemented to address the four criteria defined by Lincoln and Guba (1985): credibility, dependability, confirmability and transferability. Credibility was accomplished through data triangulation, which included non-participant observations, semi-structured interviews, open-ended questionnaires and document analysis that allowed for diverse viewpoints on educators' educational techniques. Member checking was used to ensure the accuracy of interview transcripts and interpretations with participants and extended participation in the research setting helped to create trust and familiarity. Dependability was assured by keeping a complete audit trail of the study process, which included data gathering phases, coding techniques and theme development. A consistent interview guide and observation protocol further supported methodological consistency (Creswell & Poth, 2018). Confirmability was increased by reflexive journaling, in which the researcher actively recorded and reflected on personal biases, decisions and assumptions to ensure that findings were based on participant accounts rather than researcher interpretations. Raw data, including transcripts and field notes, were saved to enable for external auditing of the study's conclusions. Transferability was enhanced by providing detailed descriptions of the Madibeng school environment, participants and classroom dynamics. These contextual factors assist readers in determining if the findings may be applied to comparable situations. Together, these measures strengthened the study's methodological rigor and trustworthiness (Shenton, 2004).

### 2.4 Ethical Considerations

Prior to beginning data collection, the relevant institutional review board provided ethical clearance. Participation was fully voluntary and all educators provided informed consent after explaining the study's goal, procedures and potential dangers. Participants were informed of their freedom to withdraw at any time without penalty. To guarantee anonymity and confidentiality, pseudonyms were employed and all data was securely stored and accessible only to the researcher. Furthermore, approval to conduct the research was secured from the North West Department of Education and the school management teams concerned. These safeguards guaranteed that the study followed acknowledged ethical guidelines for qualitative research (Creswell & Poth, 2018; Cohen et al., 2018).

## 3. Result and Discussion

This section provides the findings of the study obtained from non-participant observations, semi-structured interviews, open-ended questionnaires and document analysis. The following are the themes that emerged from (RQ1) What teaching strategies do Grade 8 educators use for mechanical systems and control? (RQ2) What challenges do educators face in teaching mechanical systems and control? In line with the strategies used by educators, it emerged that educators created scenario and how they did that is unpacked below.

### 3.1 Result

#### 3.1.1 Create Scenarios for Learners in Order to Enact Prior Knowledge

Scenarios in Technology subject are a norm in that learners are always given a problem to solve. This could be a problem where a blind person wants to use a cup of tea and learners should come with a solution on how the blind person could get indication that his or her cup is full. Teachers present such scenarios to learners to enact critical thinking, content engagement and design capabilities (Mtshali et al., 2021). Nevertheless, this is how educators enacted prior knowledge to their learners.

Educator A used an educator-centred strategy and standard textbooks. There was no collaborative approach, and learners were still unable to match anything to the curriculum. As a result, learners were unable to create connection between what the teacher said with their existing knowledge. The lesson led in Educator A being active alone in the lesson. The Educator began the class by asking learners to define levers; while they were still confused, he produced scenarios to remind them of what the notion might be about. As a researcher, I noticed that the learners in the classroom appeared disorganized and largely confused because of the teacher's pedagogical knowledge shortcoming. When one learner asked the educator, *"Can I categorize a scissor as a first-class lever?"* the educator responded, *"Yes, it is a first-class lever."* From these two responses, one can see that the leaner was trying to signal the teacher on their confusion of the present lesson. Moreover, while the learner asked the question from the perspective of prior knowledge, there was a need for the educator to elaborate.

Educator B presented the three sorts of levers and provided worksheets for categorizing each example as a first-class lever, a secondary lever or a third-class lever. The researcher noted a challenge in Educator B's lesson: while scenario-based learning can help learners, he did not design the scenario in simple terms. Educator C was able to describe how mechanical advantage is obtained, also how the fulcrum, effort and load relate to first-class levers. The worksheet exercise which required learners to apply these ideas by identifying lever components and describing how mechanical advantage is obtained, served to reinforce this as observed by the researcher.

Educator D took a learner-centered approach, presenting a realistic scenario in which a man utilizes a ramp and a pulley to transport a large package. This inquiry-based method was particularly helpful in activating learners' prior knowledge and fostering deeper thinking. Through open discussion, learners were invited to explain how such mechanical devices reduce effort, allowing the educator to expose the learners intuitive understanding of mechanical advantage. Educator E's lesson was based on a real-world problem-solving scenario: *'You wish to lift water from a deep hole without using electricity. How will you use your knowledge of systems?"* This strategy instantly engaged learners by simulating a true mechanical challenge that was complex and motivating them to apply prior knowledge. Educator F used a thoughtful instructional strategy by integrating existing knowledge to new concepts in mechanical systems and control using story and analogies. He began the lesson with a story about how cranes are used to lift massive loads on construction sites, piquing learners' interest with a real-life example.

Educator G's teaching strategy focused on making learning relevant by relating mechanical systems to the learners' daily lives. During the lesson, the educator asked learners to list tools they frequently used at home such as door handles, bottle openers and scissors. This method is consistent with constructivist ideas, which allow learners to build new knowledge on previous experiences (Mpofu & Khoza, 2020). This method exhibits an understanding of the significance of contextual relevance in technology education, even if the execution lacked technical depth. Moreover, it encourages classroom discourse, which is still a limping exercise in most technology subject classrooms (Mtshali, 2024). It is not surprising that most technology teachers lack PCK, Gumbo (2023) stated that most of these teachers do not have a good grasp of what constitutes a technology teacher PCK in that the current assessment standards and curriculum structure is outcomes driven and do not assist teachers to develop their pedagogical and professional craft as educators.

### 3.1.2 Create Scenarios for Learners in Order to Enact Prior Knowledge

Educator A stated that ''I prepare my lessons using the annual teaching plan, prescribed textbook and worksheets which I give my learners.''

Educator B stated that ''The lessons which I prepare are mostly the ones which are challenging for learners. I consult the CAPS document for proper planning and outline the objectives which I wish to obtain.''

Educator C stated that ''By identifying learning objectives and plan to assess learners understanding for specific learning activities''

Educator D stated that ''It is difficult to integrate sufficient hands-on approach to illustrate the defined concepts and catering for different learning needs.''

Educator E stated that ''Proper tools to aid the concept as I normally use what is stated on the textbook.''

Educator F stated that ''The challenges which I normally face includes not receiving a developmental program which will assist in learning new ways to make the topic interesting and making it easier for learners to grasp.''

Educator G stated that ''I consult the CAPS document to align the lesson with lesson aims and objectives. Think of how to link the lesson with prior knowledge''

According to the results of the open-ended questionnaires, technology educators in grade 8 believe that practical work is an essential teaching strategy for mechanical systems and control. The majority of educators concur that practical exercises like constructing models, giving demonstrations and letting learners handle components greatly increase learner engagement. However, time constraints, lack of resources and an absence of systematic reflection frequently restrict these advantages. These reflected gaps in both Content Knowledge (CK) and Pedagogical Content Knowledge (PCK) since educators often relied on trial-and-error learning or design assignments but struggle to reinforce the underlying mechanical concepts (Rollnick & Mavhunga, 2022). These results provide credence to the notion that, even while experience learning boosts motivation, deep learning requires systematic feedback and targeted concept checking (Herrmann & Kollmannsberger, 2024).

Another important discovery was that educators largely used curricular materials and textbooks as structural manuals rather than all-inclusive teaching resources. It is interesting to note that Bean and Melzer (2021) see no harm in that practice since textbooks give leaners a reference point to their learning and provide authenticity to content knowledge. A fair argument can still be retained that no matter how organized content knowledge is, if the lesson delivery (pedagogical knowledge) is confusing to leaners, there can never be satisfactory learning outcomes (Msimango, Mtshali & Khoza, 2024). Interestingly, the Curriculum and Assessment Policy Statement (CAPS) and textbooks shortcomings were criticized by many educators, who pointed out that they lacked useful advice, cultural relevance and contextual appropriateness. These sentiments resonate with Ankiewicz, (2021) who maintain that the Technology curriculum should continue to be revised in order to resonate with current technological problems. It is for this reason that Mtshali and Singh-Pillay (2024) called for an urgent curriculum restructure and reinforcement of teacher pedagogical autonomy in order technology concepts that respond to the contemporary industrial demands. In order to better meet the requirements of their learners, a number of educators modify or add to existing resources using original content, online simulations or real-world comparisons. As educators work to convert abstract mechanical principles into approachable classroom experiences, this reflective use of instructional resources demonstrates differing levels of PCK development (Moodley & Aronstam, 2016). Refer to the summarized data in Table 2.

Table 2. Summary of Emergent Themes on Pedagogical Practices

| Main themes | Description | Educator insights |
|---|---|---|
| Creating scenarios for learners to enact prior knowledge | Educators design classroom activities that connect new Mechanical Systems concepts to learners’ prior experiences and everyday contexts. | Teachers reported using relatable examples (e.g., bicycle gears, pulleys in school gates) to stimulate learners’ recall of familiar systems |
| Using various methods to prepare lessons | Teachers employ multiple instructional strategies and resources (demonstrations and group discussions) to engage learners with abstract concepts. | Participants indicated using practical demonstrations and improvised materials to simplify complex mechanical processes. |

### 3.2 Discussion

One of the common practices used by educators in mechanical systems and control lessons was textbooks. This looked to be more compliance-driven than pedagogically transformative. The content of mechanical systems in technology can sometimes become confusing, especially when only one source of content is used. A study by Ndwandwe et al. (2024) reflects that smartboards are effective in explaining lever classes because they give leaners extended knowledge through coloured pictures and videos that provide context. Even though most schools are heavily reliant on textbooks to enact their curriculum and content knowledge, the current learners in our schools are digital citizens and using their social platforms to engage with content can advance engagement with relevant and timely mechanical systems and control content. While some educators altered resources to meet the requirements of their learners through translated notes, improvised materials, or multimedia, many found the CAPS document too abstract and the textbooks too inflexible or simplistic. Molapo (2024) agrees that educators differ in how they enact the CAPS Guidelines in the classroom and the principal cause is that they are not always keen to consult the policy documents for better implementation of their teaching. Based on the findings, it shows that teachers’ PCK demise is caused by insufficient understanding and consultation of official policy documents such as CAPS.

The capacity to bridge the gap between mandatory content and learner-friendly pedagogy has emerged as an important indicator of advanced PCK (Estaji & Sanajou, 2024). Educators who were reflective and adaptive, such as Educators E and F, were better able to modify instruction to their learners' linguistic, cognitive and sociocultural contexts. Blose and Gumbo. (2024) stresses the need to develop a framework that would assist in integrating social imperative and indigenous knowledge systems in technology in order to align with the sustainable development principles.

Hence, it was good to see Educator E and F teaching towards achieving sustainable development goals. Demonstration emerged as another widely used method, especially when educators had access to basic tools or improvised teaching aids. According to Herlambang et al. (2024) is prevalent in vocational technology classroom because educators actively show learners how to perform a task and understand concepts simultaneously. However, this happens well when teachers PCK is in good standing. This method emphasizes visual learning, allowing students to observe the process in real-time, which can enhance understanding and retention (Zhang, 2024). These demonstrations, though often limited by the availability of physical resources, allowed educators to visually illustrate mechanical movement and mechanical advantage.

Group work and learner discussions were also observed in some classrooms, although these were used inconsistently and often lacked clear facilitation or guidance. Group work is often viewed as a good PCK trait because an educator monitors the instructional climate as learners develop confidence in their own ideas (Vettriselvan et al., 2025). Educators across all participating schools reported a number of challenges that hindered effective teaching of mechanical systems and control. A major concern was the lack of teaching resources, including mechanical kits, demonstration models and practical tools. These findings reflect the constant challenges in technology classroom that hinders effective implementation of teacher pedagogy. For instance, a study by Mjobo et al. (2025) posit that teachers' PCK can be greatly affected by the lack of adequate teaching and learning resources and subsequently negatively impact on learner outcomes. Without adequate resources, educators find it difficult to translate abstract mechanical concepts into tangible learning experiences. The absence of functioning workshops or dedicated Technology classrooms in some schools further limited opportunities for hands-on learning and compromised teachers' PCK.

Another recurring challenge was the limited pedagogical content knowledge among some educators. While most had a general understanding of the curriculum, they struggled to break down complex concepts or respond to learners' misconceptions, particularly in topics involving mechanical advantage or system integration. Similar sentiments were observed by Magolego et al. (2024) where they discovered that often technology teachers struggled to deliver content to learners because most of them were underqualified to teach the subject. This often resulted in superficial teaching that focused on memorization rather than conceptual understanding. In summary, while educators demonstrated commitment to covering the content, their teaching strategies were constrained by systemic challenges including resource limitations, insufficient trait teaching strategies and school-level barriers. These findings highlight the need for targeted support to enhance educators' capacity to teach mechanical systems and control in a way that is both practical and conceptually meaningful. And so, a pedagogical capital framework that currently exist in literature could be modified to address the method of teaching mechanics concepts.

This section displays the findings of the data analysis, with a focus on participant demographics and the testing of research hypotheses. Table I shows the distribution of Business Studies teachers who took part in the survey. Ninety-five (65%) and 48 (35%) of the responders were female. Age-wise, 94 teachers (68%), were in the 47–60 age range, with 41 teachers (23%) being between the ages of 36 and 46 and 13 teachers (9%) being between the ages of 25 and 35. With respect to work experience, 95 teachers (69%) had between 21 and 35 years of experience, 7 teachers (5%) had between 6 and 10 years, 26 teachers (19%) had between 11 and 20 years, and 10 teachers (7%) had less than 6 years.

## 4. Conclusion

The study emphasizes that while Grade 8 educators are eager to engage learners through practical and accessible teaching practices, variations in CK and PCK restrict the efficiency of these methods. To improve teaching quality in Mechanical Systems and Control, professional development should focus not only on increasing mechanical subject understanding but also on improving educators' ability to portray this knowledge pedagogically. A hybrid approach that blends real-world context, interactive learning and explicit conceptual reinforcement would help learners grasp more deeply and meaningfully. However, the scope and usefulness of these approaches varied significantly among educators. Some educators used interactive techniques to engage learners, but others relied mostly on textbook knowledge and educator explanations. The majority of educators used the CAPS document for subject organization but did not fully include curriculum objectives into their lesson plans, whilst some did not have lesson plans. Educators reported encountering a variety of obstacles, including a lack of time, resources, overcrowding and insufficient professional development. The overall nature of mechanical systems and control was also considered as a problem for learners to successfully comprehend the subject, especially in schools with restricted access to materials utilized for practicals and demonstration equipment.

### Conflicts of interest

The authors declare no conflict of interest regarding publication of the paper.

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