leadership Support: Enhancing Kenyan Junior School Teachers' Pedagogical Content Knowledge in STEM Education

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Abstract

All teachers require continuous professional development and support for effective teaching and learning. Many Kenyan Junior School teachers are novices, having been recently recruited, and therefore require support. This article presents findings from a study conducted by the Centre for Mathematics, Science and Technology (CEMASTEA) and Quality Assurance and Standards Officers (QASOs) in 20 counties in Kenya. The study examined the role of leadership-driven in enhancing junior school teachers' Pedagogical Content Knowledge (PCK) in STEM education. Aspects of the lesson evaluated included learner engagement, use of resources, and assessment. Data were collected through pre-and post-lesson observation and group discussion. Findings show that leadership support significantly improved teachers' use of resources, learner-centered pedagogy, and formative assessment practices. The study recommends institutionalizing school-based support mechanisms to ensure lasting impacts in STEM education.

Keywords: *Leadership support, Professional development, mentoring and support, STEM Education, Junior School, Lesson observation*

1.0 Introduction

Instructional leadership has proven as an important driver for enhancing teacher quality and improving learner outcomes, particularly in STEM subjects globally (Zhou et al., 2024). Fullan and Hargreaves (2020), as well as Darling-Hammond et al (2019), affirm that sustained leadership support practices such as lesson observation, mentoring, and coaching are influential drivers of teachers' professional growth. In well-performing countries such as Singapore, educational leaders frequently conduct structured collaborative lesson planning and feedback with teachers. These activities have resulted in measurable gains in STEM subjects learning (UNESCO, 2021). Additionally, Pesina (2025) contends that digital instructional mentorship and coaching highlight the effectiveness of leadership-led support networks in promoting teachers' professional growth.

Efforts to institutionalize leadership-led teacher support in Africa have gained a lot of support in Africa. Rwanda, South Africa, and Ghana, for example, have developed structures that have integrated education officers and school leaders into a structured mentoring and coaching system in school resources (Mabaso & Hirst,

2020). These initiatives promote reflective practice in STEM classrooms, inquiry-based learning, and effective use of learning. However, challenges in the implementation of such support initiatives have been reported, such as limited evaluation capacity among educators (Oduor & Mugambi, 2023).

Roll-out of the Competency-Based Curriculum (CBC) has seen intensified attention on instructional leadership. Indeed, policy frameworks such as the Ministry's Education Sector Plan (2023-2027), the 2023 National Education Strategic Plan emphasize the need for structured school-based leadership involvement. For novice junior school teachers, teaching STEM subjects has proved challenging, requiring structured mentorship and support from school leadership (CEMASTEA, 2023). CEMASTEA conducted nationwide training for 150 QASOs in 2025 and 358 QASOs in 2024. The trainings aimed to equip the QASOs with knowledge and skills to conduct lesson evaluation; support inquiries based learning and effective use of learning resources and promote reflective practice in STEM classrooms. This training was intended to enable the QASOs to provide ongoing pedagogical support to teachers in the classroom, thereby enhancing instructional quality and learner outcomes.

2.0 Problem Statement

Despite the importance of effective STEM education, Junior School (JS) teachers in Kenya face challenges in implementing learner-centred pedagogies and integrating ICT in their classrooms. These challenges hinder the successful realization of CBE objectives in STEM subjects and impact on learners' foundational understanding and interest in STEM fields. Without ongoing and support, these pedagogical gaps could persist, undermining the quality of STEM education and failing to prepare learners adequately for future academic and professional endeavors. This study aimed to address these gaps by evaluating the impact of structured leadership-led teacher monitoring and support on pedagogy and learner engagement in Junior STEM classrooms in Kenya.

3.0 Literature Review

Research has demonstrated the importance of Teachers' Professional Development globally (TPD) (Ansyari et al.2022; Popkewitz et al., 2021; Zhang et. 2024). Darling-Hammond et al. (2017), for example, noted that mentoring and support interventions are effective strategies in improving teachers' Pedagogical Content Knowledge (PCK). Fullan (2016) also observed that sustained support assists teachers in adopting new curricula. Specifically, supporting the integration of learner-centred pedagogies

enhances learner achievement (Bybee, 2014).

The findings of a study conducted by Mabaso and Hirst (2020) in South Africa found that mentoring is an effective component of professional development for effective teachers. They recommended support of student teachers by mentors in order to develop the necessary skills and competencies required of a professional teacher. The findings of a study conducted in Kenya on principals' instructional leadership and its influence on students' academic achievement (Gatama et al., 2023) showed that instructional leadership is positively and significantly related to students' academic achievement. The two dimensions of instructional leadership that had the largest effects were promoting teacher support through capacity building and the strategic provision of instructional materials. The study recommended the need to priorities instructional leadership in schools to promote learner academic achievement. This school-level monitoring and support study reported in this paper was informed by findings from the Junior School (JS) baseline research (2023). It was also guided by gaps identified during the April/May, 2023 training of the JS teachers both conducted by CEMASTEA.

The study reported in this paper builds on empirical evidence of impact of leadership-driven and structured feedback from this literature.

4.0 Research Methodology

The study employed a quasi-experimental design to assess the impact of leadership support in enhancing Junior School teachers' pedagogical content knowledge. Specifically, a quasi-experimental pre-posttest design with a single group was adopted. The choice of this design was due to its flexibility in researching natural setting such as schools in this study. According Creswell and Creswell (2018) Quasi-experiments are useful in school-based research where the researchers work within the school natural settings. The design also allowed all the learners from the sampled classes to benefit from the intervention, in this study improved lesson delivery by the supported teachers. Indeed, Fraenkel et al. (2019) noted that quasi-experimental designs are ethical in education research compared to experimental since they provide equal treatment to research participants.

4.1 Objectives of the monitoring and support study

The study sought to determine the effects of leadership-led, school-based monitoring and support on Junior School teachers' Pedagogical Content Knowledge (PCK) in STEM education. The specific objectives were to:

i. Measure changes in teachers' lesson planning quality before and after receiving structured leadership support.

ii. Evaluate improvements in learner engagement resulting from the adoption of learner-centred teaching strategies promoted during the support process.

iii. Assess the extent of change in teachers' use of instructional resources following leadership-led pedagogical guidance.

iv. Determine the improvement in teachers' application of formative assessment strategies after participating in the support initiative.

4.2 Sample and sampling procedures

The study employed a multi-stage, stratified sampling procedure (Creswell & Creswell, 2019). This ensured that all eight regions were represented and also ensured coverage of diverse JS teaching contexts across Kenya as follows:.

1. In the first stage, 12 counties were randomly selected from all the regions of Kenya. Since this was the second phase of the CEMASTEA monitoring and support initiative, the counties that were involved in phase one were excluded.
2. Two sub-counties were randomly selected from 12 counties in the second stage.
3. At the third stage, one school was purposively selected based on the availability of STEM JS teachers. At least two JS teachers who have previously attended CEMASTEA trainings were randomly selected in those schools.

This stratified and purposive sampling procedure ensured that the sample was representative.

4.3 Participants

A total of 46 teachers across 20 counties were observed and supported, 24 males and 22 females. Figure 1 shows percentage of teachers observed by gender.

Figure 1: Number of teachers observed by gender

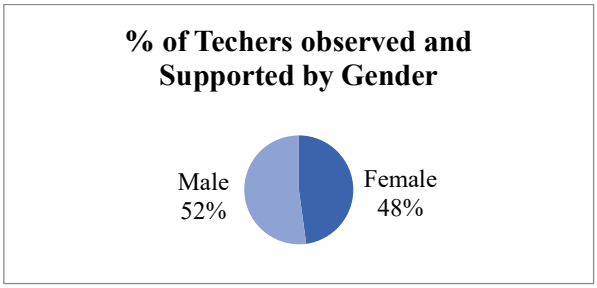

Figure 1 shows that out of the 46 teachers observed, 52% were males and 48%, indicating a relatively balanced gender representation.

4.4 Monitoring and support tools

Two tools were employed to gather data during the school-level monitoring and support exercise. These were:

(a) *Lesson observation tool*

This was the primary tool used in data collection. It evaluated lesson planning and key aspects of lesson delivery. The aspects of lesson delivery included lesson planning, utilization of both locally available and virtual resources, learner-centeredness of the lesson, CBC aspects, and formative assessment. The rating was based on a scale of 1-5 with the following key: 1- Very Poor, 2- Poor, 3- Fair, 4- Good, and 5- Very Good.

(b) *Post lesson discussion guide*

The post-lesson discussion tool was used to provide guidance on how to conduct post-lesson discussion. It focused on learner-centered strategies used in the lesson, resources, assessment, attainment of learning outcomes and further guidance

5.0 Data Collection

Each monitoring and support team was composed of two CEMASTEA staff and the quality assurance and standards officers (QASOs) in the county. As instructional leaders, they observed lesson 1 (Raw lesson) prepared by the teacher without their input. After lesson 1, both the teacher and the observer reflected on the lesson and suggested areas of improvement.

A subsequent lesson 2 was planned by the teacher with the support of the instructional leaders, guided by the suggested areas of improvement from lesson 1. Lesson 2 was then implemented by the teacher. This lesson was observed, and further areas of improvement were suggested by both the teacher and the instructional leaders.

After lesson 2, a feedback session for all the JS teachers, the HOI, and the observers was conducted. In this session, participants reflected on the entire support process. They were also given further support on virtual laboratories, improvisation of learning resources and how to establish communities of practice. The school leaders and senior teachers were advised to continue supporting the JS teachers and establish a community of practice in their schools.

6.0 Data Analysis

An explanatory sequential mixed

approach of data analysis was employed (Frontiers et. al. (2025). In this approach, quantitative data (pre- and post-test lesson observation scores) are analyzed first, and then qualitative data (teachers' reflections and the instructional leaders' comments regarding the support initiative). This triangulated approach enhanced the research rigor and allowed for a comprehensive understanding of the monitoring and support initiative (Kawar et al., 2024).

Quantitative data analysis involved a comparative analysis of scores from both the first and second lessons. The scores were based on a 5-point scale, with 5 indicating excellent performance, 4 good, 3 satisfactory, 2 needs improvement, and 1 poor. Mean scores for the observed lesson aspects were calculated for the two lessons ('before' and 'after' support).

Qualitative data from the teachers' reflections and the instructional leaders' comments were analyzed thematically to capture their perceptions and experiences regarding the support initiatives.

7.0 Findings and Discussions

All the observed aspects registered a significant increase in mean score as shown in Table 1.

Table 1: Comparative Analysis of Lesson Scores

Lesson Aspect	Mean Score	
	Before Support	After Support
Lesson Planning	3.2	4.5
Learner Engagement	2.8	4.3
Use of Resources	3.0	4.6
Assessment Strategies	2.7	4.2

7.1 Lesson planning

Regarding lesson planning, despite the fact that most teachers had prepared lesson plans, many were sketchy and lacked evidence of mainstreaming essential components of CBC, such as core competencies. After the support, there was a significant increase in the mean score for this aspect (from 3.2 to 4.5), suggesting that the support initiatives empowered the teachers' ability to plan lessons. Research studies have resonated with this finding. Oner (2010) found that peer coaching

significantly improved lesson planning and classroom implementation for 12 teachers using digital storytelling of 12 teachers in Turkey. Zewude and Borko (2024) also, in their scoping review, found that inquiry-based professional development involving mentors and peer planning led to a positive shift towards more deliberate planning and increased confidence in lesson planning.

7.2 Learner Engagement

The improvement in learner engagement is reflected in the rise in mean score from 2.8 to 4.3, suggesting that the support initiatives empowered the teachers' ability to conduct learner-centered lessons. Before the support, learner engagement was partially evident, with some teachers involving learners in group, pair, or individual activities. However, these efforts often lacked inclusivity since demonstrations were conducted by the teacher or one learner. Group work was rushed and lacked adequate teacher guidance. After the support, teachers adopted more effective learner-centered strategies. Learners participated in well-structured group discussions, presented their work, received clear guidance from and the teacher used their ideas to reinforce concepts.

However, despite these improvements, some gaps persisted. A few teachers still **did not consistently ask learners questions**, which limited opportunities for learners to **think critically, reflect, and verbally articulate their understanding**—key aspects of engagement and formative assessment in CBC.

Research findings support this observed improvement in learner engagement following teacher support. Guo et al. (2025) affirmed that supportive teaching practices, such as giving learners clear instructions and allowing classroom participation, enhance learner engagement and learning outcomes. In Kenya, Gatundu et al. (2023) found that learner engagement positively influenced learners' academic achievement and self-efficacy. These engagements included individual attention, encouragement and supervision. Taye and Tadesse (2024) in Ethiopia demonstrated that cooperative learning approaches led to an increase in learner motivation and active participation in the classroom. Overall, Ndebele and Legg-Jack (2022) recommended that student teachers should be supported to enable them to achieve their mandate of impacting knowledge and skills among young learners.

7.3 Use of Resources

The use of instructional resources recorded the highest increase in score,

from 3.0 to 4.6. It is therefore evident that school-based support initiatives similar to ones reported in this study empower teachers to utilize learning resources effectively.

Research studies have shown that individualized instructional coaching by heads of departments significantly improved teachers' confidence and capacity to select and use context-appropriate instructional materials (Were & Muthoni, 2023). Pedagogical leadership through lesson observation and feedback enhances the quality and diversity of instructional materials used in STEM subjects (Kariuki &Ochieng, 2022).

Nguyen et al. (2021) in their study found that school-based professional learning communities and one-on-one mentorship led to better integration of instructional materials in lesson planning and delivery. Reeves and Liou (2022) further emphasized that instructional leadership that includes individualized teacher support and resource modeling fosters more meaningful classroom application of teaching aids and digital tools. In sub-Saharan Africa, Tebele and Mugisha (2021) noted that in-school mentoring models are more effective than workshop-based training in equipping teachers with practical skills to adapt and use instructional materials.

These studies collectively affirm that school-based, personalized support from pedagogical leaders plays a crucial role in strengthening teachers' ability to meaningfully incorporate instructional resources into the learning process.

7.4 Assessment Strategies

The use of assessment strategies recorded a significant improvement, with the score increasing from 2.7 to 4.2. This suggests that the school-based support, particularly the individualized engagement with pedagogical leaders, enhanced teachers' ability to implement more effective and learner-centered assessment approaches. This finding is consistent with the literature that emphasizes the influence of personalized instructional support on teachers' formative assessment practices.

In Kenya, **Njeri and Atambo (2023)** found that school-based instructional coaching significantly improved teachers' ability to design and administer formative assessments that align with competency-based learning outcomes. Likewise, **Mwakubo and Maina (2022)** observed that continuous pedagogical support from departmental heads led to increased teacher confidence in using varied assessment tools, including rubrics, peer assessment, and reflective journals.

Regionally, **Adusei and Boateng (2021)** in Ghana reported that teachers who participated in school-level communities of practice demonstrated improved capacity in providing constructive

feedback and adapting assessments based on learner needs. Internationally, **Cilliers et al. (2022)** conducted a study in South Africa and found that personalized, in-school teacher support led to sustained improvement in assessment literacy, especially in how teachers interpreted evidence of learning to inform instruction. In Southeast Asia, **Tran and Pham (2021)** showed that mentoring and lesson observation cycles helped teachers adopt more diagnostic and continuous assessment techniques in their classrooms.

These findings support the observed gains in the use of assessment strategies, indicating that school-embedded support from pedagogical leaders plays a key role in enhancing teachers' capacity to apply assessment not just for grading, but as a tool for improving learning.

8.0 Conclusion and Recommendations

8.1 Conclusion

This study confirms that leadership-led, school-based support significantly enhances Junior School teachers' pedagogical content knowledge, particularly in lesson planning, learner engagement, use of instructional resources, and assessment practices. Structured, one-on-one engagements with pedagogical leaders, such as Quality Assurance and Standards Officers (QASOs), were shown to effectively build teachers' capacity to implement learner-centred and competency-based teaching. The evidence supports the view that sustained, context-specific, and in-school professional development is more impactful than external or workshop-based approaches in supporting effective curriculum implementation.

8.2 Recommendations

It is recommended that school-based support for teachers be formalized to ensure sustained and structured mentorship. Efforts should also be made to establish simple monitoring systems that help in tracking progress and improving the effectiveness of these support initiatives.

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