Toward Synergistic Enactment: A Multi-Stakeholder Framework for Physical Science Curriculum Implementation

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ABSTRACT

This article addresses the persistent gap between policy aspirations and pedagogical actualities within the Physical Science syllabus for Grades 8 and 9 by proposing an empirically grounded multi-stakeholder framework for curriculum implementation. Drawing on a qualitative critical-hermeneutic study conducted in three northern regions (Oshana, Ohangwena, and Oshikoto) of Namibia, the research engaged 33 participants, including policymakers, curriculum developers, Senior Education Officers, inspectors of education, teachers, learners, and parents. The study addressed four objectives: to examine stakeholders' lived experiences in Physical Science curriculum implementation in Namibia's selected junior secondary schools; to understand the strategies employed by different stakeholders in the implementation of the Physical Science curriculum; to identify the challenges encountered in the implementation of the Physical Science curriculum; and to develop a multi-stakeholder framework that can strengthen the effective implementation of the Physical Science curriculum in Namibia. Data were collected through hermeneutic interviews, focus group discussions, classroom observations, and document analysis. The findings reveal that existing implementation efforts are characterised by stakeholders working in isolation, teachers finding their own ways without sharing them, limited communication between groups, and inadequate support. In response, the study proposes a Multi-Stakeholder Framework comprising four interconnected pillars: Collaborative Engagement, Context-Sensitive Pedagogical Support, Innovation and Adaptation, and Feedback and Monitoring, anchored by a Hermeneutic Core of collaborative meaning-making. This framework provides a practical approach for transforming isolated efforts into coordinated action. Importantly, while the framework is empirically derived from study's qualitative findings, it requires further validation through implementation studies. The article contributes to curriculum theory by demonstrating how ecological systems theory and hermeneutic philosophy can be integrated to understand and improve curriculum implementation in resource-constrained contexts.

Keywords: Curriculum implementation, multi-stakeholder framework, Physical Science, Namibia, hermeneutic-ecological approach

INTRODUCTION

The translation of subject curriculum policy into classroom practice represents one of education's most persistent challenges, particularly in developing countries where resource constraints magnify the gap between policy aspiration and reality (Sepadi & Moshia, 2025). In Namibia, the National Curriculum for Basic Education articulates a vision of learner-centred, inquiry-based science education designed to develop scientific literacy and prepare learners for STEM careers essential to national development (MoEAC, 2016). Yet, as multiple studies have documented, the enactment of this vision falls significantly short in many classrooms, particularly in rural and semi-urban schools where laboratories, equipment, textbooks, and qualified teachers remain scarce (Nghipondoka & Shikongo, 2019; Mushelenga, 2020; Shivolo, 2024).

Physical Science in Grades 8 and 9 has two parts: one covers foundational concepts in chemistry (matter, chemical reactions, atomic structure, and so on), and the second covers physics (forces, energy, electricity, and so on). There is also a topic on scientific process (more on scientific inquiry) dealing with experimental design, measurement, and data interpretation. These topics present unique curriculum implementation challenges distinct from other subjects, as they require practical investigations, laboratory materials and equipment, laboratory safety protocols, and the development of abstract conceptual understanding that builds sequentially. Furthermore, the Physical Science curriculum for Grades 8 and 9 requires learners to: use and organise techniques, apparatus and materials; observe, measure and record; handle, process and evaluate experimental observations and data and plan investigations (MoEAC, 2016).

However, the practical and abstract nature of Physical Science makes it particularly challenging due to resource constraints. While economics studies, languages, or social studies teachers might improvise their lesson presentations, science teachers cannot fully implement inquiry-based pedagogy in the absence of laboratory equipment. This article addresses these science- specific challenges.

While considerable research has focused on documenting these implementation challenges, far less attention has been directed toward developing systematic frameworks for addressing them. Existing studies tend to identify problems—resource shortages, inadequate teacher training, language barriers—without offering integrated solutions that account for the complex interactions among stakeholders across the education system (Nginga, 2025; Moses et al., 2024). This gap is particularly significant in the Physical Science Grades 8 and 9 curriculum, where practical experimentation and conceptual understanding demand conditions that many Namibian schools cannot provide.

The present study addresses this gap by developing an empirically grounded multi-stakeholder framework for strengthening Physical Science curriculum implementation in Grades 8 and 9. Drawing on Bronfenbrenner's Ecological Systems Theory (1979) and Ricoeur's Hermeneutic Philosophy (1981), the research examines how multiple stakeholders—policymakers, curriculum developers, Senior Education Officers, inspectors of education, teachers, learners, and parents—experience, interpret, and enact the curriculum within their specific contexts. The study addresses four research objectives: (1) examining stakeholders lived experiences, (2) understanding implementation strategies, (3) identifying challenges encountered, and (4) developing a framework for effective implementation.

The article contributes to knowledge in three ways. First, it provides a comprehensive, multi-perspective analysis of Physical Science curriculum implementation that moves beyond teacher-focused studies to include the full range of stakeholders. Second, it integrates ecological and hermeneutic theoretical lenses to reveal how implementation is shaped by both structural conditions and interpretive processes. Third, it proposes a practical, evidence-based framework that can guide policy and practice in Namibia and comparable contexts across sub-Saharan Africa.

LITERATURE REVIEW

Theoretical Foundation

This study is grounded in two complementary theoretical traditions that together provide a comprehensive lens for understanding curriculum implementation.

Bronfenbrenner's Ecological Systems Theory (1979) conceptualises human development as shaped by multiple nested environmental systems. The microsystem represents the immediate environment where direct interaction occurs—the classroom where teachers and learners interact daily. The mesosystem encompasses the relationships between home and school (parents and teachers), capturing how these environments influence each other. The exosystem includes broader institutional structures such as education offices (inspectors of education, Senior Education Officers) and funding mechanisms that affect the learner indirectly. The macrosystem comprises national policies, cultural values, and ideological patterns that define what constitutes a valuable education. The chronosystem accounts for changes over time as curricula are updated and teaching practices evolve. In this study, the ecological lens enables examination of how Physical Science curriculum implementation is influenced by interactions across all these levels.

Ricoeur's Hermeneutic Philosophy (1981) provides tools for understanding how stakeholders interpret and make meaning of the curriculum as a *"text."* His concept of pre-understanding acknowledges that curricula carry the intentions and assumptions of their developers. His concept of over-understanding recognises that meaning is actively constructed by readers—in this case, educators and other stakeholders—who interpret the curriculum through the lens of their own contexts and experiences. His concept of distanciation names the inevitable gap between policy intentions and classroom realities. Together, these concepts illuminate the interpretive labour through which policies become practice.

The integration of these frameworks offers a powerful analytical lens. Bronfenbrenner helps answer the question of where implementation occurs (environment structure), mapping the structural terrain within which stakeholders work. Ricoeur helps answer the question of how people in those contexts make meaning within those structures, illuminating the interpretive processes through which policies are enacted. This integration positions curriculum implementation as neither simple policy execution nor free interpretation, but rather the interpretive work of situated agents within a layered and often contradictory system.

The science education research engaged identifies particular challenges in Physical Science implementation that distinguish it from other subjects. Recent studies confirm that conceptual understanding in Physical Science is facilitated by practical experience and inquiry-based instruction (Sharpe & Abrahams, 2020; Shivolo & Mokiwa, 2024), without which learners struggle with abstract concepts like chemical bonding, electric circuits, and force dynamics. In addition, Physical Science knowledge is cumulative, and interruptions in this sequence create gaps that compound over time; Mudadigwa (2023) found that the South African Physical Science curriculum shows gaps in conceptual progression that compromise its intended spiral structure, while Mkandawire et al. (2026) identified that insufficient instructional time compounded by curriculum demands weakens learner engagement in physics education. Furthermore, the specialized vocabulary of Physical Science and commanding words used in questions such as analyse, describe, determine, evaluate, explain, estimate, discuss, and outline present significant barriers for second-language learners (Mavuru & Ramnarain, 2019; Shubani & Mavuru, 2022), and in Namibia, where English is a second language for most learners, these linguistic demands compound conceptual challenges. These science-specific characteristics make curriculum implementation in Physical Science distinct from other subjects and require targeted frameworks.

International, Regional, and National Contexts

Globally, successful curriculum implementation in high-performing systems like Finland, Singapore, and Canada demonstrates strong alignment between curriculum design, teacher preparation, assessment, and classroom practice (Ramaila, 2020; Jack, 2025). These systems are characterised by coherent policy frameworks, sustained professional development, adequate resources, and collaborative stakeholder engagement (Gholam, 2019; Ladson-Billings et al., 2024). However, in many developing countries, implementation is constrained by overcrowded classrooms, inadequate resources, and underprepared teachers (Mabasa et al., 2024; Akakpo & Akakpo, 2025).

In Sub-Saharan Africa, these challenges are particularly acute. South African studies reveal that teachers often prioritise content coverage over learner comprehension due to resource constraints and limited pedagogical content knowledge (Mpungose, 2020; Akuma & Callaghan, 2020). Similar patterns are observed in Tanzania, Zambia, and Botswana, where limited professional development and weak links between curriculum content and real-world applications hamper implementation (Mtika & Gates, 2010; Kitta & Tilya, 2010; Thaba-Nkadimene, 2020).

Recent research emanating from Namibia confirms that the dissimilar challenges of Physical Science implementation, including the need for practical engagement and sequential concept building, are deepened by severe resource constraints and linguistic barriers. A study by Nginga and Kalengay (2025) identified a lack of teaching materials, inadequate laboratory infrastructure, and insufficient foundational knowledge from primary school as among the key factors contributing to poor performance. Similarly, Shivolo et al. (2024) evaluated practical work at a resource-constrained school and found that insufficient equipment and materials, limited laboratory space in schools, and overcrowded classrooms collectively impeded effective teaching, confirming that resource limitations directly undermine the experiential learning essential for conceptual understanding in the subject.

In Namibia, post-independence curriculum reforms have emphasised learner-centred pedagogy and practical engagement (MoEAC, 2016). However, implementation faces significant constraints: inadequate laboratories, limited teaching materials, insufficient teacher training, and language barriers in assessment (Nghipondoka & Shikongo, 2019; Mushelenga, 2020; Poti et al., 2022). These challenges are compounded by the historical legacy of apartheid education, which systematically excluded science education for indigenous Namibians (Amukugo, 1993; Josua et al., 2022). Research has documented that teacher professional development programmes often fail to address the contextual realities teachers face daily (Nakambale, 2018), and that teacher competence and curriculum quality must evolve together (Kanandjebo, 2022).

Literature Gaps

The review identified five significant gaps in existing research. First, a population gap: most studies focus exclusively on teachers, neglecting the perspectives of curriculum developers, inspectors, Senior Education Officers, learners, and parents (Matiki et al., 2023). Second, a geographical gap: research has concentrated on specific regions, leaving cross-regional patterns unexplored. Third, a contextual gap: studies examine isolated contexts rather than the intersections between them. Fourth, an empirical gap: while studies document problems, few develop integrative frameworks for systemic improvement. Fifth, a methodological gap: no existing Namibian study has integrated ecological systems theory with hermeneutic philosophy in a single analytical framework.

METHODOLOGY

Research Philosophy and Approach

This study employed a qualitative interpretive paradigm informed by critical hermeneutics (Ricoeur, 1981). This approach recognises that knowledge is socially constructed, context-dependent, and best understood through the meaning's individuals attribute to their experiences. The researcher approached curriculum implementation not as a detached observer documenting facts, but as an interpreter seeking to understand how different stakeholders make meaning of their experiences across ecological system levels.

Sampling and Participants

Purposive and snowball sampling techniques were used to select 33 participants across three northern regions of Namibia (Oshana, Ohangwena, and Oshikoto). Expert purposive sampling recruited participants whose positions shape curriculum work: policymakers, curriculum developers, Senior Education Officers, and inspectors of education. Snowball sampling, starting with teachers as gatekeepers, reached learners and parents. The final sample comprised 2 policymakers, 1 curriculum developer, 4 Senior Education Officers, 4 inspectors of education, 10 Physical Science teachers, 10 learners from Grades 8 and 9, and 2 parents.

The sample distribution reflects the realities of the education system and the logic of purposive qualitative sampling. Expert stakeholders such as policymakers and curriculum developers are fewer in number and also senior education officers, inspectors of educations are few in numbers, and it is worth mentioning that those holding these positions were purposively selected for their unique expertise. Teachers and learners, who are more numerous in the system, were sampled in larger numbers to capture the diversity of classroom experiences. However, it is acknowledged that the small number of parents (n=2) limits the depth of perspective from this group. It should be noted that only one curriculum developer is responsible for Physical Science nationally, and this individual was included in the study. The limited number of curriculum developers reflects the structure of the Namibian Education system rather than a a sampling limitation. Despite this limitation, the study's multi-stakeholder design provides a more comprehensive view than existing teacher-only studies.

Data Collection

Data were collected through multiple methods to facilitate triangulation. Hermeneutic interviews were conducted with all participant groups using semi-structured guides that encouraged open-ended, dialogical engagement. Focus group discussions with teachers examined common experiences, challenges, and teaching strategies.

Classroom observations documented actual teaching practices, capturing non-verbal cues, instructional strategies, and contextual factors. Document analysis of policy documents, curriculum guidelines, National Standards and Performance Indicator (NSPI), and assessment records provided contextual richness (Bowen, 2009).

Data Analysis

Data were analysed using hermeneutic and thematic analysis approaches. Following Ricoeur's (1981) hermeneutic philosophy, the analysis proceeded through three stages: naïve understanding—initial reading of transcripts to grasp the overall meaning of stakeholders' experiences; structural analysis—systematic examination to identify pre-understanding (assumptions stakeholders brought to their roles), over-understanding (how stakeholders actively constructed meaning beyond the written curriculum), and distanciation (gaps between policy intentions and classroom realities); and critical interpretation—integration of structural findings with Bronfenbrenner's ecological theory to understand how meaning-making occurs within systemic layers and how hermeneutic processes both shaped by were shaped by ecological conditions (Josephsson et al., 2022). Thematic analysis identified patterns, convergences, divergences, and emergent themes aligned with the research objectives (Nowell et al., 2017). While AI tools assisted in initial coding, all interpretations were guided and verified by the researcher to ensure contextual relevance and fidelity to participants' voices (Morgan, 2025).

In addition, AI tools (ChatGPT) were used as an initial coding assistant to generate preliminary codes from participants interview transcripts. This process involved: (1) submitting anonymised transcript excerpts to the AI with a standardised prompt requesting initial code identification; (2) reviewing all AI-generated codes against the raw data to verify accuracy and contextual appropriateness; (3) discarding, merging, or refining codes based on interpretive judgement; and (4) conducting all subsequent thematic development and interpretation without AI assistance. The AI was used as a pattern-recognition tool only; all analytical decisions, theme development, and interpretive conclusions remained the sole responsibility of the researcher. This approach aligns with guidance from Morgan (2025) on maintaining researcher control in AI-assisted qualitative analysis.

To ensure trustworthiness, the study employed multiple strategies. Triangulation was achieved through multiple data sources (hermeneutic interviews, focus group discussions, classroom observations, and document analysis). Member checking was conducted by sharing preliminary transcripts and thematic interpretations with participants to verify accuracy and clarify meanings—participants were given the opportunity to confirm that their views had been accurately represented. The reflexive journal was maintained throughout data collection and analysis to examine personal biases, positionality, and assumptions, documenting how these might influence interpretation. Expert consultation with academic supervisors provided additional scrutiny of coding decisions and thematic coherence. While intercoder comparison was not formally employed due to the single researcher nature of the study, the reflexive processes and expert validation served to strengthen analytical rigour. An audit trail of analytical decisions was maintained through detailed coding records, versioned thematic maps, and dated journal entries documenting the progression from raw data to final themes. These measures established a transparent, dependable, and trustworthy analytic process that faithfully represents participants' experiences and aligns with the study's critical-hermeneutic orientation.

Ethical Considerations

Ethical clearance was obtained from the Africa Research University Ethics Committee, and research permission was granted by the Namibian Ministry of Education, Innovation, Youth, Sports, Arts and Culture. Informed consent was obtained from all participants, with parental consent for learners who were minors. Pseudonyms were assigned to ensure the confidentiality and anonymity of participants. All data were securely stored on a password-protected personal laptop and shared with the institutions' supervisors via a secured student portal.

FINDINGS

The findings are organised around four emerged themes corresponding to the study's objectives. Verbatim quotations are included to preserve participants' authentic voices.

Stakeholders' Experiences (Objective 1)

Different stakeholders experienced the curriculum differently, reflecting their positions within the educational ecosystem. Policy Maker A explained: *"As policy makers, we set the direction… we decide on curriculum development, teacher training, and… how resources are allocated."* Curriculum Developer A described: *"Green hydrogen content was incorporated in the renewable energy section during the most recent syllabus review."* Teacher A explained: *"The best methods… are video simulation… using YouTube learners can see what the competency is wanting from them."* Teacher F reflected: *"so far what I have done is more of just draw on the board and try to explain and then I make them watch video."* Learner F stressed: *"A science lab… there are many things that we cannot practice in class."* Learner I recalled: *"An electricity project where the bulb was able to light."* Parent B lamented: *"Science without doing experiments is just like reading a storybook."* Parent A described: *"She was very excited at first… but that interest has gone down a bit because they don't really do hands-on experiments."*

Implementation Strategies (Objective 2)

Teachers employed adaptive strategies to make the curriculum work despite constraints. Teacher F explained: *"If I try to explain something and the kids don't understand, I can just easily go on YouTube and they understand."* Teacher F reflected: *"I used the example of a grandmother using a small still to produce ombike, which helped them remember distillation concepts even without access to a laboratory."* Teacher E reflected: *"Sharing teaching ideas with other teachers on WhatsApp helps me improve and find solutions when I lack resources."* Teacher A explained: *"I try to make the lesson more practical by using local examples so that learners can relate easily to the concepts."* Inspector B remarked: *"We discourage purely theoretical lessons… learners need experiments and practical demonstrations to understand abstract concepts."* Senior Education Officer D described: *"Some schools have established internal mentorship systems where experienced teachers support new or struggling colleagues… teachers formed study groups to review lesson plans and share resources."* Curriculum Developer A highlighted: *"We needed to improve the way we articulate the practical work, the topic of the scientific process… it will be more clear in terms of Physical Science to say no, we record data from the instrument, significant figures and all that, this is what we mean."*.

Challenges (Objective 3)

Challenges were interconnected across all ecological levels. Curriculum Developer A acknowledged: *"In many rural schools, there are no labs or even electricity. That makes practical science nearly impossible."* Senior Education Officer B explained: *"The majority of the teachers… were trained in a different era and… have [limited] content competency to handle the current content in Grade 8 and 9."* Senior Education Officer D observed: *"Learners sometimes fail because they cannot understand the scientific terms used in the question papers ... language can be a barrier… learners are taught in English but communicate better in local languages."* Teacher A noted: *"Some of the content that used to be taught in Grade 10 is now taught in Grade 9… they have advanced the level of content."* Teacher A explained: *"Many come from poor backgrounds and deal with issues such as hunger, making after-school or weekend lessons unproductive."* Teacher H observed: *"Textbooks are only available for teachers." Inspector C explained: "Learners at school end up sharing a book which is not good."* Teacher A noted: *"Some policies demand too much paperwork… 45 to 50 minutes just to design a lesson plan."*

Classroom Observation and Non-Verbal Data

Classroom observations across 10 lessons revealed that teachers predominantly used chalkboard-based instruction (8/10), with demonstrations in half the lessons and practical activities in only one; no formal laboratory experiments were recorded. Textbooks were used in six lessons, improvised materials in three, and limited laboratory equipment was noted. Non-verbal data indicated that seven classrooms lacked basic equipment, leading teachers to use exaggerated gestures and mimed procedures. Learner confusion was observed in six lessons when scientific terminology lacked visual support, while engagement increased when teachers incorporated local examples. Assessment practices were limited, with formative assessment in four lessons and summative components in only two. Teachers demonstrated adequate content knowledge in eight observations.

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Challenges included resource shortages (7/10), language barriers (6/10), time constraints (4/10), and large class sizes (3/10). Observation-interview alignment occurred in seven cases, while in three cases, teachers used improvisation strategies not mentioned in interviews, suggesting some adaptive practices have become routine.

Opportunities and Best Practices (Objective 4)

Stakeholders identified several opportunities. Inspector A stated: *"We ensure that teachers participate in continuous professional development (CPD) programmes. These refresher courses help teachers develop a common understanding of what is expected of them in teaching the subject."* Senior Education Officer D explained*: "Internal mentorship systems, study groups for lesson planning, and resource-sharing initiatives have been particularly effective. Grassroots innovations are sometimes adopted by other regions, demonstrating successful local adaptations."* Teacher C stated: *"One laboratory [was] built and funded by the parents and community."* Senior Education Officer B stated: *"We use WhatsApp groups where teachers post problems related to content or assessment activities. Colleagues and Senior Education Officers respond promptly, providing immediate support. This strategy is more effective than occasional workshops because support is continuous."* Senior Education Officer A explained: "We usually do research and then when we gather with other Senior Education Officers or with NIED, we share what we have found — what is happening globally. We make sure that our syllabus is well-aligned with Cambridge and even SADC standards so that we remain within international standards."

DISCUSSION AND FRAMEWORK DEVELOPMENT

The Hermeneutic-Ecological Interpretation

The findings reveal curriculum implementation as constrained hermeneutic agency within a disjointed ecological system. This interpretation emerges from the triangulation of interview data (subjective experience), classroom observations (enacted practice), and document analysis (policy intent and history).

Bronfenbrenner's lens reveals a fundamental ecological misalignment. The macrosystem (national policies, NCBE, Vision 2030) prescribes inquiry-based, learner-centred pedagogy, assuming laboratories, equipment, and prepared teachers. The microsystem (classroom) lacks critical elements the macrosystem assumes. The exosystem (education offices, funding mechanisms) should bridge this gap but consistently fails. Education Management Information System (EMIS) data indicated that in the three regions, 369 schools offer Physical Science, but only 162 have laboratories which illustrates this gap. The mesosystem (school-home connections) is strained by poverty, language barriers, and limited communication. The chronosystem reflects the historical legacy of apartheid education.

Ricoeur's lens illuminates the hermeneutic labour that occurs within this ecology. When teachers draw diagrams instead of conducting experiments, they are not failing—they are interpreting. The curriculum arrives in classrooms as a *"text"* carrying the pre-understanding of its developers. Teachers must create an *"over-understanding"* that can survive within their constrained context. Teacher F's use of *ombike* distillation represents sophisticated hermeneutic work: translating abstract competencies into a narrative that can live within a world without laboratories but one rich with indigenous knowledge.

This analysis reveals that existing implementation efforts are characterised by four interrelated problems: (1) fragmented stakeholder engagement, with limited communication and collaboration across ecological levels; (2) unsystematised teacher innovations, where effective adaptive strategies remain isolated and unrecognised; (3) weak feedback mechanisms, where monitoring focuses on compliance rather than learning; and (4) inadequate support structures, where professional development and resource allocation fail to address contextual realities. These problems formed the basis for developing the proposed Multi-Stakeholder Framework.

The Multi-Stakeholder Framework

Based on the triangulated findings, the researcher developed a proposed Multi-Stakeholder Framework for Effective Physical Science Curriculum Implementation. The framework presents effective implementation as a continuous, cyclical process anchored in a Hermeneutic Core of collaborative meaning-making and interpretation, supported by four fundamental pillars.

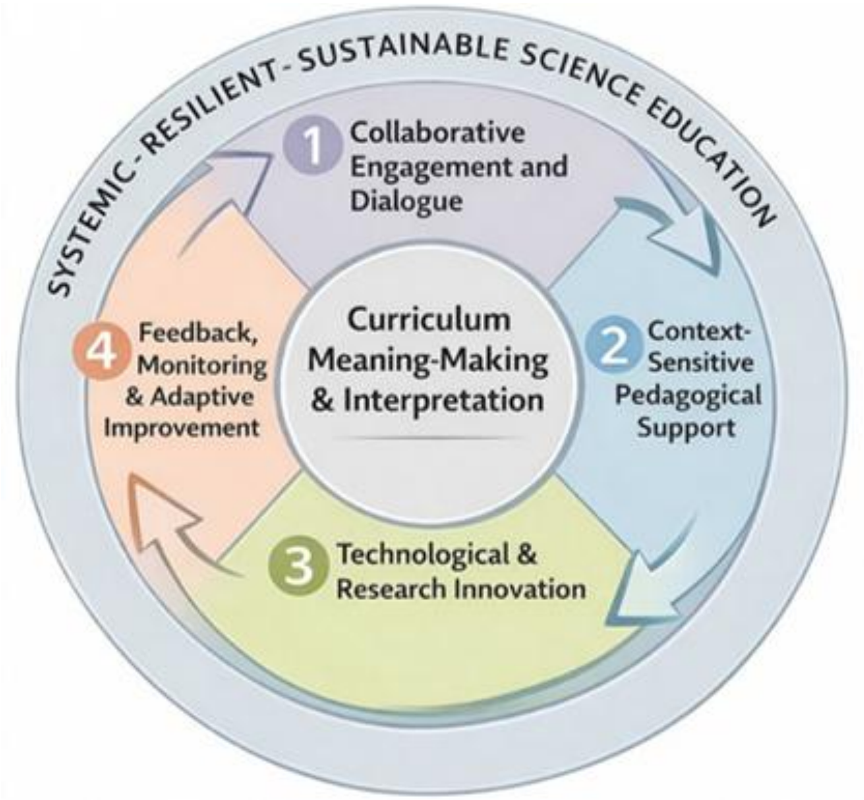

Figure 1.1: Multi-Stakeholder Framework for Effective Physical Science Curriculum Implementation. *Developed by Mushelenga (2026).*

It is important to emphasise that the framework presented here is empirically derived from the qualitative findings of this study. It is grounded in the lived experiences, strategies, challenges, and opportunities identified by stakeholders across the Namibian Physical Science education ecosystem. However, this framework has not yet undergone a separate validation or implementation study. The framework should therefore be understood as a research-informed proposal for systemic improvement, not as a fully tested or validated intervention. Future research should test its feasibility and effectiveness in diverse school contexts before wider adoption.

Pillar 1: Collaborative Engagement addresses the fragmentation revealed in Objective 1. Different stakeholders operate in different realities—policymakers see a promising curriculum, teachers and learners experience daily struggles with missing resources, parents see a difficult subject. The framework advocates for structured, multi-directional dialogue between all ecological levels through institutionalised *"Curriculum Interpretation Forums"* and support for digital Professional Learning Networks (WhatsApp groups) already established by teachers. This pillar recognises that effective implementation requires shared understanding and collective ownership of curriculum goals.

Drawing on this collaborative foundation, Pillar 2: Context-Sensitive Pedagogical Support builds on the adaptive strategies documented in Objective 2. Teachers develop strategies to teach without equipment—using YouTube, local examples like *ombike* distillation, and peer collaboration. However, these strategies happen in isolation. This pillar recommends developing a National Digital Repository of Open Educational Resources (OER) with adaptable lesson plans and low-cost practical activities, paired with sustained, context-embedded mentorship through formalised "lesson study" cycles. The goal is to provide teachers with practical tools that recognise and work within resource constraints.

Pillar 3: Innovation and Adaptation addresses the systemic resource and monitoring challenges identified in Objective 3. The framework proposes systematising teacher-led innovations through *"Innovation and Adaptation Platforms,"* including annual Teachers' Innovation Fairs and action research grants. This pillar transforms

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isolated adaptive acts into shareable professional knowledge. Over time, this builds a culture of continuous improvement where teachers are recognised as knowledge producers rather than mere policy implementers.

Pillar 4: Feedback and Monitoring rethinks monitoring as formative system learning. The framework advocates for reforming the Classroom Observation Instrument (COI) process to emphasise dialogic feedback rather than compliance checks. Post-observation conversations should focus on collaborative problem-solving: exploring which adaptive strategies might work or whether indigenous knowledge offers a practical alternative. Annual *"Curriculum Implementation Learning Reviews"* would analyse inspectorate reports, exam results, and teacher feedback to identify recurring systemic blockages and inform policy adjustments.

The Hermeneutic Core at the centre is the ongoing process of curriculum meaning-making, where policy intentions, pedagogical resources, innovative practices, and feedback converge. Drawing on Ricoeur's philosophy, this is where stakeholders collaboratively interpret what the curriculum means in their specific contexts. This sense-making, made possible by the four pillars, keeps the curriculum a *"living text"* and builds shared purpose across Bronfenbrenner's ecological layers. The framework cultivates three system qualities: a systemic approach that connects all levels, resilience that enables adaptation to challenges, and sustainability that ensures long-term improvement.

IMPLICATIONS AND RECOMMENDATIONS

Implications for Policy and Practice

The Multi-Stakeholder Framework has significant implications for policy and practice in Namibia and similar contexts.

First, **stakeholder engagement must be reconceptualised** from consultation to collaboration. The framework calls for structured, ongoing dialogue where all stakeholders—policymakers, curriculum developers, education officers, inspectors, teachers, learners, and parents—participate in interpreting curriculum goals and co-constructing implementation strategies. This moves beyond the current practice where teachers report that their input is rarely incorporated.

Second, **teacher professional development must be context-sensitive and sustained.** Rather than generic workshops that assume ideal conditions, CPD should provide practical tools and strategies for making the curriculum work in resource-constrained environments. The framework's emphasis on lesson study cycles, mentorship, and OER repositories offers concrete approaches for building pedagogical content knowledge within real constraints.

Third, **teacher innovations must be systematised and scaled.** The framework recognises that teachers are already doing significant adaptive work. Rather than focusing on what teachers are not doing, the system should document, validate, and disseminate effective adaptive strategies. This shifts the discourse from deficit to asset, recognising teachers as knowledge producers.

Fourth**, monitoring must become formative rather than punitive.** The framework rethinks classroom observation and inspection as opportunities for collaborative problem-solving and system learning rather than compliance checking. This requires new protocols, training for inspectors and education officers, and institutional cultures that value learning over blame.

Fifth, **resource allocation must address foundational gaps.** While teachers can adapt and improvise, they cannot replace laboratories, equipment, and textbooks. The framework's effectiveness depends on addressing these resource constraints through equitable, sustained investment.

RECOMMENDATIONS

Based on the findings and the Multi-Stakeholder Framework, the following recommendations are offered:

Policymakers and the Ministry of Education:

1. May consider to develop and execute a multi-year investment plan to equip all junior secondary schools with basic science laboratories, demonstration kits, and a 1:1 learner-to-textbook ratio.
2. May formalise Curriculum Dialogue Forums at circuit and regional levels, including all stakeholder groups, to collaboratively interpret directives and co-construct implementation strategies.
3. May officially recognise and support digital Professional Learning Networks (WhatsApp groups) that teachers have already formed.

Curriculum Developers:

1. May consider to develop and curate a National Digital Repository of Open Educational Resources (OER) for Physical Science, including adaptable lesson plans, video demonstrations, and low-cost practical activities.
2. May conceive curriculum documents as "scaffolds for interpretation" rather than rigid scripts, explicitly anticipating resource constraints and including guides for culturally relevant, context-feasible activities.

Senior Education Officers and Inspectors:

1. May reform the Classroom Observation Instrument process to emphasise formative, dialogic feedback focused on collaborative problem-solving.
2. May revitalise school-based mentorship systems by formalising and funding structured programmes where experienced "Lead Mentors" coach colleagues through lesson study cycles.
3. May consider institute annual "Curriculum Implementation Learning Reviews" to identify systemic blockages and inform policy adjustments.

Teachers:

1. May systematise and share adaptive strategies through digital platforms, circuit cluster sessions, and formal innovation fairs.
2. May consider forming and sustain Professional Learning Communities through existing networks, supported by modest institutional recognition and resources.

Schools and Communities:

1. May strengthen school-home communication through regular, transparent reporting on learner progress and curriculum expectations.
2. May leverage community resources by inviting parents and local experts to share indigenous knowledge relevant to scientific concepts.

LMITATIONS OF THE STUDY

First, the framework presented in this article, while empirically grounded in the study's qualitative findings, has not yet been validated through a separate implementation study. It should therefore be treated as a research-informed proposal requiring further testing in diverse school contexts. Future research should examine the framework's feasibility, effectiveness, and adaptability across different regions and school types in similar settings before it can be recommended for wider adoption.

Second, the sample, while appropriately purposive for qualitative research, includes a small number of parents (n=2), limiting the depth of perspective from this stakeholder group. The single curriculum developer included in the study represents the only national officer responsible for Physical Science, reflecting the structure of the education system rather than a sampling limitation. Although these participants provided valuable insights, their voices are fewer than those of teachers and learners. Future research should aim for larger samples of parents and other under-represented groups.

Third, the study was conducted in only three northern regions of Namibia (Oshana, Ohangwena, and Oshikoto). While these regions provided rich and varied data, they do not represent the whole country. The southern, central, and coastal regions have different socio-economic conditions, infrastructure levels, and cultural contexts. Therefore, the findings may not transfer directly to those areas. Nevertheless, the depth of qualitative insight gained from these three regions offers a strong analytical foundation that can inform similar contexts through transferability.

Fourth, the study focused exclusively on Physical Science in Grades 8 and 9. The findings may not apply to other subjects, such as mathematics or biology, nor to other phases of education, such as senior secondary. Nonetheless, the conceptual framework—a hermeneutic-ecological approach—is transferable to other subjects and phases, and the recommendations are grounded in principles of curriculum implementation that are not unique to Physical Science.

CONCLUSION

This article has developed an empirically grounded multi-stakeholder framework for strengthening Physical Science curriculum implementation in Namibian junior secondary schools. Drawing on a qualitative study conducted across three northern regions, the research engaged 33 participants including policymakers, curriculum developers, Senior Education Officers, inspectors, teachers, learners, and parents. The findings reveal that existing implementation efforts are characterised by fragmented stakeholder engagement, unsystematised teacher innovations, weak feedback mechanisms, and inadequate support structures.

The Multi-Stakeholder Framework addresses these problems through four interconnected pillars: Collaborative Engagement, Context-Sensitive Pedagogical Support, Innovation and Adaptation, and Feedback and Monitoring, anchored by a Hermeneutic Core of collaborative meaning-making. This framework provides a systematic approach for transforming isolated, reactive adaptations into coordinated, resilient implementation practices.

The study makes three contributions to knowledge. Theoretically, it demonstrates how ecological systems theory and hermeneutic philosophy can be integrated to understand curriculum implementation as the interpretive work of situated agents within a layered system. Practically, it offers a context-sensitive framework and validated approaches for resource-constrained contexts. Methodologically, it demonstrates the explanatory power of triangulating multiple data sources through a critical-hermeneutic lens.

It is important to reiterate that while the framework is empirically derived from the study's qualitative findings, it requires further validation through implementation studies before it can be described as an established intervention. The framework should be understood as an evidence-based proposal for systemic improvement, not as a fully tested or validated solution. Future research should test its feasibility in schools and assess outcomes after implementation.

Realising the vision of quality Physical Science education for all Namibian learners requires more than well-designed policies. It demands an ecosystem that genuinely listens to its teachers, equips its classrooms, values its learners' experiences, and possesses the institutional courage to learn and adapt from the ground up. The Multi-Stakeholder Framework offers a blueprint for building such an ecosystem.

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