Factors Affecting the Implementation of Practical Lessons in Physics: A Qualitative Case Study of Community Day Secondary Schools in Lilongwe, Malawi

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ABSTRACT

This qualitative multiple case study explored the factors that influence the implementation of practical physics classes in three Community Day Secondary Schools in Lilongwe, Malawi. Semi-structured interviews were conducted with three head teachers and six physics teachers, while focus group discussions were held with 30 physics students. The reflexive thematic analysis of the data, conducted using the Braun and Clarke approach, identified three interrelated themes: the deprivation of systemic resource and capacity, the presence of cognitive dissonance between valued ideals and the reality of systemic constraints, and theoretical dominance with performative compliance. The results of this study confirmed that only one of the six teachers was specialized in science, that there were no operational laboratories in the schools, and that practicals were almost nonexistent despite their recognition as important by all stakeholders. With Fullan's Educational Change Model and Hofstein & Lunetta's Laboratory Learning Framework as theoretical perspectives, this study has revealed a self-fulfilling cycle of implementation failure, where resource weaknesses, teacher capacity weaknesses, and organizational barriers combine to maintain theoretically dominated teaching. The study recommends efforts at teacher capacity development and curriculum change to facilitate effective practical physics teaching.

Keywords: practical physics; Community Day Secondary Schools; educational change; laboratory pedagogy and Malawi

INTRODUCTION

It has become widely accepted that science education represents a major arena for national development, as young citizens acquire the scientific literacy and other skill elements necessary for full participation in technologically advancing societies (Kola, 2013). Moreover, a key position in this broad arena is occupied by physics, with its importance being underscored as a foundation for technological innovation and development, as well as for emerging industries that require logical thinking, quantitative thinking, modelling of the natural world, and other core skill sets (International Union of Pure and Applied Physics [IUPAP], 1999). However, the success of physics education extends beyond the substance of the content to be delivered to include the way that substance is taught, extending especially to the extent to which students are able to engage with practical exercises that allow them to "experience" physics as an investigative, as opposed to abstract, discipline.

Internationally, intuitively, there is also a strong consensus that practical work is an essential part of good science education, which is reflected in the most recent science education initiatives which stress inquiry learning, where the student is actively involved in constructing his or her own science knowledge rather than receiving information in a more passive manner. Hofstein & Lunetta (2004) highlight the importance of the science laboratory in the school providing the setting for "minds-on" as well as "hands-on" learning, in which practical work is used to build conceptual, higher-order thinking, rather than factual, learning, in accordance with information presented in class by the teacher. This distinction between procedural learning in science and laboratory learning is an important one in terms of disseminating best practice in science teaching globally.

However, studies conducted globally have shown various impediments, or barriers, to attaining the supposedly perfect situation, especially among nations categorized as developing and developing countries. For example, it has been commonly cited, particularly among those nations, that there have been insufficient availability of science labs, apparatus, and other science-related consumables like materials for the arts and crafts section, as well as science teachers (Kapting'ei & Rutto, 2014; Muleta & Seid, 2016). This seems to indicate that the issue might not, in fact, be the actual science curriculum but rather the various circumstances and conditions at the system level itself.

To understand why the application of practical physics is such a difficult task to accomplish, one must engage with literature that provides a more generalized theory of educational change. One such idea is provided by Fullan (2007), whose Educational Change Model prioritizes the following three aspects of educational change: (a) resources including the materials, time, and space available; (b) teacher capacity including the subject matter, teaching, and teacher self; and (c) institution will including leadership and the long-term support of change. When any of these drivers of change is weak, change is implemented on a superficial level only, creating a "gap" between the formally expected and the achieved.

The laboratory-specific perspective developed in the work of Hofstein & Lunetta (2004) adds a further dimension to that provided in the work of Fullan, with the focus being the unique nature of the science laboratory that requires a balance between the physical setting (space, equipment, safety), the teacher's role (organizer, facilitator, scaffolder), and the investigative processes used by the student (opportunity for design, conduct, reflection in experiments). The importance of the intersection of these perspectives is that practical work in the classroom is not seen as a "add-on" in the curriculum, but as a highly complex pedagogical approach that can be undermined in many different circumstances.

The intention of policy to improve learning outcomes through enhanced disciplinary depth in secondary school science has been signalled in recent reforms in Malawi, which have included the splitting of Physical Science into distinct Physics and Chemistry subjects. These reforms follow international trends calling for more robust and practically orientated science teaching. Yet implementation takes place within a system characterised by striking disparities between well-resourced conventional secondary schools and under-resourced Community Day Secondary Schools, serving a large proportion of the student population.

The existing literature on secondary education in Malawi reveals that CDSS schools often run with persistent shortages of science laboratories, qualified science teachers, as well as basic teaching and learning resources (Mlangeni & Chiotha, 2015). In other related contexts, studies are conducted to show, among other things, the prevalence of chalk-talk in teaching science, even in schools whose science curricula are technique-oriented, because of the schools' lack of basic science teaching infrastructure, equipment, and qualified science teachers (Chilenga & Banda, 2018; Chirwa et al., 2020). In the CDSS schools, these problems are sometimes further compounded by socio-economic challenges in the communities that surround them, which are evidently inadequate to be tapped to facilitate practical science classes.

Despite all this, empirical studies that look at the implementation of practical physics in CDSS in Malawi are still very few. Research done in similar contexts in Africa and countries with less resource-endowed schools reported findings such as a lack of laboratories, a lack of appropriate apparatus, and a lack of qualified staff, among others; however, research was basically conducted without an integrated theoretical approach to link all these aspects to processes of educational change and laboratory pedagogy (Kapting'ei & Rutto, 2014; Muleta & Seid, 2016). There is still very little known about how all this interacts to create a reality in practical physics in CDSS, and how it is all perceived by its stakeholders.

The literature, therefore, reveals the existence of two sets of gaps. First, there is a lack of specific studies in the country that specifically investigate the implementation or non-implementation of practical physics in Malawian CDSS, with a significant omission in terms of the significance of the telescopic advances in access to secondary education. In most cases, literature in Malawi on challenges to teaching science is general, including issues of resource shortages, without in-depth inquiry in specific terms in relation to teaching practical physics (Chilenga & Banda, 2018; Chirwa et al., 2020; Mlangeni & Chiotha, 2015). Second, literature in the country is lacking in terms of the application of integrated conceptual frameworks in investigating challenges to the implementation of practical physics, such as Fullan’s (2007) EMC, as well as Hofstein & Lunetta’s (2004) laboratory learning framework. The systemic, cyclical quality of implementation problems in frequent interplay between policy, school communities, teachers, and students is, therefore, underexplored.

This study addresses the call of these gaps by examining the realisation of practical physics classes within the context of CDSSs in Lilongwe through the twin prisms of educational change and laboratory pedagogy. By honing in on the particular case of physics and the interplay of teacher qualification profiles, laboratories, and concomitant perceptions, this research extends what might be considered the impoverished explanation of “lack of resources” to a somewhat deeper level of explanation, capturing a cycle of failure.

This paper, therefore, addresses this gap, which is important at the levels of both policy and practice. On a policy level, this can contribute to an understanding of how resources, teacher capacity, and institutional will entwine in the CDSS to inform more realistic and sensitive-to-context strategies for implementing curriculum reforms in science education. Insights into the real state of laboratories, equipment, and staffing situations can guide area-specific investment and deployment policies, which better align infrastructure development with human resources rather than plan them separately. This has been reiterated by Fullan (2007). At the school and classroom levels, documenting stakeholders’ perceptions of practical physics and the experiences of largely theoretical instruction may illuminate how systemic constraints impact on professional agency and student motivation.

Besides, the significance of the research also lies in the fact that it holds implications for research, as it offers a theoretically informed account of the salience of practical physics in mediating the interaction of resource conditions, teacher specializations, and institutional priorities in a low-resource context. In integrating the context of Malawian CDSS with world debates around inquiry-based approaches in teaching science as well as the function of scientific labs in facilitating “minds on” learning, it provides implications with relevance in contexts with similar constraints.

These goals are implemented via three overarching research questions, which, it should be noted, are highly aligned with the aforementioned gaps and selected theoretical approaches.

1. What is the state of teacher qualification and laboratory infrastructure in the chosen CDSS for the conduct of physics practical?

2. What are the perceptions of teachers, head teachers, and students with regard to practical physics lessons?

3. To what extent are practical activities implemented in physics lessons?

The first question deals with the fundamental groundwork for implementation, which directly relates to the work of Fullan (2007), in which the author’s focus was on resources and teachers' capacity, as well as the work of Hofstein & Lunetta (2004), in which the focus was the physical laboratory environment. The second question concerns the beliefs and attitudes of the stakeholders. It provides further insights into how these aspects are influenced or affected by the structural groundwork. The third question deals with the curriculum in action, assessing the presence or occurrence of practical work, in comparison with the “minds-on” approach in the discourse of science education.

By engaging the global issues surrounding the quality and nature of practical science and the work into which they feed to the local realities of CDSS in Malawi, and by engaging these issues in robust theoretical frameworks, the study hopes to contribute to both the knowledge base on physics education in such contexts and to the construction of practical interventions designed to bring these issues from policy to practice.

Theoretical framework

Although there are several theories guiding educational changes in developed countries, researcher's own conceptual framework in this study will utilize an integration of Fullan's model at the macro system, and Hofstein and Lunetta's Laboratory Learning Model at a micro pedagogical level. Fullan, in his model, centered basically around three interrelated drivers: resources, teacher capacity, and institutional will, as being critical in shaping whether or not changes in education will filter down from policy to implementation. To my study, resources relate to CDSS lab provisions, teacher capacity to practically teach physics; and will, to leadership and policy support for practical and inquiry-based physics teaching and learning, even if there are no provisions in formal curriculum statements. Therefore, if these drivers are not aligned to begin with, changes to implementation will likely be superficial or non-existent, thereby explaining why practical physics in whole effect tends to be theoretical in approach even when there are formal curriculum provisions to guide its implementation.

The Laboratory Learning Model proposed by Hofstein and Lunetta is operative at the classroom level and defines the school science laboratory as a uniquely designed learning setting in which the interplay among four contributing factors is critical physical learning context, the teacher's role, the student's investigative processes, and the outcomes of the students' learning. In the context of the current research, the student's investigative processes include opportunities for the students to devise experiments and inquire into the phenomena; the students' outcomes cover conceptual aspects and "minds-on" involvement. Certainly, the Laboratory Learning Model offers the possibility of evaluating not only the presence of experimentation in the classroom, but also the level and nature of that experimentation whether it is more similar to verificatory processes or not.

The integration of these two models produces a conceptual framework that directly structures how the research questions are addressed. The first research question on the state of teacher qualification and laboratory infrastructure is located at the juncture of Fullan's resource and capacity drivers, and the physical learning context of Hofstein and Lunetta's model. Based on teacher specialization profiles and the distribution of laboratories and apparatus in CDSS, the study diagnoses the foundational conditions that either enable or preclude the possibility of practical physics. The perceptions of teachers, head teachers, and students involve Fullan's constructs of teacher beliefs and institutional will with Hofstein and Lunetta's emphasis on the teacher's role and students' expectations of inquiry. In these circumstances, the framework demonstrates the extent to which ideological support for practical work is accompanied by these constraints and generates pedagogical dissonance, whereby system drivers emphasizing practical physics are experienced as beyond implementation capacity. A third set of research concerns looks at the extent of implemented practical work and how it links system drivers' alignment/misalignment with the actual quality of laboratory pedagogy, with respect to whether students really carry out investigative work and whether they realize the "minds-on" goals postulated by Hofstein and Lunetta.

Overall, the "integrated framework" conceptualizes the situation in CDSS as constituting a self-reinforcing vicious circle or loop. The basic deficits with respect to resource allocation and teacher conditions, as posited by Fullan, contribute to the physical and/or ecological conditions of the laboratory and the facilitating role of the teacher, as conceptualized by Hofstein and Lunetta. This, in turn, leads to a reality within the classroom where no practical work or investigation takes place, with little or no room for the kind of theoretical work facilitated by the teacher and the lab conditions. These "conditions" then feedback to inform investment and willingness at the institutional level, reinforcing perceptions about the lack of need for labs and competent teachers, thus perpetuating the foundational issues. By adopting this approach, the conceptual framework also offers an understanding, not only of the current situation with regard to the implementation of practical work in physics, but also how each of the three research questions conceptualizes different moments or states in the vicious circle, starting with basic conditions (RQ1), perceptions at the level of stakeholders (RQ2), and then practice/outcomes (RQ3).

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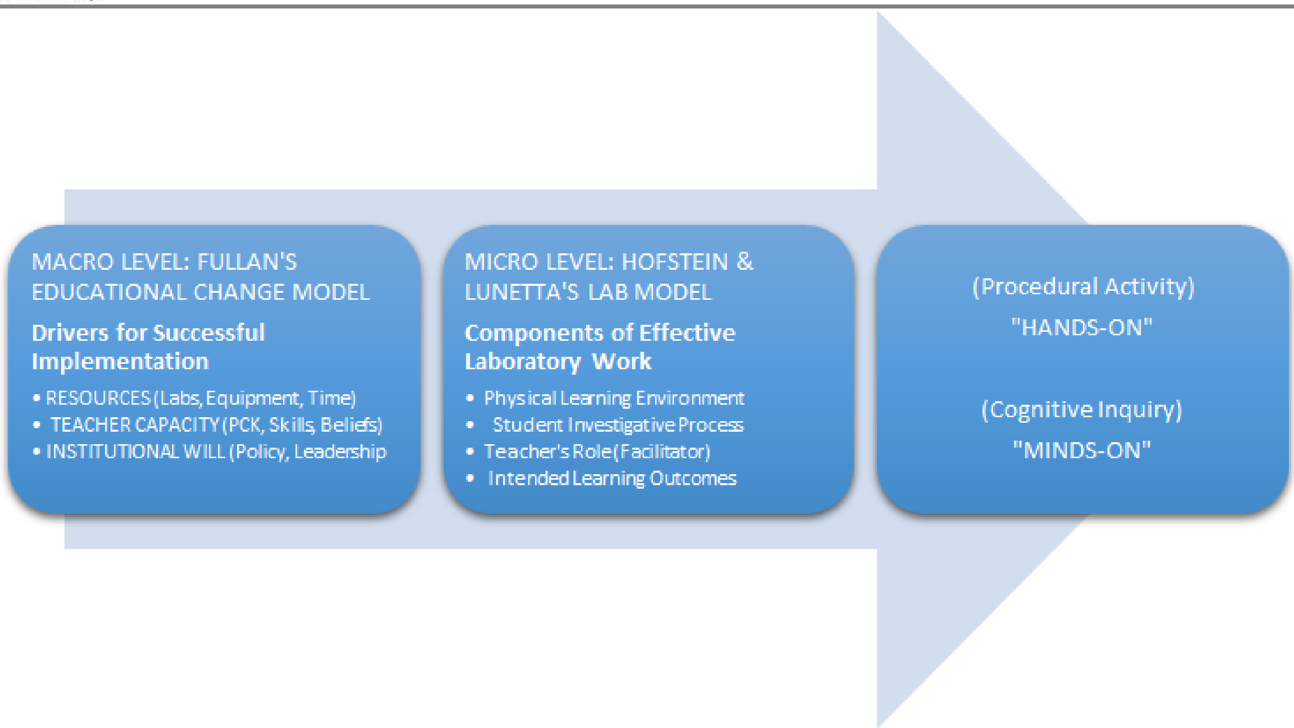

Figure 1: Conceptual Framework

Description of the Conceptual Framework

The framework integrates two complementary theoretical perspectives to analyse the implementation of practical physics in under-resourced secondary schools.

Macro Level: Fullan's Educational Change Model

At the macro level, Fullan's (2007) model identifies three interconnected drivers essential for successful educational implementation:

Resources: Material inputs including laboratory facilities, scientific equipment, and allocated time for practical activities. These constitute the physical infrastructure enabling practical work.

Teacher Capacity: Pedagogical content knowledge (PCK), practical skills in experiment design and execution, and professional beliefs about the value of inquiry-based learning. This driver encompasses both what teachers know and what they believe they can accomplish.

Institutional Will: Policy directives supporting practical science, leadership commitment at school and district levels, and systemic prioritisation of experiential learning. This driver represents the organisational and political will to sustain change.

According to Fullan, these drivers operate interdependently; deficits in any dimension compromise implementation success. The model posits that change requires coordinated development across all three drivers rather than isolated interventions.

Micro Level: Hofstein and Lunetta's Laboratory Model

At the micro level, Hofstein and Lunetta's (2004) framework specifies the components necessary for effective laboratory learning:

Physical Learning Environment: Dedicated laboratory space with appropriate infrastructure (benches, water, gas, electricity) and organised access to apparatus.

Student Investigative Process: Opportunities for students to pose questions, design procedures, collect and interpret data, and engage in scientific reasoning.

Teacher's Role: The teacher as facilitator who guides inquiry, scaffolds student thinking, and creates conditions for authentic investigation rather than merely demonstrating procedures.

Intended Learning Outcomes: Both procedural competencies (manipulative skills) and cognitive outcomes (conceptual understanding, scientific reasoning).

The framework emphasises that effective laboratory work integrates procedural activity ("hands-on") with cognitive inquiry ("minds-on"). Mere manipulation of apparatus without intellectual engagement fails to achieve laboratory learning's full potential.

Integration of Levels

The framework's analytical power lies in its integration of macro and micro perspectives. Fullan's drivers at the system level (resources, capacity, institutional will) enable or constrain the micro-level laboratory components specified by Hofstein and Lunetta. For instance: Resource availability determines whether a physical learning environment can be established; Teacher capacity influences the teacher's ability to enact the facilitator role and Institutional will shapes whether investigative processes are valued in curriculum and assessment. Conversely, micro-level experiences of successful or failed laboratory work feed back into macro-level perceptions of whether change is worthwhile, affecting institutional will and resource allocation decisions. The framework thus captures the dynamic, reciprocal relationship between systemic conditions and classroom realities.

Application to Research Questions

Table 3 maps the conceptual framework components to the study's research questions and thematic findings.

Table 3: Mapping of Conceptual Framework to Research Questions and Findings

Research Question	Framework Component	Primary Theoretical Lens	Emergent Theme
RQ1: State of teacher qualification and infrastructure	Resources; Teacher Capacity	Fullan (drivers)	Systemic Resource and Capacity Deprivation
RQ2: Stakeholder perceptions	Teacher Capacity (beliefs); Institutional Will	Fullan (change drivers)	Cognitive Dissonance
RQ3: Extent of practical activity implementation	Physical Environment; Student Process; Teacher Role	Hofstein & Lunetta (lab components)	Theoretical Dominance and Performative Compliance

This integrated framework guides both data collection and analysis, ensuring that findings at the classroom level are interpreted within their broader systemic context, while systemic analyses remain grounded in specific pedagogical practices.

METHODOLOGY

Research design

The current study applied a qualitative, multiple case study approach to explore factors influencing the practical physics lesson implementation in CDSS within Lilongwe, Malawi. The approach was applied for several reasons: Firstly, it allowed for a deeper interpretation of teaching implementation, which was appreciated as a context-based process influenced by particular circumstances, staff ability, and all stakeholders' interpretation, but not as a result of a particular trait or attribute. The boundaries of this study were established as a school level, with embedded levels of stakeholders, being the head teachers, physics teachers, and their students.

Theoretical and Analytical Fram

Two frameworks, used as interpretive tools, informed the research inquiry. The first, Fullan's perspective on educational change, informed the analysis of how implementation is enabled or inhibited by significant drivers of change, such as capacity development and resourcing, including the allocation of time and materials key areas of focus in the study's examination of systemic constraints. The second, Holstein & Lunetta's characterization of the distinctive learning environment of the school laboratory, informed the examination of the inhibiting effects of the absence of laboratory provision, as well as the role of the teacher as laboratory facilitator, in compromising inquiry-oriented learning outcomes.

Study setting and case selection

Area of Study

The design of the study took place in three different CDSS, Schools A-C, in one educational zone of Lilongwe District. The respondents' institutions were chosen purposively using two selection criteria. Firstly, the selected schools had to offer physics at the appropriate academic level. Second, the schools had to operate under similar national curriculum demands as well as exposure to the same policy demands in terms of supporting resources in the district. The purpose of this procedure was rather clear. Firstly, it facilitated the ability of the researcher to assess variations in policy implementation in terms of school capacity rather than policy. Secondly, it helped in selecting schools as "information-rich" cases of variations of contexts of secondary schools with poor resources yet with explicit demands on the teaching of PS.

Participants and sampling

The participants were selected from three groups of stakeholders who are directly involved in the implementation of practical physics: Head teachers (n = 3), to explore their perceptions of prioritization, timetabling, and resourcing; Physics teachers (6), in order to identify the practices in the delivery of subjects, their confidence and competence in teaching, and the limitations they experience in enacting these practices; Physics students (n = 30; 10 from each school), to examine learner expectations, exposure to practical activities, and barriers experienced in day-to-day learning.

The sampling type was purposive and criterion-based. All available physics teachers in the identified schools participated. Teachers were considered to ensure proper representation, staffing norms, and rates of out-of-field teaching, since this was established as a major impediment in this study. The sampled student populace was also determined by their current enrollment in physics and willingness to participate. This was in line with ensuring proper group composition, as this would guarantee openness of discussion. As discussed, all critical actors along the entire chain of implementation, such as leadership, teachers, and learners, are represented.

Data sources and data collection

The data were collected mainly through semi-structured interviews with head teachers and physics teachers, and also by conducting focus group discussions with students. The interview and discussion participants were clearly informed about the structure and design based on the three improved research questions:

• RQ1: the state of teacher qualifications and laboratory infrastructure.

• RQ2: stakeholder perceptions regarding practical physics lessons.

• RQ3: Levels of application of practical activities.

Semi-structured interviews were conducted with head teachers and physics teachers. The interviews revolved around staffing, subject specialization, and utilization; the availability and utilization of scientific labs and equipment; and timetabling. The interviews were approximately 30 minutes and held in private areas of each school.

Methods for collecting student perspectives: The student perspectives were collected through six focus group discussions, totalling 30 students from all three schools. Each focus group consisted of five students currently taking physics. The data was collected in quiet classrooms with a semi-structured approach, encouraging students to address: (a) The value of practical work from their perspective; (b) The type of practical work, how frequently this occurs, and in what form (e.g., experiment, demonstration); (c) The way in which resource availability, teacher resourcing, and teacher capacity can be seen to impact student learning. The method of focus groups helped to highlight a shared perspective on ‘the reality of a largely theoretical world.’

Data management

All interviews conducted in the study were audio-recorded based on participant consent. For the focus group discussions, recordings and transcripts were generated based on participant consent. In addition, the study coded the schools by letter (A, B, C), while the participants were coded based on role and school, such as “Head Teacher A,” “Teacher 1,” “Student FG3.” This was aimed at ensuring the participants’ privacy and confidentiality. In addition, the transcripts and the supporting data information for the analysis were neatly organized and securely stored in an online archive that only the researcher accessed. This was done to ensure that the data examples were neatly organized by school and then by participant groups.

Data analysis procedures

Data analysis was conducted following Braun and Clarke’s reflexive thematic analysis approach, with particular emphasis on the iterative engagement with the data, as well as the technicalities involved in the development of the themes through the application of the researcher’s reflexivity. In conducting the analysis, the following steps were employed:

Familiarization: Repeated perusal of the transcripts in order to formulate an overall understanding of the conditions, perceptions, and realities conveyed by different stakeholder groups.

Initial Coding: This involves coding all transcripts comprehensively, prioritizing the coded text that concerns the provision of resource, teacher qualification and confidence, conceptualization of practical work, and description of routine practice.

Pattern identification: Using the aggregated related codes to create clusters of candidate themes that spoke to each research question, including systemic resource and capacity deprivation, cognitive dissonance between ideals and reality, and theoretical dominance and performativity compliance.

Theme review and refinement: Ongoing analysis and comparison of the themes both within and across the themes extracted from the three school cases and the respective stakeholder groups to examine their correspondence and refinement, and to look for disconformity evidence. This was to ensure that the resultant themes represented common and shared experiences.

Defining and naming the themes: Gaining a sense of the essence of each theme, and of their collective significance for the research questions, which eventually resulted in the thematic structure reported in the Findings.

After developing the themes, framework-based synthesis was carried out, bringing the empirical-developed barriers into alignment with the constructs represented in the educational change model developed by Fullan, and the science laboratory model developed by Hofstein & Lunetta. In the process, each major barrier (teacher specialization deficits, equipment & material scarcity, laboratory absent, time allocation deficits, and underqualified teaching staff) was aligned with the change drivers in the educational change model and the laboratory components in the science laboratory model, facilitating the building of the explanatory "cycle of implementation failure," in which foundational deficits, pedagogical dissonance, theory dominance, and policy inaction intersect in a single cycle.

Trustworthiness

The trustworthiness of findings was enhanced through a number of mutually complementing strategies. The credibility of the findings was enhanced through the use of multiple perspectives of head teachers, physics teachers, and students, and multiple settings of the three schools, to ascertain the extent of agreement of the findings regarding the resource environment, teachers' capacity, and teaching practice. There was the use of the audit trail through the interview guide, coding, analysis, and use of the framework matrix linking the themes to the theoretical lens. There was the use of memoing through the entire analytical process to attend to the researcher's initial ideas and to be reflexive, in line with the requirements of reflexive thematic analysis. There was the use of providing thick description of the school context, resource environment, and staffing patterns through the findings, in line with the transferability requirement.

Ethical considerations

Ethical approval and appropriate permissions were sought and obtained from relevant authorities before data collection commenced. Informed consent was provided by all adult participants-head teachers and teachers- and appropriate consent/assent procedures relevant to the requirements from the institutions involved and schools were followed for student participants. Participation was strictly voluntary, and participation did not face adverse consequences should one decide to withdraw at any point. Efforts to maintain confidentiality include anonymizing schools and individuals, storing data digitally in a secure environment, and reporting with caution to avoid anything that would potentially lead to disclosure.

Transferability

In qualitative research, transferability refers to the extent to which findings can be applied to other contexts, with the responsibility lying primarily with readers to determine applicability based on sufficient contextual information (Lincoln & Guba, 1985). This study enhances transferability through several strategies. Detailed accounts of school contexts, resource environments, staffing patterns, and stakeholder perspectives have been provided throughout the findings, enabling readers to assess similarities with their own contexts. Descriptions of teacher qualification profiles, laboratory infrastructure, and classroom practices allow comparison with other under-resourced secondary school settings.

The three schools were selected as information-rich cases representing common conditions in Malawian CDSSs: out-of-field teaching, absent laboratory facilities, and dependence on mobile laboratory services. These characteristics are not unique to the study sites but reflect broader patterns across Malawi and similar Sub-Saharan African contexts. Readers in comparable settings rural or peri-urban community secondary schools with limited resources may find the findings particularly transferable. By anchoring findings within established theoretical frameworks (Fullan; Hofstein & Lunetta), the study demonstrates that observed phenomena are not merely idiosyncratic but reflect broader theoretical patterns. The identified cycle of implementation failure may manifest in other contexts where foundational resource and capacity deficits intersect with policy expectations for practical science. However, transferability remains bounded by the specific national policy environment, examination system, and cultural attitudes toward science education in Malawi. Researchers and practitioners seeking to apply these findings should carefully assess contextual similarities and differences.

Limitations

Several limitations inherent in the study design and scope should be acknowledged.

Sample size and geographic scope: The study focused on three schools within a single educational zone in Lilongwe district. While this enabled in-depth case analysis, it limits the range of variation captured. Malawi has twenty-eight districts with considerable regional diversity in infrastructure, teacher deployment, and access to support services. Findings may not represent conditions in more remote rural areas, urban CDSSs with better resourcing, or schools in districts with different policy implementation histories. A larger sample spanning multiple districts might reveal additional implementation barriers or context-specific adaptations not evident in this study.

Participant sampling within schools: Within each school, all available physics teachers participated, and ten students were selected for focus groups. While this provided adequate depth, it is possible that teacher participants, aware of the study's focus on practical work, presented views emphasising their appreciation of practical pedagogy while understating other factors. Student participants, selected by teachers or school administrators, may have included those more articulate or positively disposed toward physics, potentially skewing focus group discussions. Future research might employ random or stratified sampling of students to capture wider learner perspectives.

Reliance on self-report data: The study primarily relied on interview and focus group data, supplemented by limited observation of facilities. Classroom observations of actual teaching practice were not systematically conducted due to resource and time constraints. Consequently, the extent of theoretical dominance and performative compliance is based on participant accounts rather than direct observation. Participants may have described practice as they believed it should be rather than as it actually occurs. Triangulation with systematic classroom observation in future studies would strengthen validity.

Researcher positionality: As an educational researcher with prior experience in Malawian secondary education, the investigator brought particular assumptions about resource constraints and their effects. While reflexive memoing and audit trails were employed to monitor potential bias, the interpretation of findings inevitably reflects the researcher's positionality. Different investigators might emphasise different aspects of the data or arrive at alternative interpretations.

Temporal limitations: Data were collected at a single point in time, providing a snapshot rather than a longitudinal perspective. Implementation conditions in CDSSs may fluctuate with staffing changes, mobile laboratory schedules, or intermittent resource provision. A longitudinal design tracking schools over time would reveal whether the identified cycle of implementation failure is stable or subject to change.

Language considerations: Interviews and focus groups were conducted in English and Chichewa based on participant preference. Translation during transcription and analysis may have resulted in loss of nuance or cultural meaning, despite efforts to maintain accuracy through careful translation and back-translation where necessary.

Implications for Future Research

These limitations suggest directions for future inquiry. Comparative studies across multiple districts and regions would establish the generalisability of findings and reveal contextual variations in implementation patterns. Longitudinal research tracking schools over several years could illuminate whether and how improvements in one domain (e.g., equipment provision) might catalyse changes in others (teacher confidence, instructional practice). Classroom observation studies would provide direct evidence of pedagogical practices and complement self-report data. Finally, intervention research testing coordinated, multi-level strategies addressing resources, teacher development, and institutional support would advance understanding of how to break the cycle of implementation failure documented in this study.

Findings

The analysis of qualitative data collected from head teachers, physics teachers, and students across three Community Day Secondary Schools (CDSSs), Schools A, B, and C in Lilongwe district, Malawi revealed unifying constraints in the implementation of practical physics. Findings are organised according to three research questions: the state of resource availability (RQ1), stakeholder perspectives under existing conditions (RQ2), and the consequent extent of practical activity implementation (RQ3). Three cross-cutting themes emerged through reflexive thematic analysis: 'Systemic Resource and Capacity Deprivation,' 'Cognitive Dissonance between Valued Ideals and Constrained Reality,' and 'Theoretical Dominance with Performative Compliance.' The following sections present these interconnected themes.

State of Teacher Qualification and Laboratory Infrastructure (RQ1)

Analysis revealed systemic resource and capacity deprivation across two interrelated domains: teacher qualification deficits and infrastructural inadequacies.

Teacher Qualification Deficit

Staffing profiles across all three schools showed critical mismatches between teacher specialisation and teaching assignment. Of the six physics teachers interviewed, only one held tertiary qualifications in a science-related discipline. Table 1 summarises teacher qualifications.

Table 1. Qualification Profile of Physics Teachers (n=6)

School	Teacher	Qualification	Area of Specialisation
A	Teacher 1	Diploma in Education	Humanities
A	Teacher 2	MSCE	–
B	Teacher 1	B. Sc. Technical Education	Sciences
B	Teacher 2	Diploma in Education	Sciences
C	Teacher 1	Diploma in Education	Humanities

Cross-case analysis confirmed that Teacher 1 at School B represented the sole instance of science specialisation. This pattern indicates systemic misalignment between teacher expertise and subject requirements.

Laboratory Infrastructure

Concurrent with human capacity deficits was acute scarcity of material resources and spatial facilities. None of the three schools possessed a functioning science laboratory. Basic scientific equipment meters, lenses, trolleys was entirely absent. Where practical activities were contemplated, they occurred in ordinary classrooms or small storerooms. All schools depended on infrequent and unreliable visits from District mobile laboratory

facilities.

Stakeholder Perceptions Regarding Practical Physics Lessons (RQ2)

Within this resource-constrained environment, stakeholder perceptions revealed a phenomenon of cognitive dissonance between valued ideals and constrained reality. Despite the absence of apparatus and laboratories, all stakeholder groups expressed strong appreciation for practical work's pedagogical potential.

Teachers emphasised that "*experimentation makes abstract concepts tangible" and "develops scientific thinking." Students expressed motivational commitment to "doing things ourselves" and the belief that "experiments would make physics more fun and easier too."*

However, these ideals coexisted with feelings of professional disillusionment and student disappointment. Teachers described themselves as *"demoralised" and "handicapped" by their inability to conduct experiments. Students frequently commented: "We hear it's important, but we never see it."* Cross-case comparison verified the consistency of this dissonance across all three schools, despite minor variations in resource allocation.

Extent of Implementation of Practical Activities (RQ3)

Analysis of classroom practice revealed a dominant theme of theoretical dominance and performative compliance across all three schools. Physics instruction was almost exclusively theoretical in character. Even where teacher demonstrations were acknowledged as important, they remained aspirational rather than actual components of lessons. Instances of hands-on practical learning were virtually non-existent.

The standard 40-minute lesson period was universally cited as inadequate: *"too short to even fetch water for an experiment, let alone do it."* Consequently, the laboratory component of the national curriculum existed primarily in principle rather than practice.

Synthesis: Interconnected Constraints

The three themes identified above demonstrate dynamic interrelation. Teacher qualification deficits, equipment scarcity, laboratory absence, and time constraints collectively produced conditions under which practical work could not be implemented as intended. Table 2 summarises the barriers identified across all schools.

Table 2: Summary of Implementation Barriers Across Three Schools

Barrier	Evidence from Data
Teacher specialisation deficit	Only one of six teachers held science qualification; majority teaching out-of-field
Equipment and material scarcity	100% of respondents reported absence of basic apparatus
Laboratory infrastructure absence	No dedicated laboratories in any school; reliance on storerooms or mobile units
Time allocation	40-minute lessons insufficient for practical work

The data indicate that even where institutional actors demonstrated willingness to innovate, such initiatives were neutralised by entrenched structural deficits. Policy intentions regarding practical physics were systematically undermined by the accumulated constraints documented above.

DISCUSSIONS

This section will discuss the findings in terms of the three research questions, locating them in relation to existing literature and theory, and considering the researcher's interpretation.

Teacher Qualifications and Infrastructure: Foundational Deficits

The findings reveal systemic deprivation in resources and capacity across the three Community Day Secondary Schools (CDSSs), evidenced by widespread out-of-field teaching and absent laboratory facilities. Of the six physics teachers, only one held tertiary qualifications in a physics-related field; the remainder possessed humanities or school-level backgrounds. This qualification deficit directly undermines pedagogical content knowledge and confidence in managing practical instruction, reinforcing the dominance of didactic, theory-oriented classroom practices.

Concurrently, all three schools lacked functional laboratories and basic equipment meters, lenses, trolleys necessary for practical work. Where practical activities were contemplated, they were relegated to conventional classrooms or makeshift settings, often dependent on occasional mobile laboratory visits. This material deprivation effectively eliminated the laboratory learning experience that Hofstein and Lunetta conceptualise as essential for authentic scientific inquiry.

These findings align with regional scholarship across Sub-Saharan Africa. Studies from Ghana, Rwanda, and broader SSA contexts consistently identify absent equipment, non-existent laboratories, and unqualified teachers as primary obstacles to effective practical physics instruction. The consequence is a conspicuous disconnect between curriculum policy and classroom reality a gap systematically documented in assessments of practical science across African secondary schools.

Theoretically, these results validate Fullan's assertion that educational change requires coordinated capacity building, resourcing, and motivation; policy direction alone proves insufficient. When teacher expertise and material resources remain critically low, curriculum mandates for practical work cannot progress beyond stagnation. From the researcher's perspective, the situation in these CDSSs represents not merely implementation failure but fundamental impossibility: teachers are not failing to conduct practical work; the essential prerequisites for such work have never been provided at the systemic level.

Consequently, strategies relying solely on exhortations to "do more practical work" are futile. What is required is coordinated investment: specialist subject teacher training, in-service provision targeting practical pedagogy, and laboratory resourcing not as discrete interventions but as interconnected components of a coherent framework within which practical physics ceases to be an optional extra.

Stakeholder Perceptions: Valued Ideals Amidst Constrained Reality

The study identified significant cognitive dissonance across all stakeholder groups head teachers, physics teachers, and students. All acknowledged the value of practical work: teachers recognised its role in conceptual understanding, interest generation, and scientific skill development; students expressed enthusiasm for hands-on engagement. However, these positive orientations were overshadowed by frustration, demoralisation, and disillusionment. Teachers described feeling "professionally handicapped," unable to deliver experiences they knew were crucial. Students articulated this dissonance succinctly: "We hear it's important, but we never see it."

This contradiction between pedagogical ideals and material constraints diminished teacher and student agency, fostering a learning culture where practical work was simultaneously valued and absent. The phenomenon reflects extensive literature documenting that resource-constrained teachers, despite positive attitudes towards practical work, lack the means, confidence, and support to implement it effectively. Students in such contexts, while valuing experimentation, are systematically disadvantaged by the theoretical emphasis accorded to physics, resulting in disengagement.

Fullan's framework illuminates this dynamic: when educators' beliefs about best practice are obstructed by conditions, the outcome is not resistance to change but learned helplessness. Similarly, Hofstein and Lunetta's emphasis on teachers as facilitators of inquiry-based learning cannot materialise without laboratories and appropriate teacher preparation, leaving exposition as the default pedagogical mode.

The researcher interprets these findings as evidence that attitudinal change is not the primary constraint. The emotional language employed "handicapped," "demoralised" suggests prolonged pedagogic disempowerment rather than mere inconvenience. Two implications warrant attention. First, resourcing interventions unaccompanied by teacher development risk leaving underlying feelings of professional incompetence unaddressed. Second, the mismatch between discourse emphasising practical work's importance and students' actual experience threatens the credibility of both the physics programme and the educational system itself. Sustainable improvement therefore requires not only material investment but systematic rebuilding of stakeholder faith in the possibility and value of change.

Extent of Practical Activities: Theoretical Dominance and Performative Compliance

The convergence of resource scarcity and cognitive dissonance produces a classroom reality characterised by theoretical dominance and performative compliance. Physics instruction across all three schools was overwhelmingly theoretical: teacher explanations, chalkboard use, textbooks, and occasional aspirational demonstrations constituted the pedagogical repertoire. Hands-on, inquiry-based approaches were virtually absent. The standard 40-minute period compounded this pattern, proving insufficient for setup, conduct, and debriefing of experiments particularly given requirements for improvisation or equipment retrieval from remote storage.

Under these conditions, the practical component of the physics curriculum exists primarily as a formal requirement, observable in planning rhetoric and examination discourse but rarely enacted in daily instruction. This performative compliance sustains the idea of practical work at discursive level while structurally excluding it from classroom practice.

This pattern resonates with studies of practical science in under-resourced settings across Africa, where practical work often reduces to occasional teacher demonstrations or examination-driven exercises emphasising theoretical recall. System-level analyses attribute this disconnect to interlocking deficits: material scarcity, teacher preparation gaps, time constraints, and cultural emphasis on propositional knowledge over investigative skills.

Fullan's interdependence principle explains why isolated improvements equipment provision without corresponding changes in time allocation, assessment, or support fail to shift teachers from entrenched theoretical approaches. Hofstein and Lunetta's framework similarly demonstrates that the laboratory's potential for inquiry, collaboration, and reflection cannot materialise when practical activities remain infrequent, teacher-centred, and disconnected from assessment.

The researcher interprets the dominance of theoretical approaches not as personal teaching preference but as rational adaptation to conditions of inadequate training, absent laboratories, scarce equipment, and time constraints. Performative compliance represents a survival strategy within an unsupportive systemic environment. This reading reinforces the necessity of conceptualising implementation challenges systemically rather than attributing them to individual teacher failings.

The Cycle of Implementation Failure: Integrative Synthesis

The interconnected findings reveal a self-reinforcing cycle of implementation failure. Foundational resource and capacity deficits unqualified teachers, absent laboratories undermine teacher confidence and student engagement. This generates cognitive dissonance between stakeholder values and enacted capabilities. The resulting tension produces classroom reality dominated by theory and performative compliance, which normalises practical work's absence and weakens demand for structural change.

Breaking this cycle requires systemic, multi-level response. Resources, teacher learning, time allocation, curriculum design, and assessment practices must be addressed not as separate problems but as interlocking components of a coherent strategy for advancing practical physics in low-resource secondary schools. The study thus extends prior work by demonstrating, within a specific CDSS context, how global patterns documented in the literature manifest in the lived experiences of head teachers, physics teachers, and students and how theoretical frameworks can be mobilised to understand and reimagine conditions for meaningful implementation.

CONCLUSION

This study has exposed the deep-seated systemic barriers that hinder practical physics implementation in Community Day Secondary Schools in Lilongwe, Malawi. Based on a qualitative multiple-case study across three purposively selected schools, the findings reveal a self-reinforcing syndrome of resource and capacity deprivation, cognitive dissonance, and theoretical dominance. Of the six physics teachers, only one had science specialization, laboratories were lacking altogether, and practical inquiry became mere perfunctory compliance with curriculum imperatives. All stakeholders, from head teachers and teachers to students themselves, uniformly asserted the value of practical work in developing conceptual understanding and skills, but structural limitations made this an unattainable ideal.

These are not isolated deficiencies but seem to form an integral part of the failure in Malawi's secondary education ecosystem. Inadequate teacher qualifications erode away at pedagogical content knowledge, while the absent apparatus and other dedicated spaces tear down the investigative environment so crucial in the Hofstein and Lunetta laboratory model. The typical lengths of 40-minute standard periods entrench theoretical instruction, reflecting chronic patterns in Sub-Saharan African science education where policy rhetoric outpaces infrastructural capacity. This perpetuates educational inequity and particularly denies CDSS students from generally poorer backgrounds the experiential learning so essential for scientific literacy and further opportunities.

Fullan's change framework underlines the point that implementation requires aligned capacity, resources, and motivation. Foundational deficits here nullify strong convictions of stakeholders, leading to demoralization and a general inertia. This dynamic is confirmed in the reflexive thematic analysis of this study across cases and illustrates how resource scarcity begets perceptual frustration that sustains the dominance of classroom theory. In the end, practical physics is less a pedagogical choice than it is a structural impossibility without systemic reconfiguration.

In synthesizing such understanding, the study maintains the message from existing research that the process of advancing practical sciences involves the acknowledgment of unique vulnerabilities within the context of CDSS, as well as exploring the applicability of theory to identify underlying causes of implementation failure. The prescriptive value of the study is in presenting an explanatory model of implementation failure to an established model of barriers, contextualizing theory for intervention in the lives of Malawian schools.

RECOMMENDATIONS

The Malawian education authorities, including the Ministry of Education and district offices, should ensure that targeted teacher capacity building through mandatory subject-specialist recruitment and sustained professional development is pursued. Recruit physics graduates for the CDSS posts and provide annual in-service workshops on practical pedagogy, inquiry facilitation, and low-cost experimentation techniques. Such programs, informally aligned with Fullan's capacity driver, would guarantee mentorship pairings between specialist trainers and out-of-field teachers to rebuild confidence and pedagogical content knowledge and address directly some of the qualification deficits across the three schools.

This, in turn, requires an investment in infrastructure and resourcing on a parallel basis so that a viable laboratory learning environment can exist in schools-as a result of the model portrayed by Hofstein and Lunetta. Provide each CDSS with a dedicated science laboratory, equipped initially with a modular kit comprising meters, lenses, and trolleys obtained via bulk national tender processes for value for money. Scheduling, routine maintenance, and teacher training need to be integrated at the district level to ensure mobile laboratory units at the district level are much more than just "unreliable." Budget allocations need to identify funds for continued replenishment to prevent equipment decay characteristic of low-resourced systems.

Lastly, curriculum and time tables should be transformed to enable the realization of authentic implementation, i.e., extend the physics practical lessons to 60-90 minutes each week and lessen the theoretical content to fit the schedules. The national examinations should be transformed to treat both practical and theoretical aspects equally, incorporating cheap and universal practices that motivate minds-on approaches. The three levels of interventions – capacity, resource, and systemic supports – constitute a coherent strategy for breaking the cycle and promoting access to minds-on science studies in CDSS.

Directions for Future Research

Future research should focus on the longitudinal evaluation of the impact of interventions like teacher upskilling or new modular kit sets in additional zones in Malawi, using a combination of methods to measure the progression in implementation and concepts gained by the students. Comparative research with the CDSS, urban schools, and other regions in Sub-Saharan Africa might help assess the degree of generalization with the cycle model, while assessments of virtual simulations and the construction of new technology might reveal new innovations for scalable interventions. Policy-oriented research on exam pressures and finance mechanisms will help shed more light on the pathways for a durable implementation for the practical physics equity model.

REFERENCES

1. Amunga, J. K., Musasia, M. A., & Musera, G. (2011). Disparities in physics achievement and enrolment in secondary schools in Western Province: Implications for strategy and renewal. Problems of Education in the 21st Century, 31, 18–32.
2. Braun, V., & Clarke, V. (2006). Using thematic analysis in psychology. Qualitative Research in Psychology, 3(2), 77–101. https://doi.org/10.1191/1478088706qp063oa
3. Braun, V., & Clarke, V. (2022). Thematic analysis: A practical guide. SAGE Publications.
4. Chilenga, K., & Banda, F. (2018). Challenges of implementing practical science lessons in secondary schools in Malawi. International Journal of Science and Education, 10(4), 123–135.
5. Chirwa, G., Phiri, A., & Mwale, M. (2020). Factors influencing science teaching and learning in Malawian secondary schools: A case study of Lilongwe District. Journal of Education and Practice, 11(12), 45–53.
6. Creswell, J. W., & Poth, C. N. (2018). Qualitative inquiry and research design: Choosing among five approaches (4th ed.). SAGE Publications.
7. Fereday, J., & Muir-Cochrane, E. (2006). Demonstrating rigor using thematic analysis: A hybrid approach of inductive and deductive coding and theme development. International Journal of Qualitative Methods, 5(1), 80–92. https://doi.org/10.1177/160940690600500107
8. Fullan, M. (2007). The new meaning of educational change (4th ed.). Teachers College Press.
9. Hofstein, A., & Lunetta, V. N. (2004). The laboratory in science education: Foundations for the twenty-first century. Science Education, 88(1), 28–54. https://doi.org/10.1002/sce.10106
10. International Union of Pure and Applied Physics (IUPAP). (1999). The importance of physics.
11. Jere, C. M. (2010). Research methods in education (2nd ed.). Chancellor College Publications.
12. Kapting'ei, K. B., & Rutto, D. K. (2014). Challenges facing laboratory practical approach in physics instruction in Kenyan district secondary schools. Journal of Education and Practice, 5(6), 122–129.
13. Kola, A. J. (2013). Students' challenges in conducting adequate physics practicals in colleges of education. Academic Journal of Science, 2(1), 1–10.
14. Mlangeni, T., & Chiotha, S. S. (2015). Why is the student performance in physical science examinations at rural community day secondary schools poor in Lilongwe Rural West Education District in Malawi? International Journal of Science and Research, 4(11), 1842–1846.
15. Muletal, T., & Seid, M. (2016). Factors affecting the implementation of practical activities in science education in some selected secondary and preparatory schools of the Afar Region. Journal of Education and Practice, 7(34), 32–40.
16. Patton, M. Q. (2015). Qualitative research & evaluation methods (4th ed.). SAGE Publications.
17. Stake, R. E. (1995). The art of case study research. SAGE Publications.
18. Yin, R. K. (2018). Case study research and applications: Design and methods (6th ed.). SAGE Publications.