Status of Physics Practical Work in Senior Secondary Schools in Kenema Town: A Constructivist Inquiry

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Abstract: Practical work is a vital part of effective physics teaching, giving students the chance to test theories, handle equipment, and link abstract ideas to real-world observations. Unfortunately, in many sub-Saharan African countries, including Sierra Leone, the execution of physics practicals is hindered by significant challenges like insufficient resources, overcrowded classrooms, and a focus on exam preparation. This study looks into the state of physics practical work in senior secondary schools in Kenema Town, using constructivist learning theory as a framework, which highlights the importance of students actively creating meaning from their experiences. We used a mixed-methods approach that included surveys with 150 students, interviews and focus groups with 12 physics teachers, classroom observations, and infrastructure assessments across twelve schools. The results showed that over half of the schools didn't have functional laboratories, and teachers often depended on chalkboard explanations or makeshift demonstrations instead of encouraging student-led experiments. While students were excited about practical work, they expressed frustration over its scarcity and the limited chances for hands-on involvement. Teachers pointed out systemic issues like insufficient funding, a lack of training in practical teaching methods, and the pressure to prepare students for the West African Senior School Certificate Examination (WASSCE). Despite these hurdles, some innovative practices were noted, such as using local materials creatively and fostering collaborative group work. By applying a constructivist approach, the study concludes that allowing students to actively participate in inquiry-based practicals, even with low-cost improvisations, can greatly improve their physics learning experience. This research offers valuable insights for policymakers, educators, and curriculum developers aiming to enhance science education in Sierra Leone and similar settings.

Keywords: *Physics Education, Constructivism, Sierra Leone, Secondary Schools, Practical Work, Science Pedagogy.*

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I. INTRODUCTION

Science education is widely acknowledged as a cornerstone for national development, equipping learners with critical thinking skills, problem-solving abilities, and the capacity to participate in technological and scientific advancement. Within the sciences, physics plays a particularly vital role because of its emphasis on experimentation and its application to engineering, technology, and innovation. Central to the teaching of physics is practical work, which provides students with the opportunity to interact directly with physical phenomena, test theoretical principles, and cultivate experimental reasoning (Hodson, 2014; Millar, 2010).

Globally, research demonstrates that practical activities enhance student engagement, deepen conceptual understanding, and foster positive attitudes toward science (Abrahams & Reiss, 2012; Hofstein & Lunetta, 2004). Yet, practical work must be implemented effectively to realize these benefits; otherwise, it risks becoming routine, teacher-led demonstrations with limited educational impact.

Across sub-Saharan Africa, the delivery of effective physics practicals remains a challenge. Resource shortages, large class sizes, and exam-oriented curricula often lead teachers to prioritize theoretical instruction at the expense of laboratory-based activities (Onwu & Stoffels, 2005; Ogunniyi, 2006). In many schools, practicals are conducted infrequently, with students observing teacher demonstrations rather than engaging directly in inquiry. This situation not only undermines students' understanding of physics but also contributes to persistent underachievement in science examinations and low enrollment in science-related fields at higher levels of education (Okebukola, 2005).

In Sierra Leone, these challenges are compounded by historical, social, and infrastructural factors. The country's civil war (1991–2002) devastated school infrastructure and disrupted teacher training pipelines, leaving a legacy of under-resourced institutions (World Bank, 2020). Despite recent efforts to expand access and improve quality, science education outcomes remain weak. Reports from the West African Examinations Council (WAEC) consistently highlight low performance in physics, particularly in sections assessing experimental and problem-solving skills. Anecdotal evidence suggests that many schools lack functional laboratories, forcing teachers to rely on abstract explanations rather than practical engagement (Sesay, 2017).

Against this backdrop, this study investigates the status of physics practical work in senior secondary schools in Eastern Sierra Leone. It is guided by a constructivist framework, which emphasizes that learners actively build knowledge through experiences, interactions, and reflection. By exploring teacher perceptions, student attitudes, classroom practices, and resource availability, the study seeks to provide a comprehensive account of current realities and to generate actionable recommendations for strengthening physics education.

➢ *Statement of the Problem*

Practical work is widely recognized as a cornerstone of effective science education, particularly in physics, where it enables students to connect abstract theories with observable phenomena, develop experimental reasoning, and engage in inquiry-based learning (Hodson, 2014; Millar, 2010). International research demonstrates that well-designed laboratory experiences enhance student motivation, deepen conceptual understanding, and foster positive attitudes toward science (Abrahams & Reiss, 2012; Hofstein & Lunetta, 2004). However, these benefits are often unrealized in sub-Saharan Africa due to systemic barriers such as inadequate laboratory facilities, limited equipment, overcrowded classrooms, and exam-driven instruction (Onwu & Stoffels, 2005; Ogunniyi, 2006).

In Sierra Leone, these challenges are particularly acute. The country's education system is still grappling with the legacies of prolonged civil conflict, which devastated school infrastructure and disrupted teacher preparation (World Bank, 2020). Despite curricular requirements for practical activities, evidence suggests that many schools lack functional laboratories, compelling teachers to substitute experiments with chalkboard explanations or improvised demonstrations (Sesay, 2017). Reports from the West African Examinations Council (WAEC) consistently indicate that students perform poorly in practical-based sections of physics examinations, underscoring the inadequacy of current instructional practices (Ministry of Basic and Senior Secondary Education [MBSSE], 2019).

Compounding these infrastructural and systemic challenges are pedagogical issues. Teachers often lack training in improvisation and inquiry-based pedagogy, leading to a predominance of teacher-centered approaches (Ogunleye, 2009). Students, in turn, are deprived of opportunities to actively construct knowledge through hands-on inquiry, contradicting the constructivist principle that meaningful learning arises from interaction with phenomena and collaborative exploration (Driver et al., 1994; Vygotsky, 1978). This gap between curricular expectations and classroom realities not only undermines students' conceptual understanding but also discourages interest in pursuing science-related careers (Mokiwa & Agbenyega, 2014).

Given these realities, there is an urgent need to investigate the status of physics practical work in Sierra Leonean secondary schools, with particular attention to teacher practices, student experiences, and infrastructural constraints. While global and regional studies have highlighted the importance of practical work and the challenges of implementing it in resource-limited contexts, empirical research focusing specifically on Sierra Leone remains limited. Addressing this gap is critical for informing evidence-based interventions that can enhance science education and contribute to the nation's broader development goals.

➢ *Research Objectives:*

The research objectives are as follows:

- To assess the availability of resources and infrastructure for practical activities.
- To examine the frequency and nature of practical activities conducted in the educational settings.
- To explore teachers' perceptions of and practices related to practical activities.
- To identify systemic and institutional challenges affecting the implementation of practical activities.

II. LITERATURE REVIEW

➢ *Global Perspectives on Practical Work in Physics*

Practical work is widely recognized as a central element of effective science education. In physics, experimentation provides students with opportunities to test theoretical principles, manipulate apparatus, and develop investigative skills. Research from developed contexts consistently demonstrates that practical activities enhance conceptual understanding, improve problem-solving skills, and foster positive attitudes toward science learning (Hodson, 2014; Millar, 2010).

Nevertheless, scholars caution that practical activities must be carefully designed and implemented to achieve meaningful outcomes. Hofstein and Lunetta (2004) argue that poorly structured laboratory exercises risk becoming mechanical "cookbook" activities, with students following instructions without engaging in genuine inquiry. Abrahams and Reiss (2012) similarly emphasize the importance of aligning practical work with learning objectives, ensuring that experiments support conceptual development rather than serving as superficial add-ons to theoretical lessons. Thus, while practical work is celebrated as a cornerstone of physics pedagogy, its impact depends heavily on the pedagogical approach and the learning context.

➢ *Challenges in Sub-Saharan Africa*

In sub-Saharan Africa, the delivery of effective science practicals faces systemic barriers. Chronic underfunding of education has resulted in inadequate laboratories, shortages of equipment, and overcrowded classrooms (Onwu & Stoffels, 2005). Teachers often lack training in inquiry-based pedagogy or improvisation with local materials (Ogunleye, 2009), and high-stakes examinations encourage theory-focused teaching at the expense of practical engagement (Esiobu, 2005).

Studies across the region confirm these trends. Okebukola (2005) found that many Nigerian schools rarely conduct genuine laboratory activities, relying instead on teacher demonstrations. Mokiwa and Agbenyega (2014) reported similar findings in South Africa, where students expressed frustration at the limited opportunities for hands-on learning. Despite these challenges, innovative practices are emerging. Low-cost science kits, professional development in improvisational methods, and curriculum reforms emphasizing process skills have shown promise in countries such as Ghana, Kenya, and Uganda. However, scalability and sustainability remain major obstacles, particularly in rural contexts.

➢ *Science Education in Sierra Leone*

Sierra Leone’s education system reflects many of the broader African challenges while also facing unique historical legacies. The civil conflict of the 1990s and early 2000s severely disrupted schooling, destroyed infrastructure, and constrained teacher development (World Bank, 2020). Although significant progress has been made in rebuilding the education sector, quality remains a persistent concern, especially in science and mathematics (Ministry of Basic and Senior Secondary Education, 2019).

Performance in physics at the West African Senior School Certificate Examination (WASSCE) is consistently low, with students struggling particularly in practical-oriented sections. Sesay (2017) notes that the lack of functional laboratories in many schools forces teachers to substitute practical sessions with chalkboard explanations. In rural areas, equipment shortages are especially severe, and safety materials such as goggles and extinguishers are often nonexistent. Teachers, already burdened by overcrowded classrooms, may avoid practical work altogether.

Nonetheless, pockets of innovation exist. Some teachers improvise using everyday materials for example, bottles for optics experiments or locally available weights for mechanics demonstrations. A few urban schools, often supported by donor funding, have established functional laboratories. However, these positive examples are not widespread, and disparities between urban and rural schools remain stark. Importantly, few empirical studies have systematically documented the realities of physics practical work in Sierra Leone, underscoring the need for the present investigation.

➢ *Constructivism and Practical Science Education*

Constructivist learning theory, derived from the works of Piaget, Vygotsky, and later science educators such as Driver, emphasizes that learners actively construct knowledge through interaction with their environment and reflection on their experiences. In the context of science education, this means that students learn most effectively when they engage directly with phenomena, test ideas, and build understanding through hands-on inquiry (Driver, Asoko, Leach, Mortimer, & Scott, 1994).

Constructivism is particularly relevant to physics practicals, where abstract concepts such as force, motion, or electricity can be rendered meaningful through experimentation. By manipulating apparatus, observing outcomes, and discussing results, students develop not only conceptual understanding but also metacognitive awareness of their learning processes.

In low-resource country such as Sierra Leone, constructivism provides a framework for maximizing limited opportunities. Even improvised or simplified experiments can enable students to construct meaning, provided that teachers adopt inquiry-based approaches and encourage reflection. In contrast, teacher-dominated demonstrations or purely theoretical instruction deprive students of opportunities to actively construct knowledge. Thus, constructivism highlights both the problem the absence of student-centered practical engagement and the solution: creating active, inquiry-oriented learning environments even within material constraints.

➢ *Synthesis and Research Gap*

The literature confirms the value of practical work in science education while also highlighting systemic barriers to its effective implementation in African classrooms. In Sierra Leone, anecdotal evidence points to serious constraints, including resource shortages, overcrowding, and inadequate teacher preparation. However, empirical research documenting these challenges remains limited. Furthermore, few studies explicitly apply a constructivist framework to analyze how students and teachers interact with practical activities in such contexts.

- *This Study Addresses these Gaps by:*

✓ Providing a systematic account of the status of physics practical work in senior secondary schools in Kenema Town.
✓ Examining teacher perceptions, student beliefs, and classroom practices through the lens of constructivist theory.
✓ Identifying both systemic barriers and contextually appropriate strategies to improve practical science instruction.

By situating its analysis within constructivism, the study contributes to the broader discourse on science pedagogy in resource-limited settings while offering practical recommendations for enhancing physics education in Sierra Leone.

- *Theoretical Framework: Constructivism*

This study is grounded in constructivist learning theory, which posits that learners actively build knowledge through interaction with their environment, prior experiences, and social dialogue (Piaget, 1972; Vygotsky, 1978; Driver et al., 1994). In contrast to traditional transmission models where the teacher is the sole source of knowledge, constructivism emphasizes that understanding emerges when learners engage directly in inquiry, test ideas, and reflect on outcomes.

In Science education, constructivism underscores the importance of practical work. Experiments allow students to connect abstract theories to tangible experiences, develop process skills, and construct meaning through observation and discussion. By manipulating apparatus, testing predictions, and collaborating with peers, students actively participate in knowledge construction rather than passively receiving information.

Applying constructivism to Sierra Leone's is especially pertinent. Given the scarcity of resources and the dominance of teacher-centered methods, constructivist pedagogy highlights both the challenges and potential solutions. Even when resources are limited, teachers can facilitate inquiry-based learning through improvisation, peer collaboration, and reflective discussions. Constructivism thus provides a powerful framework for analyzing the current status of physics practicals while guiding recommendations for improvement.

III. METHODOLOGY

- *Research Design*

This study adopted a mixed-methods design, combining both quantitative and qualitative approaches to capture measurable patterns while also gaining rich, contextual insights. Mixed-methods research is increasingly recognized in educational studies for its ability to combine the breadth of quantitative data with the depth of qualitative exploration, providing a more comprehensive understanding of complex phenomena (Creswell & Plano Clark, 2018; Morgan, 2014). This approach aligns with constructivist principles, acknowledging the multiple perspectives that exist within educational contexts and emphasizing the value of drawing on diverse forms of evidence to build a fuller picture of reality.

To assess the availability of resources and infrastructure for practical activities, the study conducted detailed infrastructure audits through site visits to the sampled schools. These audits documented the presence and condition of laboratories, equipment, utilities, and safety provisions, enabling a systematic understanding of the physical and material conditions supporting practical work.

The quantitative strand of the study involved administering structured questionnaires to students. These instruments captured information on prior knowledge, attitudes toward physics, and experiences with practical activities, thereby addressing the objective of examining the frequency and nature of practical activities conducted in educational settings. The resulting numerical data provided insights into how often practical sessions were conducted and how students perceived their contribution to learning outcomes.

The qualitative strand comprised semi-structured interviews with teachers, focus group discussions with students, and classroom observations. These methods allowed the study to explore teachers' perceptions and practices regarding practical activities, as well as the systemic and institutional challenges influencing their implementation. Qualitative approaches were particularly valuable for uncovering the meanings participants ascribe to their experiences, offering nuance and depth beyond what surveys alone can capture (Merriam & Tisdell, 2016).

By integrating quantitative, qualitative, and infrastructural data, the study employed triangulation to enhance the validity and reliability of the findings (Denzin, 2012). Triangulation enabled confirmation of patterns across data sources, resulting in a robust account of the status of physics practical work in Sierra Leone. This comprehensive methodology not only quantified challenges but also illuminated the lived experiences of students and teachers navigating resource-constrained educational environments, directly addressing the study's objectives of resource assessment, activity frequency, teacher practices, and systemic challenges.

- *Participants*

The study was conducted in twelve senior secondary schools located across Eastern Kenema Town. Schools were purposively selected to reflect both urban and rural settings, as well as to capture variations in resource availability. Purposeful sampling is particularly appropriate in educational research where the aim is to generate in-depth insights from information-rich cases, rather than to generalize statistically to a broader population (Cohen, Manion, & Morrison, 2018).

A total of 150 Senior Secondary 2 (SS2) physics students participated in the study. Students were selected through stratified sampling, ensuring representation across gender and academic performance levels. This strategy enhanced the trustworthiness of the data by capturing a diversity of perspectives within the student body. As recommended by Creswell and Creswell (2018), stratification ensured that subgroups within the population were adequately represented, making it possible to identify both common trends and variations in experiences.

In addition to students, the study engaged 12 physics teachers, whose professional experience ranged from early-career educators with fewer than five years of service to veteran teachers with over two decades of classroom practice. The inclusion of teachers at different career stages provided

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valuable insights into variations in pedagogical strategies, levels of professional training, and approaches to addressing resource constraints.

Finally, 12 school administrators, including principals and laboratory assistants, were interviewed to provide institutional perspectives on science education. Their testimonies illuminated systemic factors such as policy implementation, funding mechanisms, laboratory maintenance, and broader administrative challenges. By including administrators alongside teachers and students, the study was able to integrate perspectives from multiple levels of the school system, thereby strengthening the comprehensiveness and validity of the findings.

Together, the inclusion of these three groups of participants students, teachers, and administrators ensured that the study offered a multi-layered account of the status of physics practical work in Sierra Leonean secondary schools. This triangulation of perspectives aligns with the mixed-methods approach adopted in the study and reinforces the constructivist principle of valuing multiple voices in the co-construction of knowledge.

➢ *Data Collection Methods*

Data for the study were gathered using four complementary methods: student questionnaires, teacher interviews and focus groups, classroom observations, and infrastructure audits. The use of multiple data collection techniques reflects the logic of mixed-methods research, which seeks to generate comprehensive insights by combining quantitative and qualitative evidence (Creswell & Plano Clark, 2018). This approach also aligns with constructivist principles, emphasizing the value of capturing diverse perspectives and experiences in order to build a richer understanding of educational realities.

Student questionnaires were used to collect quantitative data on learners' prior knowledge, beliefs about physics, and attitudes toward laboratory work. The instruments incorporated both Likert-scale items, which enabled the measurement of trends and patterns, and open-ended questions**,** which provided students with the opportunity to articulate their experiences in their own words. This design made it possible to examine not only the frequency and quality of exposure to practical activities but also students' perceptions of how these experiences influenced their learning. Surveys are particularly effective in educational settings for capturing broad patterns across large groups of learners (Bryman, 2016).

Teacher interviews and focus group discussions provided qualitative insights into classroom practice and pedagogical challenges. Semi-structured interviews were conducted with individual teachers to explore their perceptions of physics practical work, the strategies they employed, and the systemic barriers they encountered. Focus group discussions complemented these interviews by fostering collaborative reflection among teachers and highlighting shared experiences. Such methods are especially effective in uncovering professional perspectives and drawing out tacit knowledge embedded in teaching practice (Merriam & Tisdell, 2016).

Classroom observations were conducted to document the practical realities of instruction. A total of twelve physics practical sessions were observed across the participating schools. Observers employed a structured checklist to record student interactions with equipment, levels of engagement, adherence to safety practices, and the role of teacher facilitation. Field notes were also maintained to provide contextual richness, capturing nuances such as classroom dynamics, teacher-student dialogue, and the extent of collaborative learning. Observation is a valuable tool in education research because it provides direct evidence of behavior and practice in naturalistic settings (Cohen, Manion, & Morrison, 2018).

Finally, infrastructure audits were carried out in each of the twelves schools. These audits involved systematic inspections of laboratory facilities, focusing on the availability and condition of equipment, access to utilities such as electricity and water, and the provision of essential safety resources. Infrastructure audits provided objective data that corroborated the self-reports of teachers and students, ensuring that claims about resource constraints were grounded in observed evidence.

By integrating these four methods, the study ensured triangulation, which enhances the validity and reliability of findings by corroborating information across different data sources (Denzin, 2012). This comprehensive approach provided not only quantifiable measures of access to physics practicals but also rich insights into the experiences of teachers and students, as well as the systemic and infrastructural conditions shaping science education in Sierra Leone.

➢ *Data Analysis*

Survey data were first analyzed quantitatively using SPSS, where descriptive statistics such as frequencies, means, and percentages provided a clear picture of students' experiences. Cross-tabulations were also carried out to explore how school type and student demographics might relate to these experiences. At the same time, qualitative data from interviews, focus group discussions, and field notes were examined through thematic analysis, following Braun and Clarke's (2006) six-phase framework. NVivo software supported the coding process and helped identify patterns and themes across participants' responses. By triangulating findings from both quantitative and qualitative sources, the study was able to produce a richer, more reliable understanding of the phenomena under investigation, ensuring that the results reflected both measurable trends and the lived experiences of students and teachers.

➢ *Ethical Considerations*

The study adhered to ethical standards for educational research. Approval was obtained from the relevant institutional review board. Informed consent was secured from teachers and administrators, while students provided assent along with parental permission. Participants were

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assured of confidentiality and anonymity, and pseudonyms were used in reporting. All interviews and focus groups were conducted in a respectful, non-intrusive manner, with participants free to withdraw at any time.

IV. FINDINGS

➢ *Availability of Resources and Infrastructure*

The infrastructure audit revealed widespread shortages of functional laboratories and basic equipment.

Table 1 Availability of Physics Laboratory Facilities in Sampled Schools (n = 12)

Facility/Resource	Fully Available (%)	Partially Available (%)	Not Available (%)
Dedicated Physics Laboratory	33.00	17.00	50.00
Standard Physics Equipment (voltmeters, pendulums, optics sets)	20.00	30.00	50.00
Electricity Supply	17.00	33.00	50.00
Water Supply	17.00	17.00	66.55
Safety Equipment (goggles, fire extinguisher)	0.00	33.00	67.00

Only two schools possessed a dedicated physics laboratory, and just one maintained a reasonable stock of functioning equipment. Most schools lacked basic apparatus for core topics such as electricity and optics. The absence of safety equipment was almost universal.

➢ *Frequency and Nature of Practical Activities*

Student survey responses indicated infrequent exposure to practical work, with only 28% of students reporting participating in at least one practical activity per month and 47% stating that practical sessions occurred less than once per term, while 25% reported never conducting a formal physics experiment during secondary school. Observations confirmed that when practical sessions were held, they primarily consisted of teacher demonstrations with limited student involvement, and in large classes averaging 65 students, only a small number of students interacted directly with the equipment.

"Most times, we just watch the teacher. Only a few students are chosen to do the experiment." (Student, urban school)

➢ *Teacher Perceptions and Practices*

Teachers generally acknowledged the importance of practical work but cited multiple constraints, including resource shortages, with half of them reporting a lack of even basic apparatus needed for curriculum experiments, as well as challenges posed by overcrowded classes that made managing practical sessions difficult, and exam pressures that compelled teachers to prioritize theoretical coverage to adequately prepare students for WASSCE examinations. Despite these barriers, some teachers demonstrated resourcefulness. Four out of twelve schools reported using improvised materials**,** such as bottles for optics or stones for weights in mechanics. One urban school had created a mobile practical kit shared among classrooms.

"We cannot rely on the Ministry for equipment. I improvise using local materials to make sure the students see at least something practical." (Teacher, urban school)

➢ *Student Attitudes and Experiences*

Students expressed strong enthusiasm for practical learning but felt frustrated by its limited availability, with 82% agreeing that practicals made physics more understandable, 76% believing that the absence of practicals discouraged them from pursuing careers in science or engineering, and 68% indicating that they felt "unprepared" for the practical component of the WASSCE exam.

Focus group discussions revealed that students associated practical work with "making physics real" and "learning by seeing." However, many reported feeling disadvantaged compared to peers in better-resourced schools.

"Without practicals, physics is just mathematics with words. We want to touch and see." (Student, urban school)

➢ *Systemic and Institutional Challenges*

Administrators highlighted several systemic issues impacting the effective delivery of practical work, including funding constraints, as schools lacked dedicated budgets for laboratory maintenance and equipment procurement; policy gaps, where despite curriculum mandates for practicals, there was insufficient financial or logistical support to facilitate their implementation; and sustainability challenges, exemplified by donated equipment frequently falling into disrepair due to a lack of spare parts and maintenance expertise.

"We once received laboratory materials from an NGO, but when they broke, we had no way of repairing them. Now they sit in storage." (Principal, rural school)

- *Emerging Innovations*

Despite systemic barriers, several notable innovations emerged, including teachers' creative use of improvised apparatus by repurposing everyday items for demonstrations, which helped connect theoretical concepts with real-world applications; peer collaboration among students in overcrowded settings, where they worked in small groups to share equipment and collaboratively solve problems; and external partnerships, such as one school collaborating with a local NGO to access a mobile science laboratory once per term, enhancing practical learning opportunities.

These examples illustrate how local initiatives can partially mitigate resource shortages, aligning with constructivist principles by enabling students to construct meaning through contextual experiences.

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V. DISCUSSION

➢ *Resource Shortages and Their Impact on Constructivist Learning*

The findings revealed that most schools lacked functional laboratories and adequate equipment, echoing earlier studies in Nigeria, Ghana, and South Africa that document similar constraints (Okebukola, 2005; Onwu & Stoffels, 2005; Mokiwa & Agbenyega, 2014). From a constructivist perspective**,** this absence is particularly detrimental. Constructivism emphasizes that learners build knowledge through direct interaction with materials and phenomena (Driver et al., 1994; Vygotsky, 1978). Without opportunities to manipulate equipment and engage in experiments, Sierra Leonean students are denied essential pathways to meaningful understanding, instead being limited to rote memorization of abstract formulas.

➢ *Teacher Practices: Between Constraints and Innovation*

Teachers acknowledged the importance of practical work but were constrained by overcrowding, exam pressures, and lack of resources. These findings resonate with research across Africa that highlights how external pressures push teachers toward teacher-centered, theory-heavy methods (Esiobu, 2005; Ogunleye, 2009).

However, the study also identified creative adaptations, such as the improvisation of apparatus and the use of mobile kits. Constructivism values such innovation, as even improvised activities can provide students with experiential learning opportunities if framed as inquiry-oriented tasks. These adaptations show that, although systemic barriers remain, teachers can foster constructivist learning environments through ingenuity and resourcefulness.

➢ *Student Engagement and the Desire for Active Learning*

Students' enthusiasm for practicals, coupled with frustration at their scarcity, highlights the motivational power of hands-on work. Studies globally affirm that practical activities enhance motivation and conceptual understanding (Hodson, 2014; Abrahams & Reiss, 2012). In Sierra Leone, students explicitly articulated that practicals made physics "real" and distinguished it from mathematics. This aligns with constructivist theory, which posits that learners make sense of abstract concepts more effectively when they are grounded in concrete experience (Piaget, 1972).

The lack of adequate exposure, however, risks disengagement and diminished aspirations for science-related careers. This finding reflects regional concerns that inadequate science teaching contributes to declining STEM enrollment across West Africa (Mokiwa & Agbenyega, 2014).

➢ *Systemic Barriers and Policy Gaps*

Administrators' testimonies pointed to systemic issues such as insufficient funding, lack of maintenance structures, and weak policy enforcement. These systemic shortcomings mirror critiques in the African science education literature that reforms often emphasize curriculum change without addressing material and infrastructural realities (Ogunniyi, 2006).

From a constructivist standpoint, policy gaps are particularly damaging because they fail to support the conditions necessary for experiential learning. A curriculum that mandates practicals without providing resources or training sets teachers and students up for failure. For constructivist pedagogy to thrive, systemic investment in laboratories, teacher development, and sustainable maintenance structures is essential.

➢ *Innovations and Opportunities for Scaling*

Despite the challenges, the study found encouraging evidence of teacher improvisation, peer collaboration, and partnerships with NGOs. These innovations embody constructivist ideals by situating learning within students' lived realities and encouraging collaboration and inquiry. The challenge, however, is moving from isolated examples to system-wide practice.

Scaling such initiatives requires institutional support. For instance, teacher improvisation could be formalized through professional development workshops, while NGO-supported mobile labs could be expanded through public–private partnerships. Such pragmatic approaches align with constructivist theory by emphasizing that knowledge is context-dependent and constructed through real-world experiences.

➢ *Implications for Science Education in Sierra Leone*

Taken together, the findings underscore the tension between curriculum expectations and classroom realities. While the curriculum mandates physics practicals, the lack of resources and training constrains their delivery. Constructivism provides both a critique and a vision: it reveals how current practices limit students' opportunities to construct knowledge, while also pointing toward strategies such as improvisation, peer collaboration, and inquiry-based teaching that can maximize learning within existing constraints.

- *Thus, the Study Highlights the Need for a Dual Approach:*

✓ Immediate, low-cost interventions (teacher improvisation, mobile science kits, collaborative practicals).
✓ Long-term systemic reforms (investment in laboratories, alignment of WASSCE assessments with practical competencies, and sustainable funding mechanisms).

VI. CONCLUSION AND RECOMMENDATIONS

A. Conclusion

This study examined the status of physics practical work in senior secondary schools in Eastern Sierra Leone through the lens of constructivist learning theory. The findings revealed that most schools lack functional laboratories and basic equipment, leading to infrequent or teacher-dominated practical sessions. Students expressed strong enthusiasm for hands-on learning but reported frustration at its limited

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availability. Teachers recognized the importance of practicals but were constrained by resource shortages, overcrowded classrooms, and exam-oriented pressures.

Despite these challenges, examples of innovation emerged, including improvisation with local materials, peer collaboration, and partnerships with NGOs. These practices illustrate the potential for constructivist learning even in resource-limited settings, provided that systemic and institutional support is strengthened.

The study contributes to the limited empirical literature on science education in Sierra Leone and demonstrates how constructivism can inform both the analysis of current challenges and the design of context-sensitive solutions.

B. Recommendations

Based on the findings, the following recommendations are proposed:

➢ *Teacher Professional Development*

- Introduce in-service training programs on improvisation, inquiry-based learning, and reflective teaching practices.
- Establish teacher learning communities to share effective strategies for low-resource contexts.

➢ *Improvised and Low-Cost Resources*

- Encourage the use of locally available materials to simulate experiments.
- Support the development and distribution of mobile practical kits tailored to the Sierra Leonean curriculum.

➢ *Curriculum and Assessment Reform*

- Align WASSCE assessments more closely with practical competencies, ensuring that laboratory work is not marginalized.
- Incorporate continuous assessment of practical skills alongside final examinations.

➢ *Policy and Funding Initiatives*

- Establish dedicated budget lines for laboratory development and maintenance at the secondary level.
- Strengthen partnerships with NGOs and private organizations to sustain resource provision.

➢ *Scaling Innovations*

- Expand successful grassroots practices, such as teacher improvisation and mobile laboratories, through government-led initiatives.
- Pilot community-based fabrication of simple apparatus to reduce dependency on imported equipment.

By implementing these recommendations, Sierra Leone can take meaningful steps toward improving the quality, equity, and sustainability of physics education, thereby preparing students more effectively for scientific and technological participation in the 21st century.

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