

Embedding Sustainability and Practical Competence in Education: A Case for “Fix-It Labs” and the Analysis of Uganda’s Competency-Based Curriculum

Asimwe Isaac Kazaara¹, Musiimenta Nancy²

1,2 Metropolitan International University

ABSTRACT

Background: Uganda's adoption of a Competency-Based Curriculum (CBC) in 2018 represented a significant shift toward practical skills development and sustainability integration, yet implementation gaps have emerged between curriculum intentions and classroom realities, particularly regarding hands-on learning experiences that develop technical competence and environmental consciousness.

Objective: This study examined the potential for embedding Fix-It Labs—innovative repair-based learning spaces—within Uganda's CBC framework as mechanisms for enhancing practical competence development and sustainability education in secondary schools.

Methods: A concurrent mixed-methods design was employed across 24 secondary schools in Central Uganda (Kampala, Wakiso, Mukono, and Mpigi). The quantitative component involved surveys of 384 teachers (determined using Cochran's formula to achieve 80% statistical power) and 422 students selected through stratified random sampling, with analyses including descriptive statistics, one-way ANOVA, Pearson correlations, and multiple regression.

Results: One-way ANOVA revealed significant differences in CBC implementation fidelity across school contexts ($F = 28.64, p < 0.001, \eta^2 = 0.131$), with urban schools ($M = 3.42$) significantly outperforming peri-urban ($M = 3.18$) and rural schools ($M = 2.76$), though sustainability integration remained low across all contexts (overall $M = 2.55, SD = 0.82$). Correlation analysis demonstrated strong positive relationships between practical learning opportunities and student practical competence ($r = 0.679, p < 0.01$) and between sustainability integration and student environmental awareness ($r = 0.596, p < 0.01$), confirming the pedagogical alignment between Fix-It Lab approaches and CBC competency goals. Multiple regression analysis identified resource availability ($\beta = 0.341, p < 0.001$) as the strongest predictor of Fix-It Lab integration feasibility, followed by administrative support ($\beta = 0.253, p < 0.001$), teacher training adequacy ($\beta = 0.235, p < 0.001$), CBC implementation fidelity ($\beta = 0.226, p = 0.002$), and school context ($\beta = 0.218, p < 0.001$), collectively explaining 61.2% of variance ($R^2 = 0.612, \text{Adjusted } R^2 = 0.605, F(7, 376) = 84.63, p < 0.001$).

Conclusion: Uganda's CBC framework provided conceptual space for Fix-It Lab integration, and repair-based pedagogical approaches aligned strongly with curriculum competency goals; however, successful implementation required systemic interventions addressing resource disparities (particularly between urban and rural schools), teacher professional development needs, and institutional support structures. Teachers perceived Fix-It Labs as feasible ($M = 3.52$) and students demonstrated high interest in repair activities ($M = 3.92$), indicating favorable attitudinal conditions for integration despite current structural implementation challenges.

Recommendations: The study recommends establishing a national Fix-It Lab implementation framework with tiered resource allocation prioritizing under-resourced schools; developing comprehensive teacher professional development

programs for repair-based pedagogy; and integrating Fix-It Lab performance indicators into CBC monitoring systems to ensure sustained attention and accountability.

Keywords: Competency-Based Curriculum, Fix-It Labs, Sustainability Education, Practical Competence

INTRODUCTION

The global education landscape is undergoing a fundamental transformation as societies grapple with pressing challenges of environmental sustainability, resource scarcity, and the need for practical problem-solving skills. Traditional education systems, long criticized for their emphasis on theoretical knowledge at the expense of hands-on competencies, are increasingly recognized as inadequate for preparing learners to navigate complex 21st-century challenges (Monica, 2022; Prosper Mubangizi, 2020). This inadequacy is particularly pronounced in developing contexts like Uganda, where rapid technological advancement coexists with limited access to repair services, pervasive electronic waste, and a growing disconnect between educational outcomes and labor market demands. This study explores the intersection of sustainability education and practical competence development through the lens of "Fix-It Labs"—innovative learning spaces designed to cultivate repair culture, technical skills, and environmental consciousness among learners (Putro, 2023; Ssentanda & Wenske, 2023).

By examining Uganda's Competency-Based Curriculum (CBC), which purports to prioritize practical skills and real-world application, this research investigates whether current educational frameworks adequately support the integration of sustainability-oriented practical learning experiences. The study positions Fix-It Labs not merely as supplementary workshops, but as essential pedagogical tools that embody the principles of experiential learning, circular economy thinking, and competency development that modern curricula aspire to achieve (Katurebe & Nalukwago, 2024; Mubaraka, 2023). As Uganda and similar contexts seek to align their education systems with Sustainable Development Goals, particularly SDG 4 (Quality Education) and SDG 12 (Responsible Consumption and Production), understanding how practical competence spaces like Fix-It Labs can be embedded within competency-based frameworks becomes critically important. This research therefore contributes to broader conversations about curriculum reform, sustainability education, and the practical implementation of competency-based learning in resource-constrained environments (Aheisibwe & Barigye, 2023; Muwanguzi et al., 2023).

BACKGROUND OF THE STUDY

The Global Shift Toward Competency-Based Education

Over the past two decades, education systems worldwide have increasingly adopted competency-based approaches that emphasize learning outcomes over inputs, focusing on what learners can actually do with their knowledge rather than what content they have been exposed to. This shift reflects growing recognition that traditional content-driven curricula often produce graduates who lack practical skills, critical thinking abilities, and adaptability—qualities essential for success in rapidly changing economies. International frameworks such as UNESCO's Education 2030 agenda and the OECD's definition of key competencies have influenced national curriculum reforms across Africa, Asia, and Latin America (Chemutai et al., 2023; Ndomondo et al., 2022).

Uganda's Competency-Based Curriculum

In 2018, Uganda's Ministry of Education and Sports introduced a Competency-Based Curriculum for lower secondary education, marking a significant departure from the knowledge-based curriculum that had dominated Ugandan schools

since independence. The CBC framework emphasizes five core competencies: critical thinking, communication, cooperation, creativity, and self-efficacy. It aims to develop learners who can apply knowledge to solve real-world problems, work collaboratively, and adapt to changing circumstances (Charles et al., 2023; VERGUN et al., 2021). The curriculum also incorporates cross-cutting issues including environmental sustainability, life skills, and entrepreneurship. However, implementation challenges have emerged, particularly regarding the gap between curriculum intentions and classroom realities. Many schools lack adequate resources, teachers report insufficient training in competency-based pedagogy, and assessment practices often revert to traditional knowledge-testing formats. The practical and hands-on learning experiences envisioned by the curriculum frequently remain aspirational rather than operational (Franco et al., 2023; Jamil et al., 2020; Julius & Isaac Kazaara, 2025).

The Rise of Fix-It Culture and Repair Labs

Globally, the repair movement has gained momentum as a response to throwaway culture, planned obsolescence, and mounting electronic waste. Fix-It Labs, repair cafés, and maker spaces have emerged as community-based initiatives that teach repair skills, extend product lifespans, and foster environmental consciousness. These spaces embody principles of sustainability, resourcefulness, and practical problem-solving (Bullough et al., 2022; Khaeruddin & Al Fiqri, 2024; Rusydiyah & Rohman, 2020). Educational institutions in Europe and North America have begun integrating repair labs into curricula, recognizing their potential to develop technical competencies, design thinking, and environmental stewardship. In Uganda, electronic waste is a growing concern, with increasing imports of electronic devices and minimal recycling infrastructure. Simultaneously, many households and institutions struggle to afford repairs or replacement of broken items (Abdulla, 2018; Mohamed & Sundberg, 2022). Despite these conditions creating a natural need for repair skills, Ugandan schools rarely incorporate systematic repair training into their curricula. This represents both a missed educational opportunity and a failure to address pressing sustainability challenges through education (Arinaitwe, 2021; Mujuni et al., 2022; Sengendo & Eduan, 2024).

Connecting Sustainability, Practical Skills, and Curriculum

Sustainability education requires moving beyond abstract environmental concepts to concrete practices that demonstrate responsible resource use. Fix-It Labs offer an ideal platform for this integration, combining technical skill development with environmental consciousness and economic empowerment (Julius & Geoffrey, 2025; Julius & Nelson, 2023). For competency-based curricula to fulfill their promise, they require learning environments where students actively engage with real-world problems—exactly what Fix-It Labs provide. This study therefore examines whether Uganda's CBC creates space for such innovations and how Fix-It Labs might be systematically embedded to enhance both practical competence and sustainability outcomes (Edge et al., 2022; Salazar-Fernandez et al., 2021).

PROBLEM STATEMENT

Despite Uganda's adoption of a Competency-Based Curriculum intended to prioritize practical skills and real-world application, significant gaps persist between curriculum intentions and educational practice, particularly regarding sustainability education and hands-on technical competence. Schools continue to emphasize theoretical knowledge transmission over experiential learning, and learners graduate with limited capacity to repair, maintain, or creatively repurpose common items, contributing to a throwaway culture that exacerbates environmental degradation and economic dependence (Cook, 2022; Geera & Onen, 2023; O'Sullivan & Ring, 2021). While the CBC framework

incorporates sustainability as a cross-cutting issue and emphasizes the development of practical competencies, there is insufficient understanding of how innovative learning spaces such as Fix-It Labs can be systematically integrated to actualize these curriculum goals (Julius, 2025a, 2025b). The absence of structured repair and maintenance education perpetuates a cycle where broken items are discarded rather than repaired, technical skills remain underdeveloped, and opportunities to connect education with environmental responsibility and economic empowerment are missed. Furthermore, there is limited research examining the alignment between Uganda's CBC framework and the pedagogical principles embodied in Fix-It Labs, leaving educators, policymakers, and curriculum developers without evidence-based guidance on how to embed sustainability-oriented practical learning experiences within existing educational structures. This research gap hinders efforts to transform competency-based curriculum from aspiration to reality and to prepare Ugandan learners with the practical skills and sustainability mindsets needed for the 21st century.

MAIN OBJECTIVE

To examine the potential for embedding Fix-It Labs within Uganda's Competency-Based Curriculum as a mechanism for enhancing practical competence development and sustainability education in secondary schools.

SPECIFIC OBJECTIVES

1. To analyze the extent to which Uganda's Competency-Based Curriculum framework accommodates sustainability-oriented practical learning experiences such as Fix-It Labs.
2. To assess the alignment between Fix-It Lab pedagogical approaches and the competency development goals outlined in Uganda's secondary education curriculum.
3. To identify the opportunities, challenges, and requirements for systematically integrating Fix-It Labs into Ugandan secondary schools within the competency-based framework.

RESEARCH QUESTIONS

1. To what extent does Uganda's Competency-Based Curriculum framework provide space for integrating sustainability-oriented practical learning experiences such as Fix-It Labs?
2. How do the pedagogical approaches employed in Fix-It Labs align with the competency development goals articulated in Uganda's secondary education curriculum?
3. What are the key opportunities, challenges, and requirements for systematically embedding Fix-It Labs within Ugandan secondary schools under the competency-based curriculum framework?

METHODOLOGY

This study employed a concurrent mixed-methods design that combined quantitative and qualitative approaches to comprehensively examine the integration potential of Fix-It Labs within Uganda's Competency-Based Curriculum. The study was conducted across 24 purposively selected secondary schools in four districts of Central Uganda (Kampala, Wakiso, Mukono, and Mpigi), representing urban, peri-urban, and rural contexts. The quantitative component involved a cross-sectional survey of 384 teachers (determined using Cochran's formula with 95% confidence level, 5% margin of error, and 50% population proportion to achieve 80% statistical power for detecting medium effect sizes), who were randomly selected from the participating schools and completed structured

questionnaires assessing their perceptions of CBC implementation, sustainability integration, and feasibility of Fix-It Labs. A separate survey was administered to 422 students (Senior 2 and Senior 3) selected through stratified random sampling to evaluate their practical competence levels, environmental awareness, and interest in repair-based learning activities. Statistical analyses included descriptive statistics (means, standard deviations, frequencies), independent samples t-tests and one-way ANOVA to compare perceptions across demographic variables and school contexts, Pearson correlation analysis to examine relationships between CBC implementation fidelity and practical competence outcomes, and multiple regression analysis to identify predictors of successful sustainability integration and Fix-It Lab feasibility (Nelson et al., 2022, 2023). The qualitative component comprised in-depth semi-structured interviews with 18 curriculum development officers and education administrators purposively selected from the National Curriculum Development Centre and District Education Offices, alongside 12 focus group discussions with teachers (6 groups) and students (6 groups) to explore lived experiences with CBC implementation, barriers to practical learning, and perceptions of Fix-It Lab value. Additionally, systematic document analysis was conducted on CBC framework documents, subject syllabi, teacher guides, and assessment materials using thematic content analysis to identify explicit and implicit provisions for sustainability education and practical competence development.

RESULTS

Table 1: CBC Implementation Fidelity and Sustainability Integration by School Context

Variable	Urban (n=128)	Peri-Urban (n=136)	Rural (n=120)	F- statistic	p- value	η ²
CBC Implementation Fidelity Score (Scale: 1-5)						
Mean (SD)	3.42 (0.68)	3.18 (0.72)	2.76 (0.81)	28.64	<0.001	0.131
Sustainability Integration Score (Scale: 1-5)						
Mean (SD)	2.89 (0.74)	2.54 (0.79)	2.18 (0.85)	26.92	<0.001	0.124
Practical Learning Opportunities Score (Scale: 1-5)						
Mean (SD)	2.95 (0.82)	2.61 (0.88)	2.24 (0.91)	22.17	<0.001	0.104
Teacher Training Adequacy (Scale: 1-5)						
Mean (SD)	2.64 (0.91)	2.38 (0.95)	2.01 (0.98)	15.38	<0.001	0.075
Resource Availability Score (Scale: 1-5)						
Mean (SD)	3.21 (0.86)	2.73 (0.91)	2.15 (0.94)	45.73	<0.001	0.194
Fix-It Lab Feasibility Perception (Scale: 1-5)						
Mean (SD)	3.78 (0.71)	3.52 (0.76)	3.28 (0.83)	14.62	<0.001	0.071

Note: One-way ANOVA with post-hoc Tukey HSD tests revealed significant differences between all groups ($p < 0.05$) for all variables. η^2 = effect size (partial eta squared).

Statistical Interpretation of Table 1

The one-way ANOVA results revealed statistically significant differences across all measured variables when comparing urban, peri-urban, and rural school contexts, with all F-statistics yielding p-values below 0.001, indicating extremely low probability that these differences occurred by chance. The effect sizes, measured by partial eta squared (η^2), ranged from small to medium, with resource availability demonstrating the largest effect ($\eta^2 = 0.194$, approximately 19.4% of variance explained by school context), followed by CBC implementation fidelity ($\eta^2 = 0.131$) and sustainability integration ($\eta^2 = 0.124$). Post-hoc Tukey HSD tests confirmed that urban schools consistently outperformed both peri-urban and rural schools across all dimensions, while peri-urban schools scored significantly higher than rural schools, establishing a clear hierarchical pattern. Notably, even urban schools, which performed best, exhibited moderate mean scores for CBC implementation fidelity ($M = 3.42$, $SD = 0.68$) and concerningly low scores for teacher training adequacy ($M = 2.64$, $SD = 0.91$) and sustainability integration ($M = 2.89$, $SD = 0.74$), suggesting systemic implementation challenges that transcended contextual differences. The relatively high standard deviations across all variables indicated substantial within-group variability, suggesting that individual school characteristics, beyond geographical context, played important roles in determining implementation success.

Discussion of Findings in Table 1

These findings illuminated critical disparities in CBC implementation across Uganda's educational landscape, with geographical context emerging as a significant determinant of curriculum fidelity and sustainability integration. The pronounced resource gap between urban and rural schools (mean difference of 1.06 points on a 5-point scale) fundamentally constrained the capacity of rural institutions to actualize the competency-based approach, which inherently required physical materials, laboratory equipment, and hands-on learning resources that many rural schools lacked. This resource disparity created a cascade effect, wherein inadequate materials limited practical learning opportunities, which in turn compromised the development of competencies that CBC aimed to foster, thereby perpetuating educational inequalities that the curriculum reform ostensibly sought to address. The universally low scores for sustainability integration across all contexts (ranging from 2.18 to 2.89 on a 5-point scale) revealed that environmental education remained peripheral rather than integrated within the curriculum implementation, despite being designated as a cross-cutting issue in the CBC framework. This marginalization of sustainability education suggested that either teachers lacked understanding of how to embed environmental themes across subjects, or institutional priorities and assessment pressures pushed sustainability concerns to the margins of actual teaching practice. The moderate to high scores for Fix-It Lab feasibility perception across all contexts (ranging from 3.28 to 3.78) were particularly encouraging, indicating that teachers recognized the potential value of repair-based learning despite current implementation challenges. This positive perception, coupled with the stark resource and training gaps, suggested that the primary barriers to Fix-It Lab integration were structural and systemic rather than attitudinal, pointing toward the need for targeted investments in teacher professional development, resource provision, and institutional support systems that could enable practical, sustainability-oriented learning experiences regardless of school context.

Table 2: Correlation Analysis Between CBC Implementation Components and Student Outcomes

Variable	1	2	3	4	5	6
1. CBC Implementation Fidelity	1.000					
2. Sustainability Integration	0.627**	1.000				
3. Practical Learning Opportunities	0.712**	0.584**	1.000			
4. Student Practical Competence	0.531**	0.448**	0.679**	1.000		
5. Student Environmental Awareness	0.412**	0.596**	0.503**	0.557**	1.000	
6. Student Interest in Repair Activities	0.368**	0.421**	0.524**	0.613**	0.489**	1.000
Mean	3.13	2.55	2.61	2.87	3.24	3.92
SD	0.79	0.82	0.91	0.84	0.76	0.68
Cronbach's α	0.87	0.82	0.85	0.79	0.81	0.76

*Note: N = 384 teachers paired with 422 students. * $p < 0.01$ (two-tailed). All correlations are Pearson product-moment correlations.

Statistical Interpretation of Table 2

The correlation matrix revealed statistically significant positive relationships among all variables at the $p < 0.01$ level, indicating robust associations between CBC implementation components and student outcome measures. The strongest correlation emerged between practical learning opportunities and student practical competence ($r = 0.679$, $p < 0.01$), explaining approximately 46.1% of shared variance ($r^2 = 0.461$), which represented a large effect size according to Cohen's conventions and suggested that increased hands-on learning directly translated to enhanced student capabilities. CBC implementation fidelity demonstrated strong positive correlations with practical learning opportunities ($r = 0.712$, $p < 0.01$) and moderate correlations with student practical competence ($r = 0.531$, $p < 0.01$), indicating that schools with higher curriculum fidelity provided more experiential learning and produced students with better practical skills. The relationship between sustainability integration and student environmental awareness ($r = 0.596$, $p < 0.01$) was notably strong, suggesting that deliberate incorporation of environmental themes in teaching significantly influenced student consciousness about sustainability issues. Interestingly, student interest in repair activities showed moderate positive correlations with all implementation variables, with the strongest associations being practical learning opportunities ($r = 0.524$, $p < 0.01$) and student practical competence ($r = 0.613$, $p < 0.01$), implying that exposure to hands-on learning and development of technical skills fostered greater enthusiasm for repair-based activities. The internal consistency reliability coefficients (Cronbach's α) for all scales exceeded the acceptable threshold of 0.70, ranging from 0.76 to 0.87, confirming the psychometric soundness of the measurement instruments and lending credibility to the observed correlations.

Discussion of Findings in Table 2

These correlational findings provided compelling evidence that the practical implementation of CBC's competency-based principles directly influenced student outcomes in ways that aligned with Fix-It Lab objectives. The particularly strong association between practical learning opportunities and student practical competence ($r = 0.679$) validated a fundamental pedagogical premise: that competence development requires actual practice rather than merely theoretical instruction, and that curriculum reforms must translate into tangible changes in classroom pedagogy to

achieve intended outcomes. This finding challenged the prevalent pattern in many Ugandan schools where CBC adoption remained superficial, with traditional lecture-based methods persisting despite curriculum documents advocating for experiential learning. The moderate correlation between CBC implementation fidelity and student practical competence ($r = 0.531$), while significant, suggested that faithful adherence to curriculum guidelines alone was insufficient—schools needed specifically to increase hands-on learning opportunities to maximize competence development. The robust relationship between sustainability integration and student environmental awareness ($r = 0.596$) demonstrated that environmental consciousness was cultivable through deliberate pedagogical intervention rather than being dependent solely on students' background or context, which had important implications for Fix-It Lab integration as a vehicle for sustainability education. These labs could serve as concrete mechanisms through which abstract environmental concepts became tangible through repair, reuse, and waste reduction practices. The correlation pattern also revealed that student interest in repair activities, which averaged 3.92 on a 5-point scale—the highest mean among all student variables—was not merely a product of individual disposition but was significantly influenced by exposure to practical learning experiences and the development of competence. This suggested a virtuous cycle wherein hands-on learning fostered competence, which in turn generated interest and motivation for further practical engagement, creating conditions favorable for Fix-It Lab sustainability. The moderate correlation between practical competence and repair interest ($r = 0.613$) indicated that as students developed technical skills, they became more enthusiastic about repair activities, potentially because competence reduced anxiety and increased self-efficacy in approaching broken items. However, it was crucial to note that correlation did not establish causation, and the cross-sectional nature of this data meant that alternative explanations existed—for instance, students with inherent interest in repair might have been more engaged in practical learning opportunities, thereby developing greater competence. Nevertheless, the overall pattern of relationships suggested that CBC implementation, particularly its practical learning components, created an educational environment conducive to both competence development and sustainability orientation, which aligned precisely with what Fix-It Labs aimed to achieve, positioning these labs as natural extensions of CBC rather than external additions.

Table 3: Multiple Regression Analysis Predicting Fix-It Lab Integration Feasibility

Predictor Variable	B	SE	β	t	p	VIF
Constant	0.847	0.192	—	4.411	<0.001	—
CBC Implementation Fidelity	0.213	0.068	0.226	3.132	0.002	2.34
Resource Availability	0.298	0.054	0.341	5.519	<0.001	1.87
Teacher Training Adequacy	0.187	0.049	0.235	3.816	<0.001	1.62
Administrative Support	0.241	0.062	0.253	3.887	<0.001	2.11
Practical Learning Opportunities	0.156	0.058	0.183	2.690	0.007	2.45
Student Interest in Repair	0.128	0.051	0.122	2.510	0.012	1.53
School Context (Urban vs. Rural)	0.342	0.087	0.218	3.931	<0.001	1.96

Model Summary: $R = 0.782$, $R^2 = 0.612$, Adjusted $R^2 = 0.605$, $F(7, 376) = 84.63$, $p < 0.001$, Durbin-Watson = 1.98

Note: B = unstandardized coefficient; SE = standard error; β = standardized coefficient; VIF = variance inflation factor. Dependent variable: Fix-It Lab Integration Feasibility (Scale: 1-5). $N = 384$.

Statistical Interpretation of Table 3

The multiple regression model demonstrated excellent overall fit, with the seven predictor variables collectively explaining 61.2% of the variance in Fix-It Lab integration feasibility ($R^2 = 0.612$, Adjusted $R^2 = 0.605$), and the model achieving statistical significance at $F(7, 376) = 84.63$, $p < 0.001$, indicating extremely low probability that these results occurred by chance. The Durbin-Watson statistic of 1.98 approached the ideal value of 2.0, suggesting that the assumption of independence of residuals was satisfied and autocorrelation was not problematic in the model. All seven predictor variables demonstrated statistically significant unique contributions to predicting Fix-It Lab feasibility, with p-values ranging from 0.012 to less than 0.001, and variance inflation factors (VIF) remained well below the threshold of 10 (ranging from 1.53 to 2.45), indicating that multicollinearity did not compromise the model's validity. Resource availability emerged as the strongest predictor ($\beta = 0.341$, $p < 0.001$), followed by administrative support ($\beta = 0.253$, $p < 0.001$), teacher training adequacy ($\beta = 0.235$, $p < 0.001$), CBC implementation fidelity ($\beta = 0.226$, $p = 0.002$), and school context ($\beta = 0.218$, $p < 0.001$), while practical learning opportunities ($\beta = 0.183$, $p = 0.007$) and student interest ($\beta = 0.122$, $p = 0.012$) contributed more modestly but significantly to the model. The standardized beta coefficients allowed for direct comparison of relative importance, revealing that structural and institutional factors (resources, administrative support, context) collectively exerted stronger influence than pedagogical factors (practical learning opportunities) or stakeholder attitudes (student interest), though all remained important.

Discussion of Findings in Table 3

This regression analysis provided critical insights into the conditions necessary for successful Fix-It Lab integration within Uganda's CBC framework, revealing that feasibility depended on a constellation of factors rather than any single element. The prominence of resource availability as the strongest predictor ($\beta = 0.341$) underscored the material reality that Fix-It Labs required tangible investments in tools, equipment, workspaces, and materials—repair-based learning could not be achieved through pedagogical innovation alone in resource-constrained settings. This finding aligned with the earlier ANOVA results showing significant resource disparities across school contexts and suggested that equitable Fix-It Lab implementation would necessitate targeted resource allocation, particularly to rural schools that started from positions of disadvantage. The substantial contribution of administrative support ($\beta = 0.253$) highlighted that curriculum innovations, regardless of pedagogical merit, required institutional commitment from school leadership to allocate time, space, and legitimacy within overcrowded timetables and assessment-driven priorities. Without administrative endorsement, Fix-It Labs risked remaining peripheral activities rather than integrated components of the curriculum, echoing broader challenges in CBC implementation where school leaders' incomplete understanding or lukewarm support undermined reform efforts.

The significant role of teacher training adequacy ($\beta = 0.235$) revealed that educators needed specific professional development to facilitate repair-based learning effectively—teaching students to diagnose problems, apply technical knowledge, and develop troubleshooting skills required pedagogical approaches distinct from traditional content delivery. This finding suggested that Fix-It Lab integration would require not only initial training but ongoing support as teachers developed competence in facilitation methods that emphasized guided discovery, problem-solving, and learning from failure.

Interestingly, CBC implementation fidelity emerged as a significant predictor ($\beta = 0.226$), indicating that schools already implementing the competency-based approach with greater adherence found Fix-It Labs more feasible, likely because these schools had already established infrastructures and mindsets conducive to experiential learning. This suggested that Fix-It Labs should be positioned as natural progressions of CBC rather than separate initiatives, potentially easing adoption by framing repair education as fulfilling existing curriculum mandates for practical competence and sustainability integration. The significant effect of school context ($\beta = 0.218$), even after controlling for resources and other factors, pointed to unmeasured contextual variables—perhaps community attitudes, proximity to technical resources, or cultural orientations toward repair versus replacement—that influenced feasibility beyond material constraints. The more modest but still significant contributions of practical learning opportunities ($\beta = 0.183$) and student interest ($\beta = 0.122$) suggested that while existing pedagogical practices and student enthusiasm facilitated Fix-It Lab adoption, they were insufficient without the structural conditions (resources, support, training) that enabled implementation. Collectively, these findings indicated that successful Fix-It Lab integration required a systems approach addressing multiple levels simultaneously: policy frameworks that legitimized repair education within CBC, administrative structures that supported implementation, resource investments that enabled hands-on learning, and teacher development that built pedagogical capacity. The model's substantial explanatory power (61.2% of variance explained) provided confidence that these identified factors captured the key determinants of feasibility, offering evidence-based guidance for policymakers and educators seeking to embed sustainability-oriented practical learning within Uganda's competency-based curriculum framework.

CONCLUSION

This study demonstrated that Uganda's Competency-Based Curriculum framework provided theoretical space for sustainability-oriented practical learning experiences such as Fix-It Labs, as evidenced by the curriculum's emphasis on practical competence development and cross-cutting sustainability themes; however, implementation gaps significantly constrained the actualization of these curriculum provisions, particularly in rural and under-resourced schools where mean CBC implementation fidelity scores remained moderate ($M = 2.76$) and sustainability integration scores were concerningly low ($M = 2.18$). The strong positive correlation between practical learning opportunities and student practical competence ($r = 0.679$, $p < 0.01$) confirmed that Fix-It Lab pedagogical approaches—emphasizing hands-on problem-solving, repair skills, and experiential learning—aligned powerfully with CBC's competency development goals, validating the premise that repair-based education could serve as a concrete mechanism for achieving curriculum objectives that often remained abstract in traditional classroom settings. The regression analysis revealed that Fix-It Lab integration feasibility depended on a constellation of factors including resource availability ($\beta = 0.341$), administrative support ($\beta = 0.253$), teacher training adequacy ($\beta = 0.235$), and CBC implementation fidelity ($\beta = 0.226$), collectively explaining 61.2% of variance and indicating that successful embedding required systemic interventions addressing infrastructure, professional development, and institutional support rather than isolated programmatic additions. The study identified significant opportunities for Fix-It Lab integration, particularly given teachers' positive feasibility perceptions ($M = 3.52$) and students' high interest in repair activities ($M = 3.92$), yet also revealed substantial challenges including pronounced resource disparities across school contexts ($\eta^2 = 0.194$),

inadequate teacher training ($M = 2.34$ across all contexts), and the persistent marginalization of sustainability education despite its designation as a cross-cutting curriculum issue. These findings collectively established that while Uganda's CBC framework was conceptually compatible with Fix-It Lab integration, translating this compatibility into practice required deliberate policy interventions, targeted resource investments, comprehensive teacher professional development, and explicit recognition of repair education as fulfilling core curriculum mandates for practical competence and environmental sustainability, thereby positioning Fix-It Labs not as supplementary activities but as essential pedagogical spaces where CBC's aspirations could be tangibly realized.

RECOMMENDATIONS

Establish a National Fix-It Lab Implementation Framework with Tiered Resource Allocation

The Ministry of Education and Sports, in collaboration with the National Curriculum Development Centre, should develop a comprehensive national framework for Fix-It Lab integration that explicitly links repair-based learning to CBC competency domains and assessment standards, while implementing a tiered resource allocation system that prioritizes rural and under-resourced schools to address the significant disparities identified in this study (urban-rural resource gap with effect size $\eta^2 = 0.194$). This framework should include standardized minimum equipment specifications, spatial requirements adaptable to diverse school contexts, suggested timetable integration models, and assessment rubrics that recognize repair competencies within existing subject evaluations, thereby legitimizing Fix-It Labs as core curriculum components rather than extracurricular additions.

Design and Implement Comprehensive Teacher Professional Development Programs for Repair-Based Pedagogy

Given that teacher training adequacy emerged as a significant predictor of Fix-It Lab feasibility ($\beta = 0.235$) while current training levels remained inadequate across all contexts ($M = 2.34$), education authorities should develop specialized professional development programs that equip teachers with both technical repair skills and pedagogical strategies for facilitating problem-based, experiential learning in Fix-It Lab contexts. These programs should emphasize guided discovery methods, formative assessment of practical competencies, integration of repair activities across multiple subjects, and strategies for embedding sustainability concepts through hands-on repair experiences, with ongoing mentorship and communities of practice to support teachers as they develop confidence and expertise in this pedagogical approach.

Integrate Fix-It Lab Performance Indicators into CBC Monitoring and Evaluation Systems

To ensure sustained attention and accountability for practical competence and sustainability integration, the Ministry of Education and Sports should incorporate specific Fix-It Lab-related indicators into existing CBC monitoring frameworks, including metrics for practical learning opportunity provision, student repair competence development, sustainability integration quality, and resource adequacy for hands-on learning. Schools should be required to report on these indicators as part of routine data collection, with performance data informing targeted support interventions and resource allocation decisions, thereby creating systemic incentives for schools and districts to prioritize Fix-It Lab implementation as integral to fulfilling CBC objectives rather than viewing repair education as optional or peripheral to core academic concerns.

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