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Article

Strengthening Renewable Energy Education through Maker Spaces: A Case Study in Uganda

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Abstract: Addressing the enduring gap between theory and practice in renewable energy education is essential to accelerating electrification in low- access regions such as Uganda, where, despite strong policy commitments (Vision 2040; National Development Plan III), national and rural electrification rates were 47% and 35%, respectively, in 2022. This study evaluated the effectiveness of a makerspace- based training model in developing practical competencies aligned with local energy needs. A longitudinal mixed- methods design was used to assess three consecutive training interventions conducted in 2024, 2025, and 2026, involving a total of 42 engineering participants. All participants completed the post- training survey and were included in the final analysis. The interventions utilised Arduino-based microcontroller platforms and open-source tools, progressing from fundamental digital applications to the control of hybrid energy systems. The survey findings showed consistently high participant satisfaction (mean score: 9.1/10) and strong perceived relevance, with the vast majority rating the training as highly relevant to the Maker Movement. Across all three cohorts, participants reported high confidence in their practical skills, with most evaluations falling within the excellent or good categories, and only a few responses indicating areas requiring further improvement. Community engagement indicators were equally encouraging: 100% of participants indicated they would recommend the course, and 92.8% expressed interest in advanced follow-up training, indicating strong acceptance of the makerspace approach and its potential to enhance applied competencies in this institutional context. To translate these gains into sectoral outcomes, future work will pursue multi-institutional, comparative or quasi-experimental studies with independent external evaluation and longitudinal tracking linked to deployment and electrification indicators, alongside expanded coverage of advanced power electronics, control, and grid integration.

Keywords: renewable energy education; makerspace; hybrid renewable energy system control; rural electrification

1. Introduction

Universal access to modern energy services in Uganda remains elusive. Despite sustained economic growth and abundant renewable resources, the national electrification rate reached only 47% in 2022, with rural access at about 35% [1]. Therefore, Uganda's Vision 2040 and the National Development Plan (NDPIII) recognized energy as essential for socio-economic progress, prioritizing improved access to electricity, particularly in rural and

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economic zones. In this context, renewable energy education allows developing nations to bypass fossil fuel dependence and align with multiple Sustainable Development Goals (SDGs), including SDG7 (Affordable and Clean Energy), SDG1 (No Poverty), SDG4 (Quality Education), and SDG13 (Climate Action) [2]. However, a persistent theory–practice gap remains a critical barrier in renewable energy education, particularly in low-resource contexts. This gap encompasses not only the insufficient integration of theory and practice but also the limited opportunities for students to develop the practical competencies required to install, operate, troubleshoot, and maintain renewable energy systems. As a result, graduates often possess adequate conceptual understanding but lack the hands-on skills necessary for real-world implementation, undermining system reliability, operational efficiency, and the long-term sustainability of deployed energy solutions [3–5]. Traditional, theory-centered curricula further constrain creativity and limit the transfer of concepts to field-ready solutions [6]. Addressing this persistent gap between theory and practice in renewable energy education is thus imperative for accelerating electrification in underserved regions such as Uganda.

The maker movement has emerged as a pedagogical response to this challenge by cultivating hands-on, project-based, and collaborative learning ecosystems. Makerspaces enable learners to design, prototype, and iterate renewable energy solutions using low-cost, high-technology methods and open tools [2,7]. Access to 3D printers, CAD software, power tools, and safety infrastructure supports experiential learning cycles in which students translate concepts into functioning artefacts, validate performance, and refine designs. In renewable energy education, such environments facilitate the construction of solar-, wind-, and biomass-system prototypes, strengthening understanding of energy conversion, system integration, and efficiency optimization while building the technical competence required for real-world implementation and maintenance [8–10]. By explicitly linking theoretical principles to practice through iterative making, makerspaces can help close the education–deployment gap that slows the progress of electrification in low-access contexts.

At the same time, persistent gender disparities in STEM fields, particularly in the energy sector, undermine the inclusivity and scalability of capacity building efforts. Globally, women constitute only 30% of researchers, with participation dropping to 24.9% in EU technical roles and to 5% on energy-sector boards [11]. These inequities stem from entrenched stereotypes, few female role models in technical leadership, and the compounded "triple burden" many women shoulder across professional, familial, and societal responsibilities [12]. In Uganda, the consequences are particularly acute: in rural areas, where 67.2% of the population still lacks access to electricity, women are often the primary managers of household energy resources. Bridging Uganda's energy access gap, therefore, requires not only scaling practical, industry-relevant renewable energy training but also intentionally addressing gender inclusion to ensure that all learners, especially women, can acquire and apply the skills needed to lead in the energy transition [13]. This study introduces and evaluates an applied, makerspace-based training model that is locally tailored and resource-aware, integrating open-source microcontroller platforms (e.g., Arduino), progressive task design from basic digital control to hybrid energy system control, and collaborative, North–South academic–practice partnerships. The innovation lies in combining makerspace pedagogy with context-specific renewable energy applications in a longitudinal, mixed-methods framework within resource-constrained institutions—explicitly targeting the theory–practice gap that impedes electrification in low-access settings. The objective is to assess the effectiveness of this model in strengthening hands-on competencies aligned with Uganda's local energy needs, as evidenced by participant learning outcomes, perceived relevance, and indicators of community diffusion and sustained engagement.

2. Methodology

This longitudinal case study evaluates the effectiveness of a makerspace-based renewable energy education program at Makerere University, Uganda, employing a mixed-methods approach to assess technical skill development and pedagogical outcomes. The study comprised three consecutive training cohorts conducted in 2024, 2025, and 2026, involving a total of 42 participants. The research design incorporates sequential training interventions, each followed by feedback and evaluation.

BOKU University has excellent experience with maker-type organized practical and theoretical courses in renewable energies. The "Practical course on measurement systems and applied programming", a maker-inspired practical course offered at BOKU University, provided basis and structure for the maker-based renewable energy education program at Makerere University.

To promote a coordinated and effective realisation of the programme objectives, a collaborative model framework comprising the following steps (Figure 1) was established.

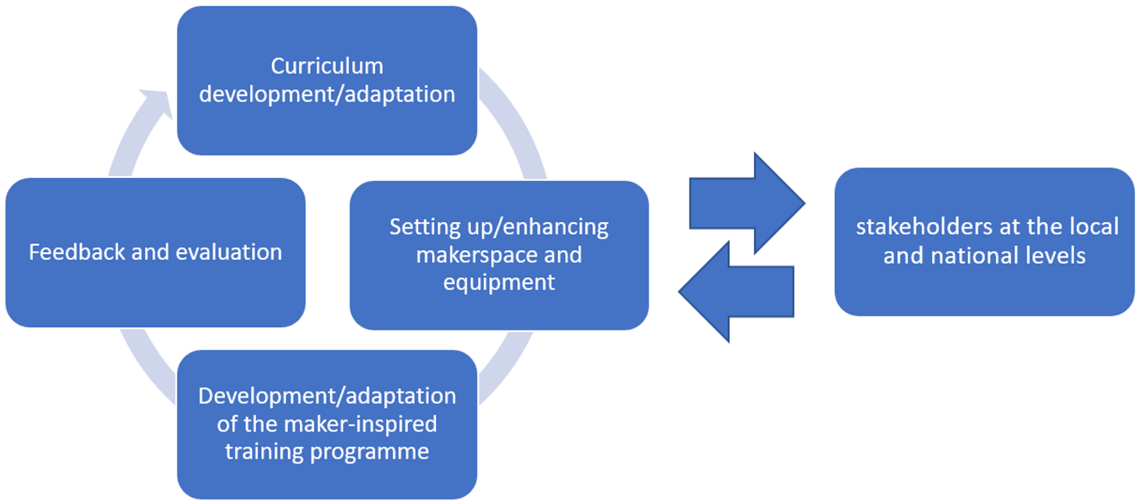

Figure 1. Staged collaborative framework for coordinated programme implementation.

Step 1: Curriculum development

This activity involves the development of courses in hybrid renewable energy systems and energy entrepreneurship and innovations at Makerere University. Courses are developed based on the local situation in Uganda and are expected to support the existing master programs in Renewable Energy at the School of Engineering at Makerere University.

Setting up makerspace and instructional laboratory for hybrid renewable energy systems for teaching and research at Makerere University.

Step 2: Establishment of the makerspace and acquisition of tools and training equipment, such as workstations, power tools, soldering stations, and other electronic equipment required for the training sessions. Setting up of 3D printing hardware and software. Acquisition of additional equipment based on the topics of forthcoming sessions.

Step 3: Development of the maker-inspired training programme for sustainable energy system solutions and technologies in Uganda.

Detailed planning of the practical training sessions–from basic knowledge to advanced real-world applications. The training program focuses on developing and enhancing skills of the target stakeholders such as engineers, policy makers, private practitioners within the renewable energy sector. Female actors in the will be encouraged to increase their awareness levels regarding planning, design, and development of hybrid renewable energy systems.

The educational intervention utilizes open-source hard and software, microcontroller platforms and a broad range of electronic equipment to facilitate hands-on learning experiences. The training programme was implemented over three consecutive annual cohorts (2024–2026) with progressively refined content based on participant feedback. The training programme was implemented over three consecutive annual cohorts (2024–2026) with progressively refined content based on participant feedback. Initial training focused on foundational concepts including digital and analogue operations, sensor–actuator integration, and basic prototyping techniques. Subsequent cohorts advanced to hybrid energy system applications, incorporating field visits to operational renewable energy installations for contextual learning. The curriculum emphasized progressive complexity, beginning with simple control exercises and culminating in the construction of Maximum Power Point Tracking (MPPT) charge controllers and hybrid renewable energy system applications. The iterative implementation across three cohorts enabled continuous refinement of the curriculum while maintaining a consistent evaluation framework.

Participants and Recruitment: This longitudinal study enrolled three annual cohorts (2024–2026; n = 42) comprising trainer-engineers and post-graduate student participants engaged in the makerspace-based renewable energy programme at Makerere University's School of Engineering. Recruitment followed a purposive strategy consistent with the project's staged framework to establish a makerspace, develop hybrid renewable energy curricula that support existing master programmes, and implement hands-on training using open-source tools, prioritising participants positioned to apply and disseminate practice-oriented instruction within the institution.

Step 4: Methodological creation of feedback and evaluation loops which impact on subsequent sessions

Quantitative data collection employed a validated 10-point Likert scale instrument measuring participant satisfaction across five domains: content relevance, material quality, pedagogical effectiveness, hands-on activity value, and program recommendation likelihood. Practical competency assessments evaluated successful completion of prototyping tasks under simulated operating conditions using standardized testing equipment. Qualitative feedback was gathered through structured interviews and open-response questionnaires, with thematic analysis identifying recurring patterns in skill acquisition challenges and providing suggestions for curriculum improvement. Post-training surveys were completed by all 42 participants across the three cohorts, resulting in a 100% response rate for the final dataset used in this study.

Ethical approval for the study was obtained from Makerere University's Institutional Review Board (IRB-2024-ENG-015), and informed consent ensured participant anonymity in data reporting. All assessment instruments were pilot-tested for clarity and reliability before implementation. To mitigate response bias, the anonymous, IRB-approved, pilot-tested 10-point Likert survey (100% response) was triangulated with standardised, performance-based practical competency assessments and structured interviews/open-response items to cross-validate findings. Data analysis combined descriptive statistics for quantitative measures with inductive coding for qualitative responses.

Step 5: Connecting the program outcomes with national and local stakeholders, to address technical, social and economic aspects related to renewable energy systems in Uganda.

Following completion of the third cohort in 2026, the study findings were presented and discussed with academic staff, industry representatives, and other stakeholders during a dissemination event at Makerere University. Feedback from this event provided contextual validation of the study findings and informed recommendations for future programme development.

3. Results and Discussion

The evaluation of the "Maker-Movement Approach to Hybrid Renewable Energy Systems" was conducted across three consecutive training courses at Makerere University in 2024, 2025, and 2026, involving a total of 42 participants. The inclusion of the third cohort enabled a longitudinal assessment of the consistency and effectiveness of the makerspace-based educational model. The results consistently demonstrate positive participant perceptions of hands-on learning, instructional quality, and the training's relevance to renewable energy education.

3.1. Technical Skill Acquisition and Pedagogical Innovation through Makerspace Implementation

The programme established and operationalised the planned makerspace and instructional laboratory for hybrid renewable energy systems at Makerere University, fulfilling the project's main aim of implementing innovative teaching methods rooted in maker-style education within renewable energy engineering programmes. The learning model segmented skill development into three levels: basic digital I/O operations, hybrid system optimisation, and field deployment of Maximum Power Point Tracking (MPPT) controllers. This implementation was executed across three consecutive cohorts (2024–2026; n = 42), enabling longitudinal assessment of consistency and effectiveness in skill acquisition.

Qualitative findings:

Structured interviews and open-response feedback were analysed using thematic analysis, as outlined in the Methods, to identify recurrent needs and priorities across cohorts. Participants consistently called for structured virtual mentorship, institutionalised knowledge-sharing platforms, and stronger links to regional industry, reflecting a desire for sustained professional networks beyond the training period. They also prioritised extended training and advanced technical topics, including smart-grid integration, digital-twin approaches for off-grid battery management, inverter design, PCB development, and microcontroller programming, indicating unmet needs in power electronics and control that should be integrated into future modules. These themes directly informed our recommendations to formalise alumni networks and industry partnerships and to expand advanced, practice-oriented modules aligned with participants' stated interests.

Figure 2 illustrates the maker-movement educational module on hybrid renewable energy, developed at Makerere University, Uganda. This tiered approach directly realises the project's vision of enabling students to create self-designed prototypes based on specific problems in renewable energy, moving beyond traditional theoretical methods to practical, hands-on learning.

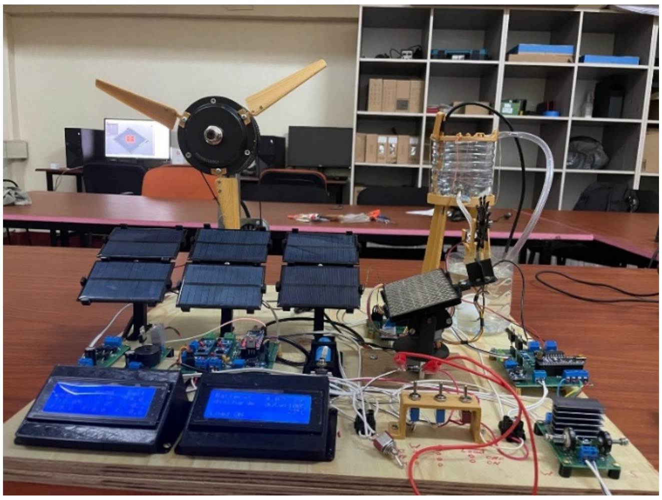

Figure 2. Hybrid renewable energy educational module using makerspace developed at makerere university.

Survey results from 2024 and 2025 (Figures 2 and 3) show that 71.4% of participants (8 in 2024 and 12 in 2025) rated the hands-on activities as "Excellent", while 28.6% rated them as "Good." Taken together, the positive skew toward "Excellent/Good" is consistent with strong cohort–content alignment within the makerspace-centred curriculum, whereas the 2026 "Needs Improvement" items indicate increased evaluation stringency accompanying higher project complexity. These results align with evidence that maker-based, project-centred learning drives engagement and practical skill development in STEM education [14,15].

Open-source hardware and software integration together with access to the global maker community proved particularly catalytic. Participants advanced from simple LED control to designing and optimising complex hardware configurations and controller algorithms, illustrating the efficacy of the competency-based progression. This mirrors findings from [16,17], which reported that iterative, hands-on learning approaches significantly enhance students' technical proficiency and innovation capacity in renewable energy systems. In the third cohort (2026), notable gains were observed in implementing small-scale hybrid control applications and in field-tuning MPPT algorithms, supported by a more systematic use of measurement, verification, and iterative prototyping.

Material adequacy emerged as a critical enabler of success, with most participants affirming that the tools and handouts provided were sufficient. The 2026 responses sustain this trend while registering a limited "Needs Improvement" signal for resources, suggesting targeted enhancements to consumables and advanced instrumentation as project complexity scales. This outcome underscores the effectiveness of the programme's equipment procurement strategy, which established functional makerspaces capable of supporting advanced prototyping despite resource constraints. Similar initiatives in resource-limited settings have demonstrated that well-equipped makerspaces can significantly enhance the quality of technical education and research. [18]. The successful installation of laboratory infrastructure at Makerere University enabled students to conduct hands-on experimentation, build prototypes, and test practical solutions to renewable energy challenges, directly addressing Uganda's renewable energy needs. In sum, the makerspace-centred, project-based instructional approach strengthened technical competencies and demonstrated scalability and adaptability in resource-constrained contexts, reinforcing the growing evidence base on the transformative role of makerspaces in engineering education and sustainable energy development.

3.2. Program Effectiveness and Learning Outcomes

Figures 3 and 4 illustrate that all participants in the first two cohorts reported clear objectives and high fulfilment of expectations, with an average overall satisfaction of 9.1/10. Instructor effectiveness and content quality were rated exclusively as "Excellent" or "Good" in both cohorts. The 2026 results are congruent: instructor effectiveness split roughly evenly between "Excellent" and "Good" (approximately 7/14 vs. 7/14), while "Content Quality", "Practical Activities", "Materials and Resources", "Course Relevance", and "Interest in Future Courses" each clustered around ~9 "Excellent", ~4 "Good", and ~1 "Needs Improvement" (see Figure 5).

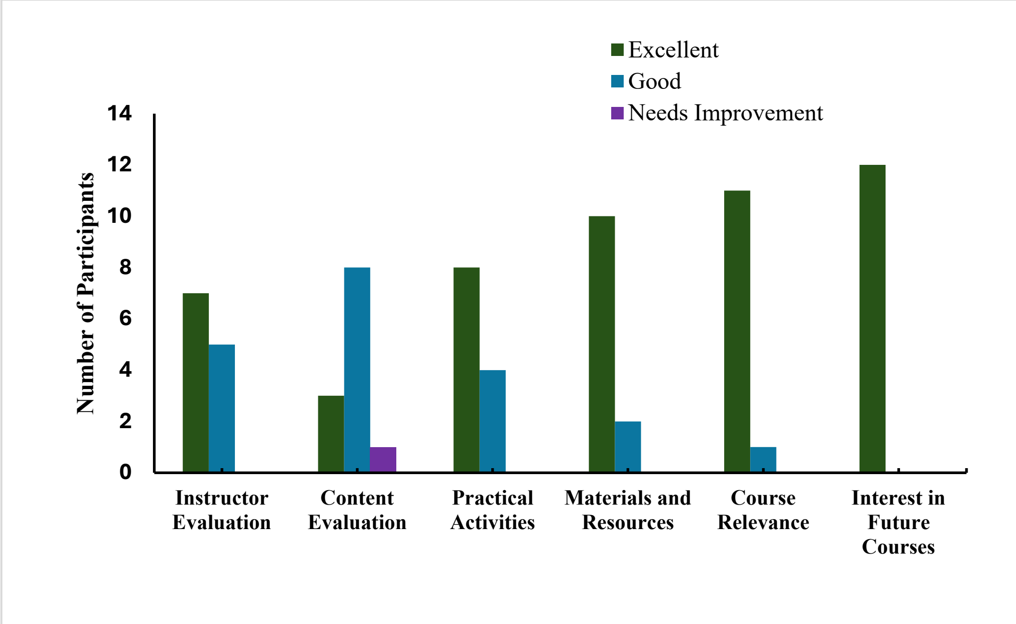

Figure 3. Participant ratings of instructor effectiveness and course content quality (2024).

Approximately 92% of participants across the first two cohorts rated the course content as "Very Relevant", with a single "Somewhat Relevant" response. In 2026, relevance remained high, though a small "Needs Improvement" signal likely reflects elevated expectations accompanying deeper, more context-specific applications, pointing to opportunities for further localisation of use cases and expanded field-testing scenarios. This result supports recent research emphasising the importance of contextualised, practice-oriented curricula in STEM education to boost learner engagement and skill development [19].

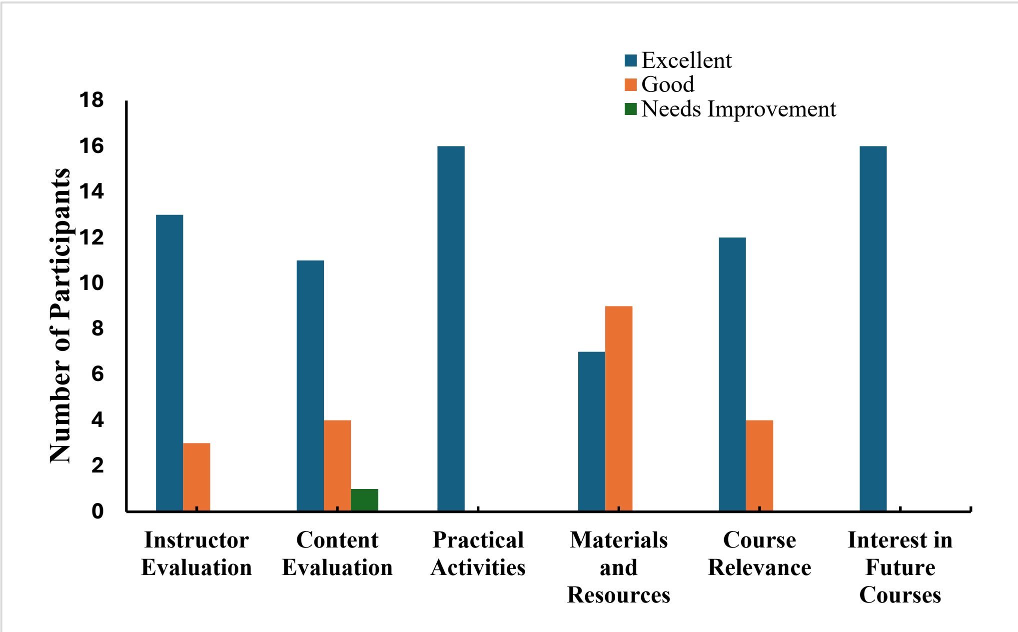

Figure 4. Participant ratings of instructor effectiveness and course content quality (2025).

Program materials and resources were deemed sufficient, and interest in advanced follow-up courses was widespread. The 2026 cohort sustained this demand for progression, despite a minor "Needs Improvement" share, plausibly indicating a desire for coverage of more advanced topics in power electronics, digital control, and industry-grade measurement systems. This demand reflects a growing recognition of the need for specialized training in renewable energy, consistent with global trends in capacity-building initiatives for sustainable development [20].

Instructor effectiveness remained a key driver of success. The 2025 cohort reported 81.3% "Excellent" and 18.7% "Good", while the 2026 cohort maintained strong ratings without negative evaluations, mirroring findings from North South knowledge transfer programs that emphasise localised content delivery [21,22]. The absence of negative evaluations further validates the program's instructional rigour and its ability to adapt to local contexts. These results fulfil the project's objective of enhancing teaching processes and fostering scientific collaboration between BOKU and Makerere Universities.

Curricular relevance to national priorities was consistently high, with 92.8% across the first two cohorts rating the materials as "Very Relevant" to the Maker Movement. The 2026 cohort supports this continuity, with constructive suggestions to deepen integrations with microgrid applications and rural load management. This aligns with recent findings that emphasize the critical role of tailored curricula in addressing renewable energy market needs in developing countries [23]. The combined focus on theoretical principles and practical skill-building supports Uganda's electrification goals (47% national and 35% rural access in 2022).

Hands-on competency ratings improved from 68% "Excellent" in 2024 to 75% in 2025, with the 2026 cohort sustaining high levels while showing a small, realistic "Needs Improvement" tail, consistent with heightened project difficulty and stricter self-assessment. These results are consistent with studies demonstrating the effectiveness of adaptive learning models in improving technical competencies over time [24]. Content quality assessments further reinforced these findings, with 50.0% of participants rating the content as "Excellent" and 42.9% as "Good", comparable to benchmarks reported in similar capacity-building programs [25].

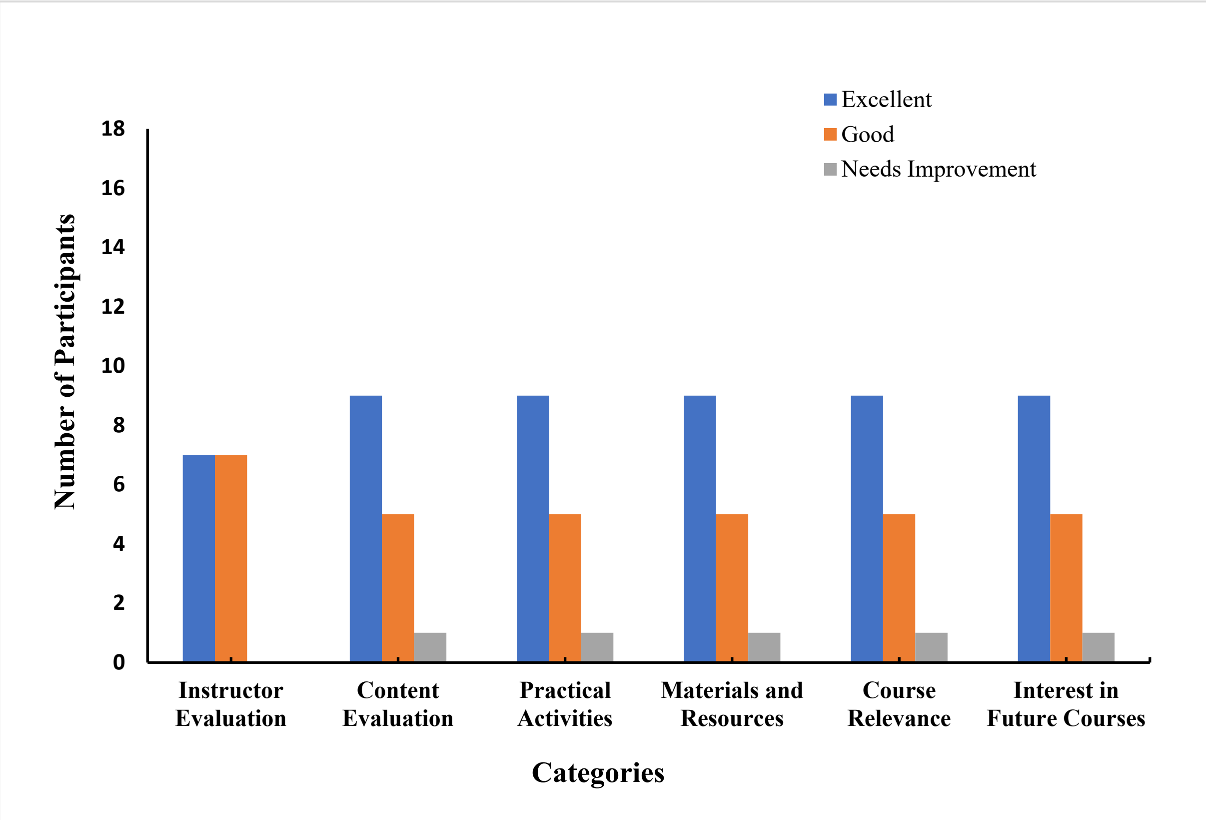

Figure 5. Participant ratings of instructor effectiveness and course content quality (2026).

In summary, the longitudinal comparison (2024–2026) demonstrates stable high satisfaction, relevance, and instructional quality, alongside qualitative deepening of applications in 2026 and targeted opportunities to strengthen advanced resources and local scenario customisation.

3.3. Institutional Capacity Building and Knowledge Transfer Networks

The program consolidated professional networks and stakeholder partnerships: 100% of participants indicated they would recommend the course, and 92.8% expressed interest in advanced follow-up training. The 2026 cohort sustained these strong community indicators, with specific interest in smart grid integration and digital twin approaches for off-grid battery management. This outcome demonstrates the cultivation of a sustainable renewable energy innovation community, evidenced by participant demands for advanced modules in smart grid integration and digital twin technologies for off-grid battery management. These findings align with recent research emphasising the importance of sustained professional networks in capacity-building initiatives for sustainable development [20,25].

Participant priorities, such as solar charging infrastructure and microcontroller-based automation, indicate effective targeting of knowledge gaps to identify appropriate technologies for underserved settings. In 2026, participants explicitly called for structured virtual mentorship, institutionalised knowledge-sharing platforms, and stronger linkages to regional industry, consistent with global trends in North-South knowledge transfer programmes [22].

These outcomes align with Uganda's National Development Plan III (NDPIII) emphasis on cross-sectoral energy clusters; participants advocated formal alumni networks and industry partnerships in solar infrastructure and electric vehicle integration. Sustained intent to pursue advanced development in 2026 suggests durable knowledge transfer mechanisms beyond the project's duration, with clear scope to expand micro-credential pathways and industry co-supervised capstone projects, mirroring findings from similar capacity-building initiatives in sub-Saharan Africa [26,27].

3.4. Gender Integration and Inclusive Education Measures

The programme was conceptualised to implement comprehensive gender integration strategies, aiming to address systemic inequalities and promote inclusivity. However, significant challenges in data collection emerged as a critical limitation, impeding the ability to conduct a thorough evaluation of gender-related outcomes.

Despite these constraints, the programme demonstrated considerable success in adopting adaptable pedagogical strategies designed to accommodate diverse learning styles and technical backgrounds. Participant feedback consistently highlighted the effectiveness of customised instructional methods in addressing the varying levels of prior experience among learners. These findings align with existing literature that emphasises the importance of inclusive design in technical education [28]. By leveraging an inclusive design framework, the programme ensured equitable access to training resources, irrespective of participants' educational or professional backgrounds. This approach not only enhanced the learning experience but also underscored the potential of inclusive pedagogical practices in fostering equitable educational opportunities. However, addressing the critical gap in gender-disaggregated data is essential for improving the evaluation of similar programmes. Future research should prioritise the development and implementation of robust data collection methodologies that capture reliable, comprehensive gender-related metrics. Additionally, longitudinal studies are needed to examine the sustained impact of inclusive pedagogical strategies on learner outcomes, particularly in the context of technical education, and to assess their role in advancing gender equity. Such research would provide valuable insights to refine programme design and evaluation, ultimately contributing to more effective and inclusive educational initiatives. It should be noted that gender-disaggregated participation data were not collected as part of this study; consequently, the analysis of gender integration is reported at an aggregated level

3.5. Scientific Dialogue and Dissemination Achievements

The programme successfully achieved its dissemination objectives through comprehensive activities including workshops, seminars, and knowledge sharing platforms. The documented participant satisfaction and engagement levels demonstrate effective evidence-based policy information development in Uganda's energy sector. The programme's success in generating demand for follow-up training and advanced modules indicates the establishment of sustainable knowledge transfer mechanisms, consistent with findings from similar international cooperation programmes [2].

The strong participant engagement and requests for continued learning opportunities reflect the programme's effectiveness in creating lasting impacts on renewable energy education and capacity building. These outcomes contribute to the growing body of evidence supporting the transformative potential of North-South academic partnerships in addressing global energy challenges [22,29].

3.6. Limitations and Future Research Directions

Although the study employed a longitudinal design across three consecutive training cohorts (2024–2026), the sample size remained relatively modest ($n = 42$), which may limit the statistical generalizability of the findings. Nevertheless, the consistency of the results across the three cohorts, together with stakeholder discussions conducted during a dissemination event at Makerere University in 2026, provides additional contextual support for the practical relevance of the proposed makerspace-based training model. Future studies should include larger, multi-institutional samples to further validate and generalise these findings.

This single-institution, capacity-building study used purposive sampling from a single engineering community, which may limit external validity and introduce response bias. Future research should use larger, multi-institutional samples, comparative or quasi-experimental designs, formal pre- and post-assessments, and independent external evaluation to strengthen generalisability and causal inference.

While the programme demonstrated robust outcomes in technical skill development, participant feedback revealed several constraints requiring attention. Participants consistently advocated for extended training durations to facilitate deeper exploration of prototyping methodologies, suggesting opportunities for expanding the makerspace model to include more comprehensive coverage of advanced system design principles. This aligns with recent research emphasising the importance of extended learning periods in technical skill acquisition [30].

Participant aspirations highlighted critical research directions, particularly in smart grid integration, with emphasis on digital twin technologies for remote battery management in off-grid contexts. Requests for inverter design, PCB development, and microcontroller programming reveal unmet needs in power electronics and control system engineering that future curricula should prioritise. The strong focus on hybrid system optimisation reflects the need for context-specific models integrating solar-wind-biomass configurations tailored to regional microclimates, consistent with global trends in renewable energy system design [31].

Scalability remains another important consideration. Future research should evaluate extended training formats, investigate long-term skill retention and professional outcomes, and assess the effectiveness of makerspace education across different institutional settings. Establishing structured alumni networks and strengthening industry partnerships, particularly in solar charging infrastructure, electric vehicle integration, and rural electrification projects, would further enhance the programme's sustainability and impact.

Overall, the programme demonstrates the potential of makerspace-based renewable energy education to strengthen technical competencies and foster innovation in resource-constrained environments. Future work should build on these findings through broader implementation and longitudinal evaluation to better understand its contribution to renewable energy capacity building in sub-Saharan Africa.

4. Conclusions

The makerspace-based renewable energy education programme at Makerere University highlights the potential of experiential, hands-on learning to bridge the theory–practice gap in technical education and to strengthen renewable energy skills development within a single-institution context. Across three cohorts (2024–2026), the programme engaged 42 engineering participants and delivered consistently positive outcomes, as reflected in high participant satisfaction (9.1/10), strong programme endorsement, and the progressive development of practical competencies, from basic circuitry to hybrid renewable energy system design.

The findings suggest that makerspace-based pedagogies, supported by locally adapted curricula, open-source technologies, and strategic North–South partnerships, provide a promising approach for strengthening applied engineering education in resource-constrained settings. The programme develops practical competencies relevant to technologies used in rural-electrification contexts, including hybrid renewable energy systems and Maximum Power Point Tracking controllers, without directly measuring impacts on rural electrification in this study.

Overall, the study demonstrates the potential of makerspace-based renewable energy education to enhance engineering training in the present case study. Future research should evaluate this approach using multi-institutional, comparative or quasi-experimental designs, independent external evaluation, and longitudinal graduate tracking linked to deployment data and electrification indicators. Such work will enable empirical assessment of its scalability, replicability, and broader contribution across diverse institutional and geographical contexts.

Author Contributions

R.A.A.: Conceptualisation, methodology, resources, writing—original draft preparation and project administration; A.B.: Investigation and contribution to writing original draft preparation; F.P.: Methodology and formal analysis; N.N.: Data curation and formal analysis; H.K.: Resources and project administration; J.B.K.: Supervision and reviewing and editing; C.P.: Supervision and reviewing and editing. All authors have read and agreed to the published version of the manuscript.

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Institutional Review Board Statement

The study was conducted according to the guidelines of the Declaration of Helsinki, and approved by the Institutional Review Board of Makerere University (protocol code IRB-2024-ENG-015)

Informed Consent Statement

Study: APPEAR Project PHRE #288–Training Courses Evaluation. Before completing the questionnaire for each training course, all participants were informed of the purpose of the evaluation and the intended use of the collected data. They were informed that: Participation in the survey was entirely voluntary; They could decline to participate or withdraw at any time without any negative consequences; Their responses would be treated confidentially and used only for research and educational quality improvement purposes; No personally identifiable information would be reported or disclosed; After receiving this information, participants voluntarily agreed to take part in the survey before completing the questionnaire

Data Availability Statement

The quantitative and qualitative data supporting the findings of this study are available from the corresponding author upon reasonable request

Conflicts of Interest

The authors declare no conflict of interest

Use of AI and AI-Assisted Technologies

No AI tools were utilized for this paper.

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