

Community-Based Computer Engineering Training for Sustainable ICT Systems in Alternative Learning Education in the Philippines

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Abstract

Sustainable integration of information and communication technology (ICT) in alternative learning environments remains a significant challenge in the Philippines, particularly due to limited technical expertise and resource constraints. This paper examines a community-based computer engineering training initiative designed to enhance the technical competencies of Alternative Learning System (ALS) implementers through hands-on instruction in computer hardware maintenance, troubleshooting, and basic networking. Anchored in the principles of digital citizenship and sustainability, the initiative highlights the role of higher education institutions in bridging ICT skill gaps through extension programs. Findings from the training evaluation indicate a high level of participant satisfaction (mean = 4.87), demonstrating the effectiveness of experiential and practice-oriented learning approaches. The program contributed to improved technical confidence, reduced reliance on external support, and enhanced capacity for maintaining ICT resources. This paper argues that community-based training models are essential for fostering sustainable ICT systems in non-formal education settings. By equipping educators with practical engineering skills, such initiatives support long-term technology utilization, resource optimization, and educational resilience. The study contributes to the discourse on inclusive digital transformation by proposing scalable, community-driven strategies for strengthening ICT infrastructure and capacity in alternative education across the Philippines.

Keywords: Community-based computer engineering training; Sustainable ICT systems; Alternative learning education; Philippines; ICT Education

Introduction

The integration of information and communication technology (ICT) in education has become a cornerstone of modern learning systems, yet disparities persist in access, utilization, and technical capacity, particularly in non-formal education sectors such as the Alternative Learning System (ALS) in the Philippines. ALS plays a vital role in providing inclusive education to marginalized learners; however, its effectiveness is often constrained by inadequate technological infrastructure and limited technical expertise among implementers. These challenges hinder the sustainability of ICT systems and the broader goal of digital inclusion.

Sustainable ICT systems require not only access to technology but also the capability to maintain, troubleshoot, and optimize these resources. Digital citizenship frameworks emphasize the importance of responsible and competent technology use, which includes technical proficiency in managing digital tools (Ribble, 2015). In this context, community-based training initiatives emerge as viable strategies for building local capacity and reducing dependency on external technical support.

Higher education institutions, through extension services, play a crucial role in addressing these gaps by facilitating knowledge transfer and community engagement (Bringle & Hatcher, 2009). The computer engineering training conducted by Kalinga State University exemplifies such efforts, aiming to equip ALS educators with practical skills in hardware maintenance and network management. This paper explores how community-based computer engineering training contributes to the development of sustainable ICT systems in alternative learning education in the Philippines.

Strengthening Digital Citizenship through Technical Skills Development

Digital citizenship in education extends beyond ethical technology use to include the competence to manage and sustain digital resources effectively. The training initiative focused on foundational computer engineering skills, including hardware identification, troubleshooting, and maintenance. By empowering ALS implementers with these competencies, the program enhanced their ability to independently manage ICT tools. This shift from passive users to active managers of technology supports more responsible and sustainable use of digital resources, reinforcing the broader goals of digital citizenship and educational empowerment.



Figure 1. Hands-on workshop on basic computer networking, maintenance, and troubleshooting, with BSCpE students and faculty providing technical assistance through collaborative, experiential ICT training.

Experiential Learning in Computer Engineering Training



The effectiveness of the program is largely attributed to its experiential learning approach, which combined theoretical discussions with hands-on workshops. Participants engaged in real-world tasks such as diagnosing hardware issues, maintaining printers, and performing basic network troubleshooting. Experiential learning theory posits that knowledge is best acquired through direct experience and reflection (Kolb, 1984). The high satisfaction rating (mean = 4.87) reflects the participants' positive response to this methodology. Such approaches are particularly relevant in technical training, where practical application reinforces conceptual understanding and skill mastery.



Figure 2: Training workshop on Computer Defragmentation, Software Installation, and Antivirus, including hands-on activities

Promoting Sustainable ICT Systems in ALS Contexts

Sustainability in ICT systems involves efficient utilization, regular maintenance, and prolonged lifespan of technological resources. In resource-constrained ALS environments, the lack of technical expertise often leads to underutilization or rapid deterioration of equipment. The training addressed this gap by equipping educators with the skills needed to perform routine maintenance and basic repairs. As a result, the program contributed to reduced equipment downtime, improved functionality of ICT tools, and increased efficiency in technology use. These outcomes align with sustainability principles in ICT, emphasizing cost-effectiveness and long-term usability (Hilty & Aebischer, 2015).

Community-Based Extension as a Model for Inclusive Development

The initiative highlights the significance of community-based extension programs as mechanisms for inclusive development. By leveraging the expertise of computer engineering faculty and students, the training fostered collaboration between academia and the ALS community. This partnership facilitated the transfer of technical knowledge in a localized and context-sensitive manner. Extension programs not only address immediate community needs but also build long-term capacity for self-sufficiency. The success of this initiative demonstrates the potential of higher education institutions to drive sustainable development through community engagement and technical empowerment.

Conclusion

Community-based computer engineering training presents a viable and impactful approach to developing sustainable ICT systems in alternative learning education in the Philippines. The initiative conducted by Kalinga State University demonstrates that equipping ALS implementers with practical technical skills significantly enhances their ability to manage and sustain ICT resources. Through experiential learning, participants developed competencies that reduce reliance on external technical support and promote efficient utilization of available technologies.

Furthermore, the program underscores the critical role of higher education institutions in fostering inclusive digital transformation through extension services. By addressing both skill gaps and sustainability challenges, community-based training initiatives contribute to more resilient and self-sufficient educational systems. Moving forward, scaling such programs and integrating them into national education and digital development strategies will be essential in ensuring equitable access to sustainable ICT systems across alternative learning environments in the Philippines.

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