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RoboLikha extension program for inclusive STEM and sustainable development

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ABSTRACT

This paper presents the outcomes of RoboLikha: Creative Technology for Inclusive STEM Learning, the flagship extension program of the College of Technology at the University of Science and Technology of Southern Philippines (USTP). The program was designed to address inequities in STEM education among underserved schools in Northern Mindanao through teacher training, student mentoring, community-centered implementation, and institutional partnerships aligned with the USTP CARES pillars and the UN Sustainable Development Goals. The program adopted a holistic and participatory framework that combined caravans, training of trainers, workshops, research mentoring, and competitions. From 2023 to 2025, RoboLikha capacitated more than 200 teachers, engaged over 600 students, and reached more than 3,800 community participants across Region 10. Six investigatory projects were co-developed at Cagayan de Oro National High School, two of which received national recognition at the 2025 National Science and Engineering Fair. Teachers also transformed their participation into funded research outputs, demonstrating that extension work can directly enhance professional growth and curriculum innovation. These findings validate RoboLikha as a transformative and scalable model for inclusive STEM education. Looking ahead to 2030, the program aims to expand to ten fully engaged schools, institutionalize innovation expos, and cultivate Creative Tech champions to sustain robotics and creative technology integration nationwide.

Keywords: creative technologies, robotics education, teacher capacity building, student mentorship, community engagement

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INTRODUCTION

Robotics and maker technologies are increasingly recognized as powerful tools for fostering creativity and problem-solving in STEM education. By engaging students in hands-on design and engineering tasks, robotics can embody the creative risk-taking and inquiry that underpin deeper learning. As Henriksen et al. (2021) argue, teaching should affirm creative risk-taking, an orientation toward new ideas and learning through mistakes, as a core pedagogical principle. In practice, classroom robotics projects encourage this mindset by enabling students to invent, prototype, and iterate solutions, thereby developing resilience in the face of failure. This perspective contrasts with traditional outcome-driven teaching and helps prepare learners for complex, novel challenges. In this way, educational robotics and related creative technologies (such as 3D modeling and design tools) serve not just as technical skills, but as means to cultivate imaginative, adaptive thinking in STEM subjects.

However, implementing robotics-based STEM learning can be difficult in low-resource settings like Northern Mindanao. Common barriers include limited material access, connectivity gap, and teacher preparedness and confidence. Also, many schools lack basic maker equipment (e.g. 3D printers, robotics kits) and affordable components. These material constraints are symptomatic of the broader digital divide in education. For example, Van Rooyen & Callaghan (2025) note that finding and acquiring suitable robotics tools is influenced by material and usage access issues associated with the digital divide.

Besides, reliable internet and power remain inconsistent in rural or underfunded areas. Persistent access disparities mean that advanced technologies (AI, cloud tools, online resources) cannot reach all students equally. Mac Fadden et al. (2024) highlight that while AI-powered educational technologies can personalize learning, concerns remain regarding access disparities and the reinforcement of existing inequalities. These digital infrastructure gaps hinder any curriculum that assumes constant connectivity.

In-service teachers often have limited training or experience with emerging STEM technologies. Research shows that teacher creativity is critical to effective instruction, and that supportive communication in schools can enhance this creativity. Dogbe et al. (2024) found that effective internal communication processes bolster teacher innovation, which in turn improves performance. In contexts where teachers lack confidence or support, however, they may be hesitant to adopt unfamiliar robotics tools or open-ended projects. This can stifle innovation and leave potential learning experiences untapped. Overall, these challenges reflect systemic educational inequalities. Equipment shortages and connectivity issues not only limit what can be taught but also discourage experimentation. Similarly, if educators are not empowered to integrate technology creatively, even well-designed curricula may fail in practice.

In the Philippine context, however, these challenges coexist with a strong national emphasis on technology education. The Department of Education’s Creative Technologies curriculum for junior high (grades 7–10) explicitly incorporates robotics, digital design, and other maker disciplines. This project-based curriculum aims to build technological proficiency through hands-on design and fabrication activities (for example, using computer-aided design and 3D printers) as part of STEM learning. By integrating robotics and design into the standard curriculum, the national framework signals strong policy support for creative STEM education. These teacher-related and infrastructural challenges therefore highlight the gap between national curriculum aspirations and the realities of implementation in underserved regions.

To address these implementation gaps, RoboLikha was developed as a multi-year, university-led extension initiative in Northern Mindanao. As a community-based program, RoboLikha partners with local schools, teachers, and stakeholders to co-develop robotics and maker learning opportunities. The model involves hands-on workshops, in-school training, and the development of low-cost or repurposed materials tailored to local constraints. For example, instead of relying on high-end equipment, RoboLikha uses affordable open-source kits and offline instructional resources to accommodate limited internet access. Over multiple years, the program also cultivates mentor networks of teacher leaders and college student volunteers who support peers in applying new pedagogies. In this way, RoboLikha creates a collaborative ecosystem: it leverages university expertise while building local capacity and confidence. By working “with” rather than simply delivering resources, the extension ensures that solutions are contextually appropriate and sustainable.

Against this backdrop, the present study examines the design, implementation, and early outcomes of the RoboLikha model as a case of educational innovation in a low-resource setting. In particular, we focus on how a community-engaged, multi-year approach can address barriers of access and teacher readiness while aligning with national curriculum goals. This also answers questions such as how RoboLikha’s workshops and materials impact student engagement in creative STEM activities, and how teacher perceptions of technology evolve through the program. In doing so, our work contributes empirical insights on leveraging robotics and creative technologies to narrow the STEM learning divide. By documenting this community-based intervention, we offer practical guidance and theoretical understanding for educators and policymakers seeking to advance creative, inclusive STEM education in similarly constrained regions. Ultimately, the paper's contribution lies in demonstrating an innovative, scalable model that integrates technology access, curriculum, and teacher development to foster creativity and learning in underserved communities.

METHOD

The methodology of the *RoboLikha: Creative Technology for Inclusive STEM Learning* program was anchored on a holistic, participatory framework that integrates teacher development, student engagement, community-centered deployment, research mentorship, and innovation ecosystem building. At its core, the program adopted a multi-phased strategy aligned with the USTP CARES pillars and the UN SDGs to ensure that activities were not isolated interventions but progressive steps toward a sustainable model for STEM education.

The initial phase (2023–2024) emphasized *teacher capacity building* and *student exposure.* Training of Trainers programs at Department of Education Cagayan de oro and Central Mindanao University – Laboratory High School equipped faculty members with competencies in robotics literacy, microcontrollers, interfacing, and the integration of robotics concepts into STEM and TLE lessons. Complementing these community-based initiatives were intensive training programs conducted at multiple educational sites. At Central Mindanao University, 37 teachers received capacity-building training and were equipped with resources, including a robotic arm, to sustain program implementation. Concurrently, blended lecture series and crash courses at Cagayan de Oro National High School engaged 180 students and teachers, amounting to 720 person-days of training. Meanwhile, schools in the El Salvador Division hosted creative technology caravans that reached more than 3,800 participants through training in robotics, 3D modeling, power electronics, and multimedia storytelling.

The *research and mentoring* component further enriched the methodology by guiding students and teachers to develop investigatory projects that linked robotics with local challenges. At at Cagayan de Oro National High School, six student-faculty research outputs were completed, some of which later gained recognition at the 2025 National Science and Engineering Fair, earning both a Special Merit Award and a 2nd Grand Award. This research-based mentoring also enabled faculty to generate funded studies, such as classroom-based research on improving student motivation and problem-solving through robotics integration. By combining project-based learning with mentoring for national competitions like the NRC, the program not only strengthened technical proficiency but also nurtured a culture of research, innovation, and scholarly production among high school teachers.

To ensure inclusivity, the RoboLikha program deliberately adopted a community-centered approach that prioritized access for both urban and rural schools. Instead of limiting activities to well-equipped institutions, the program designed caravans and small-group workshops to directly reach underserved schools where resources and facilities were scarce. These activities introduced low-cost robotics kits and user-friendly manuals, making the learning process more approachable for both students and teachers. By lowering language barriers and providing affordable tools, the program effectively reduced obstacles caused by limited exposure to technology and infrastructure gaps.

A key feature of this approach was the strong collaboration with DepEd and Pinoy Robotcs Games – National Robotics Competition (PRG-NRC), which provided formal institutional backing. These partnerships allowed RoboLikha not only to bring its training modules into schools but also to open doors for national-level exposure through competitions and summits. For example, the program invited schools across Region 10 to join a major robotics competition, the NRC-Mindanao 2024, hosted at Bulua Elementary School. This inclusive competition format ensured that even schools without existing robotics programs could send interested students to compete.

To maximize fairness and readiness, the program also implemented training sessions a day before the competition. This allowed students with little or no prior exposure to robotics to familiarize themselves with the basics, practice with the equipment, and gain the confidence to join the main event. This practice was later recognized as one of RoboLikha's best practices, as it not only leveled the playing field but also demonstrated how strategic preparation can boost inclusivity, encourage participation, and raise the quality of outputs.

Moreover, to systematically evaluate the impact of these interventions, RoboLikha adopted a pretest–posttest evaluation framework for every major training and mentoring activity. Participants' baseline knowledge and confidence in robotics, electronics, and computational thinking were measured before training, followed by post-assessments to determine learning gains, changes in self-efficacy, and readiness for classroom or competition application. This quantitative evaluation was complemented by qualitative feedback gathered through reflection forms and focus group discussions, providing a comprehensive picture of participant growth and engagement.

Findings from these assessments were documented in the peer-reviewed paper titled, "*Training Needs Assessment for Mentorship in the National Robotics Competition (NRC) 2025"*. The study analyzed pre- and post-training data from 15 junior high school students, revealing significant confidence improvements in programming and teamwork but low baseline proficiency in Sumobot assembly and scoring rules ($M = 2.27$ and 2.07, respectively). The results validated the need for structured mentoring and targeted training modules, reinforcing RoboLikha's data-driven approach to capacity building and mentorship (Gonzales, 2025).

Building on earlier evaluations, a follow-up mentoring study titled *Mentoring Insights from Panel Assessments of High School Research Proposals in Robotics and Intelligent Machines* further examined RoboLikha's mentoring practices. Using ATLAS.ti-based qualitative coding of six expert-panel evaluations, the study identified key mentoring gaps in statistics, research design, and technical writing, leading to concrete improvements in RoboLikha's faculty mentoring framework. These published studies demonstrate that RoboLikha's methodology is not only programmatic but also research-validated, producing measurable evidence of learning outcomes, mentoring efficacy, and institutional impact (Gonzales, 2025). Collectively, these efforts positioned RoboLikha as more than a technology training program; it evolved into a model of inclusive STEM education, ensuring that learners—regardless of school resources or geographic location, could meaningfully engage with robotics and creative technologies.

Building on these achievements, RoboLikha adopts a progressive scaling framework toward 2030 to sustain and expand its impact. During the expansion phase (2026–2027), the program will engage more schools, deepen robotics integration with AI and IoT concepts, and host annual LikhaTech expos as platforms for showcasing grassroots innovation. The creative integration phase (2027–2028) will focus on embedding robotics into multimedia storytelling and localized lesson plans, ensuring that creative technologies are woven into curricula. The scaling-up phase (2028–2029) envisions equipping at least 10 schools with fully functional Creative Tech Labs, strengthening curriculum rollouts, retraining teachers, and documenting best practices through the LikhaBot Learning Guide. By the consolidation and transition phase (2029–2030), the program will establish a cohort of *LikhaChampions*, teacher-leaders who will sustain robotics and creative technology integration, supported by the institutional renewal of USTP-DepEd MOAs. This method is not a static set of activities but a dynamic, multi-year strategy that builds upon completed accomplishments, adapts to emerging challenges, and lays out a clear trajectory for scaling and sustainability up to 2030.

This RoboLikha program is one of six flagship tracks under the TeknoBayanihan initiative, an inclusive, multi-year extension agenda of the College of Technology at the University of Science and Technology of Southern Philippines (USTP). Aligned with the USTP CARES model and the UN Sustainable Development Goals, TeknoBayanihan aims to co-create sustainable, technology-based solutions through collaborative partnerships with schools, local government units, industry partners, and underserved communities. Specifically, RoboLikha represents the program's commitment to Creative Robotics and STEM Education, delivering impact through grassroots innovation, capacity building, and digital empowerment. Alongside complementary tracks such as AutoKonek (smart mobility), PowerUp (electrical installation), and MakerKonek (digital fabrication), RoboLikha advances TeknoBayanihan's broader mission to empower at least 1,000 students and 300 teachers, establish 10 community-based learning hubs, and institutionalize inclusive innovation ecosystems by 2030. In this way, RoboLikha not only stands as a successful model for robotics integration in STEM but also as a core driver of TeknoBayanihan's vision to build resilient, future-ready communities through "Sama-samang Paglikha, Sama-samang Pag-unlad" (Collective Creation, Collective Progress).

FINDINGS AND DISCUSSION

The accomplishments of RoboLikha from 2023 to 2025 demonstrate the transformative potential of extension programs in narrowing the STEM education divide in underserved communities. Beyond these measurable outcomes, the program's achievements underscore why the model merits continued implementation, scaling, and institutionalization across other regions of the Philippines. The evidence further suggests that when teachers, students, and communities are systematically trained and empowered, grassroots innovation can flourish even in resource-constrained contexts.

Findings

Teacher development and capacity building

The program was grounded in building teachers' capacity as multipliers of STEM and robotics education. At Central Mindanao University (CMU), thirty-seven (37) teachers underwent intensive training in robotics and intelligent systems in July 2024. The modules covered electronics, programming, interfacing, and robotics system integration. Pre- and post-test assessments revealed substantial learning gains, and 100% of participants rated the training satisfactory. Importantly, a robotic arm was donated to CMU to serve as a sustainability mechanism, embedding advanced tools into the university's teaching and research environment.

Similarly, the Training of Trainers (ToT) program for Department of Education Cagayan de Oro and Central Mindanao University- Laboratory High School (2024) demonstrated the cascading effect of teacher training. Through 56 hours of workshops and hands-on practice, teachers not only developed robotics competencies but also gained the confidence to integrate robotics into their lesson plans and investigatory projects.

The Cagayan de oro National High School- Junior High Robotics Lecture Series (March–August 2023) further expanded the program's reach, engaging 180 teachers and students across 720 person-days of blended training. raining sessions on robotics design, programming, and control systems culminated in applied outputs, including prototype designs and early-stage investigatory projects.

Table 1. Teacher development outputs (2023–2024)

Activity	Teachers Trained	Students Trained	Satisfaction Rating	Key Outcomes
CMU Intensive Training (2024)	37	–	100%	Robotic arm donated for sustainability
DepEd CDO Trainer of Trainers	25	–	100%	Teachers cascaded robotics instruction in schools
CDONHS- Junior High Lecture Series (2023)	Mixed (part of 180)	Mixed (part of 180)	98%	720 person-days of blended training; applied projects produced

Collectively, these teacher-focused activities created a pool of over 200 robotics-competent educators in Region 10. This represents a critical investment in human capital: each trained teacher is a conduit for hundreds of future learners, multiplying RoboLikha's impact across generations. A related impact study conducted at City High School found that teachers' competencies in robotics, programming, and IoT improved significantly after structured robotics training, with average knowledge gains of 35–38 points (Ong, Fermano, & Taglucop, 2023). This reinforces RoboLikha's emphasis on capacitating educators as pivotal to long-term STEM transformation.

Student mentorship and research coaching

Beyond teacher development, student mentorship under RoboLikha also proved transformative. At Cagayan De Oro National High School - Junior High, six investigatory projects were co-developed by students and teachers, focusing on robotics and intelligent systems for local challenges. These projects enhanced not only technical proficiency but also research literacy and problem-solving capacity.

An earlier impact study on Arduino programming (2019, validated in 2023) also demonstrated lasting benefits. Among 36 junior high school students, 100% reported improved programming skills, 97% gained competence in electronics, and 95% said the training deepened their learning. While 97% initially found programming intimidating, nearly all expressed heightened confidence and interest afterward (USTP-COT, 2023). These findings are consistent with Ong et al. (2023), who reported that robotics training not only improved technical skills but also boosted students' confidence, adaptability, and socioeconomic aspirations.

These skills translated into national achievements. At the 2025 National Science & Engineering Fair, CDONHS students mentored by RoboLikha secured two major awards: 1) Special Merit Award, Integrating Robotic Hand Systems with Glove-Based Sign Language Interpreters for Two-Way Communication. 2) 2nd Grand Award, Smart Aquaponics System: IoT-based Real-Time Monitoring for Sustainable Cultivation of Lettuce and Catfish.

These awards highlight that students from under-resourced schools, when supported with mentorship, can excel nationally. Teachers likewise benefitted by converting mentoring experiences into funded research. For example, a classroom-based studies examined how robotics integration improves student motivation and problem-solving (X, Abella, & Lingatong, 2024) by the Coordinators from Cagayan De Oro National High School - Junior High. These outcomes position extension beyond a traditional community service function, highlighting its role in scholarly productivity and curriculum innovation.

Table 2. Student mentorship and research outputs

Output	Number/Recognition	Key Achievements
Investigatory projects (Cagayan de oro National High School- Junior High)	6	Research dissemination through science fairs
National Science & Engineering Fair	1 Special Merit, 1 2nd Grand Award	National-level recognition (2025)
Arduino Impact Study (2019–2023)	36 students	100% programming gains; 97% electronics competence
Faculty Research Outputs	More than 3 funded studies	Evidence-based integration of robotics into STEM classrooms

Community engagement and technology deployment

RoboLikha deliberately extended learning beyond classrooms into communities. In September 2024, a three-day Creative Technologies caravan in the DepEd El Salvador Division reached nine high schools, training 1,665 participants. The sessions included robotics, 3D modeling, multimedia communication, power electronics, and occupational safety. Despite resource limitations, participants engaged fully, and evaluation revealed a 100% satisfaction rate.

In September 2025, the RoboLikha Caravan and Bootcamp further expanded the program's impact. Over three days, 2,136 participants were trained, of whom 1,993 completed the evaluation, with all respondents (100%) rating the sessions as satisfactory. The topics ranged from microcontrollers and mechatronics to digital storytelling and power electronics. Each school established Tech Corners equipped with RoboLikha Starter Kits, ensuring long-term sustainability of robotics practice.

Additionally, the Skills Training & Capacity Building in Creative Technologies (DepEd El Salvador) recorded direct mentorship of 20 teachers and 20 students using Cagebot robotics kits. This workshop bridged exposure gaps in practical robotics and strengthened the teacher-student partnership in project-based learning.

Table 3. Community engagement results (2024–2025)

Year	Location/Activity	Teachers Trained	Students Trained	Total Participants	Satisfaction Rating
2024	DepEd El Salvador Caravan	Mixed (part of 1,665)	Mixed (part of 1,665)	1,665	100%
2025	RoboLikha Caravan & Bootcamp (El Salvador)	Mixed	Mixed	2,136	100% (1,993 evals)
2025	Skills Training in Creative Tech (Cagebot)	20	20	40	100%

Competitions and innovation ecosystem

Competitions played a dual role in the program: motivating students and serving as a benchmark for program success. One notable initiative was the National Robotics Competition (NRC) Mentorship conducted in September 2025. In this program, twenty-five participants from Gusa National High School and CDO National High School underwent structured mentorship covering Sumobot mechanics, robot assembly, debugging, and design strategies. Despite hardware-sharing constraints, the participants showed high enthusiasm.

As a follow-up, plans for establishing robotics clubs and sustaining mentorship activities were outlined. Another major event was the National Robotics Competition and Innovation Summit held in 2024. Hosted by the University of Science and Technology of Southern Philippines (USTP) in collaboration with the Philippine Robotics-Gaming National Competition (PRG-NRC), the event exposed students from Region 10 to international-standard robotics games, thereby elevating regional participation to the national stage. In addition to competitive events, the program organized RoboLikha Advocacy Caravans. During these caravans, students showcased their prototypes, research, and creative technology outputs to parents, local government units (LGUs), and industry partners. These showcases strengthened community buy-in and gave visibility to grassroots innovation.

Table 4. Competitions and ecosystem outputs

Year	Activity	Participants	Key Achievements
2024	NRC & Innovation Summit (USTP)	More than 100	Region 10 exposure to global-standard robotics
2025	NRC Mentorship (USTP Makerspace)	25	Hands-on mentorship in Sumobot, Line Tracing
2023–25	Advocacy Caravans	More than 1,000 (est.)	Platforms for student showcases and awareness

Synthesis of achievements (as of 2025)

By 2025, the RoboLikha program has delivered measurable and high-impact outcomes across multiple stakeholder groups. In terms of teacher training, more than 200 teachers have been trained across partner institutions, including Central Mindanao University (CMU), the Department of Education Division of Cagayan de Oro (DepEd CDO), Cagayan de Oro National High School (CDONHS), and El Salvador. Regarding student engagement, more than 600 students have participated in mentorship programs, competitions, and lectures. Furthermore, community outreach has reached more than 3,800 participants through caravans and bootcamps. In the area of research and innovation, the program has produced six investigatory projects, two of which have received national awards. Finally, in terms of competition and capacity building, the National Robotics Competition (NRC) mentorship program and regional hosting have been successfully implemented.

Discussion

The results of RoboLikha from 2023 to 2025 demonstrate not only the program's immediate successes but also its broader significance for STEM education in the Philippines. By systematically building teachers' capacity, mentoring students, and engaging communities, the program shows that even underserved schools can produce nationally recognized innovations when given structured extension support.

One of RoboLikha's most significant outcomes has been its emphasis on teacher capacity-building. With more than 200 teachers trained across Region 10, the program has established a strong network of teacher multipliers capable of integrating robotics and creative technologies into classrooms. Unlike one-off training workshops commonly associated with development projects, RoboLikha embeds sustainability mechanisms such as the donation of robotics kits and the training of trainers. These mechanisms ensure that teacher competencies are not confined to individual participants but continue to benefit successive cohorts of students over time.

This outcome underscores the program's strategic value by highlighting the central role of teachers in sustaining long-term STEM transformation. When teachers are adequately trained and supported, underserved schools can become sites of innovation capable of producing outcomes comparable to those of more resource-rich institutions. Conversely, without sustained teacher development, existing digital inequities are likely to persist.

RoboLikha's structured mentorship model validates that students from rural and urban-poor schools can excel nationally when guided by dedicated mentors. The Special Merit Award for a robotic hand sign language interpreter and the 2nd Grand Award for an IoT-based smart aquaponics system at the 2025 National Science & Engineering Fair provide compelling proof.. These achievements are not isolated successes but rather the result of sustained mentoring, Arduino-based training, and investigatory project coaching implemented over several years.

Beyond technical skills, students reported increased confidence, curiosity, and resilience in tackling complex problems. The shift in attitudes—from perceiving programming as "difficult" to finding it "engaging and empowering"—shows that robotics is not merely a subject but a catalyst for transforming mindsets. This psychological shift is vital in sustaining STEM pathways and in encouraging students to pursue STEM careers that directly contribute to local and national development.

Unlike conventional school-based programs, RoboLikha deliberately rooted STEM learning in communities. The caravans and bootcamps reached thousands of participants (more than 3,800 by 2025). This democratization of robotics is crucial: it reframes technology not as a privilege of elite institutions but as a right of every learner.

By linking robotics with sustainability themes (e.g., the LikhaBot Green Challenge) and local problem-solving (e.g., IoT aquaponics for agriculture), RoboLikha connected STEM with everyday realities. This then contextualization strengthens community ownership and ensures that innovation is not abstract but grounded in local relevance.

The program leveraged competitions not just as events but as platforms for growth. The NRC Mentorship (2025) and Innovation Summit (2024) exposed students and teachers to international-standard robotics challenges while also identifying skill gaps such as coding fluency and hardware availability. These gaps, once revealed, informed future planning—such as extended programming workshops and school-based robotics clubs.

Such events also created a culture of visibility, where student prototypes and research were showcased to LGUs, industry partners, and parents. This ecosystem approach—where competitions fuel community recognition and institutional support—ensures that robotics education is valued beyond the classroom.

The evidence points to a clear conclusion: RoboLikha is more than a successful extension project; it is a blueprint for national STEM equity. Its success lies in combining global best practices (project-based learning, mobile labs, teacher training) with contextualized local strategies.

If expanded to other regions, the program could replicate the same multiplier effects: capacitating teachers, empowering students, engaging communities, and producing research outputs with national and international visibility. The documented results—particularly the national awards, 100% satisfaction ratings, and faculty research outputs—make a compelling case for sustained funding and policy support.

Furthermore, alignment with the UN Sustainable Development Goals (SDG 4: Quality Education; SDG 9: Innovation; SDG 17: Partnerships) strengthens its international relevance. RoboLikha exemplifies how extension programs can serve as catalysts for inclusive innovation ecosystems.

The forward-looking roadmap positions RoboLikha to scale systematically expanding to 10 fully engaged schools by 2030, equipping Creative Tech Labs, hosting annual expos, and institutionalizing LikhaChampions teacher-leaders. By embedding robotics in community contexts and aligning with national curricula, the program ensures that STEM integration will not be dependent on external actors but owned by schools and teachers themselves.

In essence, RoboLikha transforms constraints into catalysts: limited infrastructure becomes a motivation for mobile caravans, resource gaps inspire low-cost kit innovation, and rural underrepresentation in competitions becomes a driver for mentorship. These strategies make RoboLikha a replicable and sustainable model for inclusive STEM education.

CONCLUSION

This study demonstrates that community-based extension programs such as RoboLikha can help bridge STEM education access gaps in underserved Philippine schools. From 2023 to 2025, the program trained more than 200 teachers, engaged over 600 students, reached more than 3,800 community participants, and produced six investigatory projects, two of which received national recognition at the 2025 National Science & Engineering Fair.

Theoretically, these findings contribute to the literature on inclusive STEM education by showing that a holistic approach combining teacher training, student mentorship, and community engagement is more effective than isolated, single-intervention strategies. Practically, the program offers a replicable model for other universities in developing countries to address resource constraints through sustainability mechanisms such as training of trainers (ToT), hardware donations, and the development of teacher-leader networks.

This study has several limitations, including its case study design, which limits generalizability; its reliance on self-reported satisfaction data; and its geographic focus limited to Region 10, Philippines. Future research should employ quasi-experimental designs with control groups, measure long-term impacts on student learning outcomes, and replicate the model in other regional contexts to test its external validity.

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