Development of a Regional STEM Education Ecosystem in the Lower Mekong Basin: A Case Study of the Faculty of Science, Nakhon Phanom University, Thailand

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Abstract: STEM education plays a crucial role in equipping youth and educators with essential 21st-century skills, particularly in regions with unique socio-geographical contexts such as Thailand's upper northeastern provinces and the Lower Mekong subregion. The Faculty of Science at Nakhon Phanom University has actively contributed to regional STEM development by implementing a sustained model that integrates curriculum innovation, teacher capacity building, and community-based educational outreach. The initiative began in 2019 with the project *"Capacity Building for Youth in the SANUK Provinces toward Excellence in Science and Technology through STEM Education,"* developed in collaboration with the Institute for the Promotion of Teaching Science and Technology (IPST). This phase has produced 15 STEM activity modules for primary and secondary students. In its second phase, the project expanded to include teacher professional development under the title *"Developing Model Schools and Master Teachers in STEM Education in the Lower Mekong Subregion,"* has resulted in 10 additional training modules and instructional guidebooks. Over five years, these resources have been delivered to more than 80 partner school networks and have supported both student learning and pre-service teacher training in the university's Bachelor of Education programs in Physics, Chemistry, and Biology. The project has resulted in the creation of an integrated three-tiered STEM education model: (1) student-focused, problem-based STEM learning; (2) teacher training and resource development; and (3) institutional collaboration through school-university networks. Current efforts aim to extend this model through international partnerships, notably with LUMA Centre Finland, to advance locally relevant, globally connected STEM education practices." (Hmelo-Silver, 2004)

Keywords: STEM education, teacher development, school-university collaboration, problem-based learning, Mekong subregion

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Introduction

- The rapid development of science and technology globally requires nations to invest in human capital equipped with 21st-century skills (Trilling & Fadel, 2009). In response to this need, the Faculty of Science at Nakhon Phanom University initiated a STEM Education Project targeting youth in three northeastern provinces of Thailand—SANUK region; Sakon Nakhon, Nakhon Phanom and Mukdahan.

- This project aimed to develop learners who are scientifically literate, technologically capable, and proficient in engineering and mathematics principles through integrated learning. Funded by the Thai Ministry of Education with a budget of 4.67 million THB, the project was conducted from October 2018 to September 2019 under the umbrella of Thailand's 20-Year National Strategy and the Thailand 4.0 education reform framework. (Office of the National Economic and Social Development Council, 2017)

- The SciNPU-STEM education project was designed with four main objectives:
  1) To cultivate creative problem-solvers among students by engaging them in real-world STEM-based learning.
  2) To develop an integrated STEM learning model applicable from elementary to tertiary education.
  3) To provide youth with STEM-related career readiness through hands-on activities.
  4) To establish a collaborative network of schools and academic institutions centered around sustainable STEM practices.

Implementation and Activities

- The project featured 15 uniquely developed STEM modules adapted to the learners' levels and local contexts. Activities ranged from water quality analysis, herbal soap entrepreneurship, solar energy systems, robot building, to environmental exploration such as identifying local mushrooms and medicinal plants. Training sessions were conducted for both students and teachers, totalling 1,939 participants from 26 schools. The Faculty of Science also trained 19 faculty members as STEM mentors. These activities were conducted in both on-campus and off-site settings to ensure broad accessibility.

Key Achievements

- A regional STEM Learning Centre was established at Nakhon Phanom University, equipped to serve students, teachers, and surrounding schools.
- 500 copies of a STEM activity handbook were distributed to 158 educational institutions, supporting schools in conducting their own STEM sessions.
- A local flora guidebook documenting 70 plant species with medicinal uses was published and disseminated.
- A nature study trail was developed as part of the university's learning landscape, integrating environmental education into STEM practice.

Evaluation and Impact

- The project led to a significant increase in student achievement: O-NET scores showed an average improvement of 11.76% among participants—more than doubling the project's target. (Ministry of Education Thailand, 2020)
- Participant satisfaction averaged 4.32 out of 5.0 reflecting strong approval of the project's learning activities.
- Teachers reported increased capacity to conduct STEM-based teaching, and under-resourced schools benefited from shared access to materials and university-led mentorship.
- Importantly, the project inspired students to view science and technology as accessible and relevant to their everyday lives and future aspirations.

Conclusion

This STEM Education Project demonstrates the effectiveness of collaborative, context-based learning models. By aligning with national strategies and leveraging local academic resources, it delivered measurable gains in student performance, teacher development, and institutional capacity. Its success offers a replicable model for other regions aiming to integrate STEM into education systems and cultivate youth ready to thrive in a knowledge-based economy.

Figure 1. Example of STEM activity. Students used materials provided to build Eco-friendly housing models under the climate change scenario.

Figure 2. Example of STEM handbooks designed in collaboration with in-service teacher group.

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