EXECUTIVE SUMMARY

SOUTHEAST ASIAN TEACHER EDUCATION PROGRAMME (SEA-TEP) RESEARCH PROJECT

SEAMEO STEM-ED

MARCH 2026

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SOUTHEAST ASIAN TEACHER EDUCATION PROGRAMME (SEA-TEP)

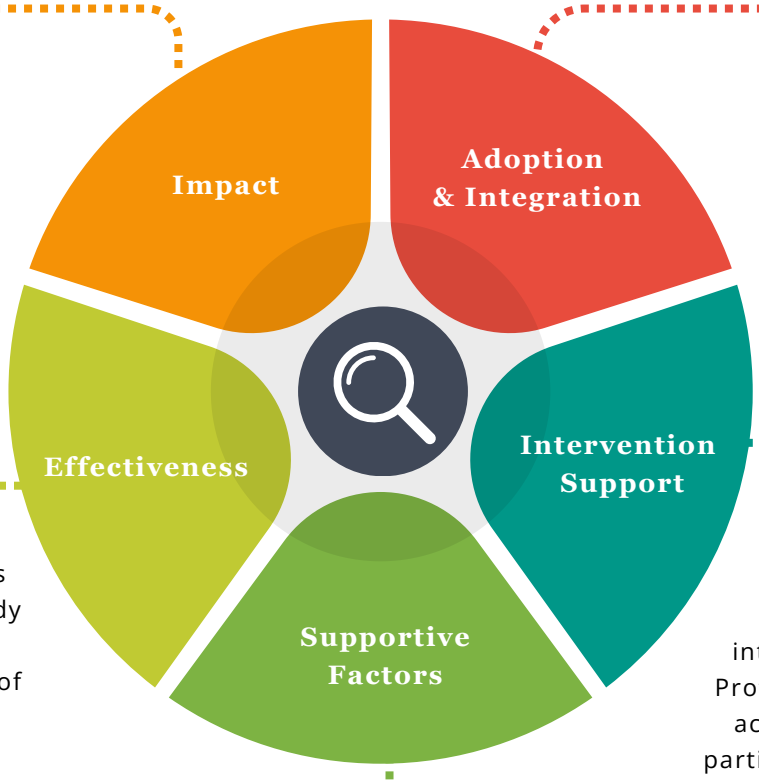
RESEARCH PROJECT

INTRODUCTION

WHAT IS THE SEA-TEP RESEARCH PROGRAMME?

The Southeast Asian Teacher Education Programme (SEA-TEP) research initiative, led by the Southeast Asian Ministers of Education Organization Regional Centre for STEM Education (SEAMEO STEM-ED), is a collaborative effort among educational organisations, institutions, and stakeholders from Cambodia, Indonesia, Malaysia, Thailand, and Kazakhstan. It aims to advance STEM teacher education in the region. Building on a commitment to capacity building, innovation, and evidence-based policy, the initiative examines the effectiveness of the SEA-TEP programme, assesses the quality and relevance of learning units integrating the Claim, Evidence, and Reasoning (CER) and modelling frameworks, strengthens collaborative research capacity, and supports evidence-informed decision-making for education reform. By embedding structured frameworks, the SEA-TEP research project meets immediate capacity needs and lays a sustainable foundation for enhancing STEM education quality, fostering pedagogical innovation, and influencing policy across diverse education systems in the region.

RESEARCH OBJECTIVES



To assess the impact of the SEA-TEP on participants' understanding and application of Claim-Evidence-Reasoning (CER) and Modelling.

To study how the participants adopt and integrate the STEM learning units and/or CER and Modelling into teaching practices and to identify any challenges they encounter.

To study the effectiveness of the feasibility/pilot study initiative of SEA-TEP by promoting the expansion of the scaling up of STEM learning practices

To examine how the intervention, which includes Professional Development (PD) activities, could support the participants in implementing the STEM learning units and/or CER and Modelling.

To study what supportive factors affect the implementation of SEA-TEP.

SCOPE OF WORK & KEY STRENGTHS

SCOPE OF WORK

KEY STRENGTHS OF THE STUDY

- **Evidence-based approach** to generate reliable and actionable insights
- **Assesses the effectiveness of the programme**, providing a holistic view of impact.
- **Strengthens research and analytical skills** in the programme.
- **Encourages creative integration** of frameworks and pedagogical models.
- **Fosters partnerships** for promoting shared learning and peer support.
- Directly **informs policy and practice** in advancing education systems.

RESEARCH IMPLEMENTATION

CAPACITY BUILDING & RESEARCH WORKSHOP

Building upon its commitment to capacity development, innovation, and evidence-based policymaking, the initiative aims to evaluate the effectiveness of the SEA-TEP programme and examine the quality and relevance of learning units incorporating the CER and modelling frameworks. The research component of the SEA-TEP further contributes to the knowledge base on effective teacher education and professional development

A series of online research workshops was convened to facilitate collaborative learning, exchange methodological expertise, refine research instruments across participating countries, and integrate the application of software and artificial intelligence (AI) for comprehensive data analysis. This collaborative engagement fosters the exchange of best practices among educators from diverse contexts, enriching the teacher preparation process and cultivating a regional community of practice dedicated to sustained advancements in STEM education.

COOPERATION & COLLABORATION

The SEA-TEP research project provides a platform for sharing knowledge, skills, and resources among researchers from participating countries. By sharing structured research frameworks with cross-country collaboration, the initiative supports evidence-based policy formulation, enhances research capacity, and fosters the development of skills among the researchers.

RESEARCH DIALOGUE SESSION

A dialogue session was held during the Thailand International Conference on Education Research (ThaiCER) 2025 to showcase the research component of SEA-TEP, a multi-country study involving five countries that examines the effectiveness of the SEA-TEP programme, its challenges, and opportunities for regional cooperation. The session shared the preliminary findings from the collaborative research project, highlighting diverse national perspectives, strategies, and common challenges in STEM education. Country researchers shared experiences from the study, including data collection processes, stakeholder engagement, and reflections on emerging trends, and explored the role of research in informing SEA-TEP's broader objectives of excellence, partnership, and innovation across participating countries to support future-ready STEM education policies and practices.

CHALLENGES

Unequal Access to Resources

Resource gaps create unequal opportunities for students and educators to fully engage in the programme

Policy and Institutional Alignment

Variations in educational policies, curriculum standards, and institutional priorities make standardised implementation difficult

Monitoring, Evaluation, and Sustainability

Standardised assessment tools across countries are lacking, making progress tracking difficult

Cultural & Language Differences

Aligning collaborative activities across diverse cultural contexts requires extra effort

Funding & Financial Sustainability

Reliance on short-term or project-based funding raises concerns about sustaining activities long-term

ARTICLE PUBLICATION

The Southeast Asian Journal of STEM Education (SAJSE) features a special issue dedicated to the SEA-TEP Research Project, highlighting innovative practices, methodologies, data collection, data analysis, and research findings, and collaborative efforts in STEM teacher education across Cambodia, Indonesia, Kazakhstan, Malaysia, and Thailand. Submissions present research findings, demonstrate key strengths of the initiative, and address challenges encountered during implementation. By gathering country-specific perspectives, experiences, and evidence-based insights, this special issue presents a valuable opportunity to enhance regional knowledge, inform policy and practice, and engage a growing community dedicated to advancing STEM education in Southeast Asia.

Collaboration

4

Countries

Submission

12

Research Articles

Insights & Feedback

100%

Researchers Engagement

Regional Perspectives on Transforming STEM Teacher Education

Strengthens Regional Collaboration

encouraging knowledge-sharing and sustained partnerships among SEA-TEP institutions and participating countries

Supports Capacity Building

Enhancing teacher educators through evidence-based practices, research dissemination, & professional learning opportunities

Enhances Programme Visibility & Impact

Showcasing SEA-TEP's contributions to advancing STEM education

KEY FACTS & BENEFITS

Evidence-Based Findings for Improvement

Identifies strengths, challenges, and actionable recommendations to enhance programme implementation and inform future policy and practice

Multi-Country Collaboration

Involves participants from Cambodia, Indonesia, Kazakhstan, Malaysia, and Thailand, providing rich cross-national insights

Use of Structured Pedagogical Frameworks

Integrates Claim, Evidence, and Reasoning (CER) and modelling approaches to evaluate teaching and learning effectiveness

Focus on STEM Teacher Education

Examines how SEA-TEP supports the development of 21st-century skills and STEM competencies among pre-service and in-service teachers

NOTE FROM RESEARCHEER

"This study offers a concise look into how SEA-TEP supports STEM teacher education and I hope these findings contribute to ongoing efforts to enhance STEM teaching and learning in the region...."

COUNTRIES IN FOCUS

CAMBODIA

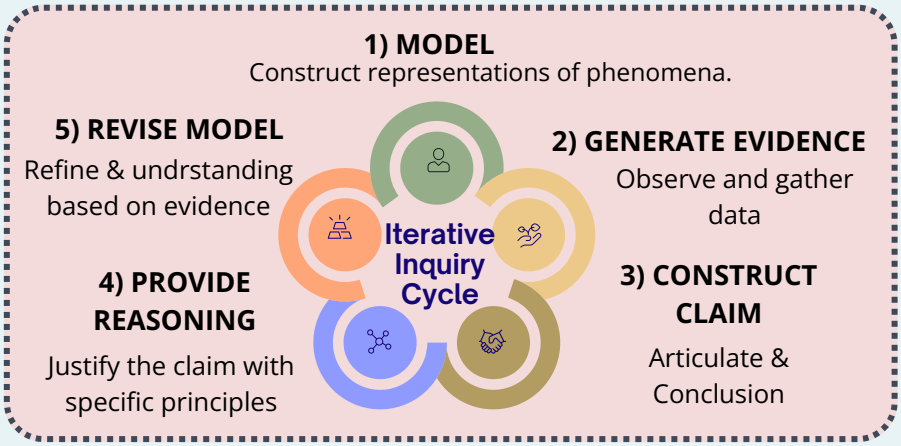
CAMBODIA

Introduction

In Cambodia, the government is reforming the education system with a focus on competency-based teacher growth and inquiry-driven pedagogy. Nevertheless, teacher education remains largely traditional and teacher-centred, limiting opportunities for active learning. The SEA-TEP initiative aims to bridge this gap by equipping teacher educators and pre-service teachers with the competencies necessary to implement inquiry-driven learning through the CER and Modelling frameworks. The research findings showed that the SEA_TEP training was highly effective, showing statistically significant gains in participants' self-assessed pedagogical competency and confidence across multiple STEM units. However, the study revealed a persistent "Success Paradox," where effective training is undermined by severe systemic constraints, including chronic resource shortages and inflexible curricula.

Methodology

Employing a mixed-methods design, the research measured the effectiveness of professional development focused on implementing inquiry-based instruction, particularly in relation to the Claim, Evidence, Reasoning (CER) framework.



Participant & Sampling

Sampling

The study was conducted at three Teacher Education Institutions (TEIs) in Cambodia, including the National Institute of Education (NIE), Phnom Penh Teacher Education College (PTEC), and Battambang Teacher Education College (BTEC).

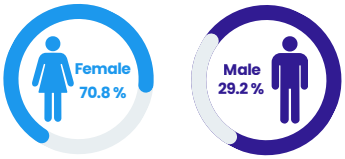
Accordingly, purposive sampling was employed in this study. The selection was made by the Ministry of Education, Youth and Sport (MoEYS), through the Department of Research and Innovation (DRI), based on the institutions' expertise in teacher training.

Participants

The programme involved a total of 594 participants, comprising 399 pre-service teachers, 126 in-service teachers, and 62 teacher educators, who participated in various SEA-TEP training, professional development, and research activities.

As part of the research, only 264 participants completed the pre- and post-tests. Consequently, the quantitative findings reported in this study are based on data obtained from these participants.

GENDER DISTRIBUTION

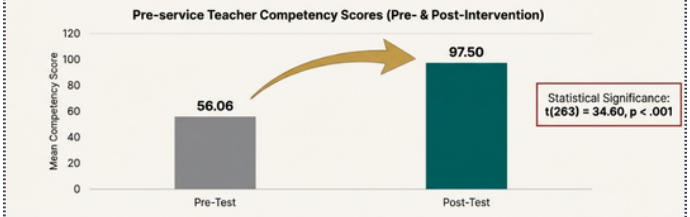


CAMBODIA

Key Outcomes

Research Findings

A statistically significant improvement in pre-service teachers' self-perceived competencies for inquiry-based STEM pedagogy.



The SEA-TEP professional development program produced a **substantial positive effect** on participants' skills in implementing the Claim-Evidence-Reasoning (CER) framework.

This study involved **264 pre-service** teachers from Cambodia's three key Teacher Education Institutions (TEIs).

STEM Learning Unit	Pre-test Mean	Post-test Mean	Result
Water Quality (Chemistry)	59.02	95.11	Significant Gain ($p < .001$)
Interactions (Physics)	60.29	90.81	Significant Gain ($p < .001$)
Health in Our Hands (Biology)	59.33	94.77	Significant Gain ($p < .001$)

PEDAGOGICAL TRANSFORMATION THROUGH INQUIRY-BASED APPROACHES

ACTIVE SENSE-MAKING

Empowers learners to construct their own understanding through exploration, reasoning, and reflection.

PEER LEARNING & CRITICAL DISCUSSION

Encourages learners to exchange ideas, challenge assumptions, and deepen their understanding together.

DEEPER CONCEPTUAL UNDERSTANDING

Enables learners to grasp core ideas more fully and apply them across different contexts.

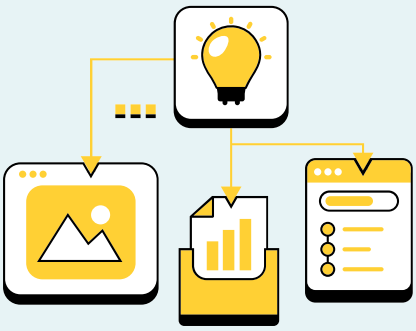
Implications

Building the evidence base:

The findings provide foundational evidence to inform future research using observational, longitudinal, and cross-country designs across regional contexts.

One-off training is not enough:

For TEIs, sustainable pedagogical change depends on continuous, practice-focused support such as coaching and professional learning communities, embedded within pre-service curricula rather than one-off training.



Systemic coherence matters:

Inquiry-based pedagogy is more effective when embedded in national curricula and assessment frameworks than when delivered through stand-alone training.

CAMBODIA

Strengths of the Study

01

Pedagogical Transformation through Inquiry-Based Approaches

The Claim–Evidence–Reasoning (CER) and Modeling frameworks were viewed as transformative tools,allowing them to guide students through hands-on experiments, data analysis, and scientific argumentation

02

Shifts in Classroom Dynamics and Learner Engagement

Teachers observed visible changes in classroom interactions following the implementation of inquiry strategies, and students became more active, communicative, and analytical

03

Emerging Best Practices and Conditions for Sustainability

Participants identified that sustained impact requires strategies such as continuous professional learning (e.g., peer-mentoring systems)

Challenges

Resource Limitations 01

Participants cited the persistent issue of inadequate laboratory materials, limited ICT access, and unreliable internet connectivity, particularly in provincial Teacher Education Institutions (TEIs)

02 Curricular and Time Constraints

Teachers reported difficulty balancing curriculum coverage with the time required for inquiry-based activities due to tight academic schedules.

03 Human Capital and Institutional Factors

Implementation fidelity was constrained by factors such as large class sizes, existing language barriers among students, and teacher resistance to shifting from traditional, lecture-based methods

INDONESIA

INDONESIA

1 SAMPLING

The initiative implementation in Indonesia was spearheaded with a total of 271 respondents participating in the study across three university clusters [Universitas Ahmad Dahlan (UAD), Universitas Islam Negeri (UIN) Raden Fatah in Palembang, Universitas Sebelas Maret (UNS) in Surakarta] with 34 faculty, 37 university students, 32 school teachers, and 168 school students.

2 RESEARCH AND IDEATION

The program was designed to address low national PISA results and the gap between student competencies and modern labor market demands by fostering STEM literacy, critical thinking, and evidence-based reasoning.

3 INSTITUTIONAL FOCUS & LEARNING UNITS

Each university adapted the SEA-TEP framework to its specific educational context:

- UAD focused on integrating STEM units into Teacher Training Institution (LPTK) curricula using 3D Learning, CER frameworks, and SAGE Modeler with themes such as clean water, smoke detectors, and urban farming.
- UNS implemented the program through Field Teaching Practice (PPL) in partner junior and senior high schools, utilising contextual units including "*Heat in Our Homes*" and local water quality testing.
- UIN Raden Fatah specialised in strengthening Madrasah (Islamic school) teacher capacity through contextual STEM-PjBL (Project-Based Learning) focused on energy conservation, water treatment, and environmental issues

4 METHODOLOGY

The research employed a quasi-experimental pretest-posttest design, comparing experimental classes that received the STEM-PBL/CER intervention with control classes that received conventional instruction. Purposive sampling was used to select the participating schools and institutions based on school status, accessibility, administrative support, comparable student demographics, and academic achievement.

5 KEY FINDINGS

- ***Scientific Argumentation:*** Quantitative results at UIN Palembang revealed significant improvements in Claim-Evidence-Reasoning (CER) skills, with experimental classes achieving *Normalized Gains* (N-Gain) of 0.618 to 0.724, compared with control groups, which scored as low as 0.231.
- ***Mastery by Component:*** At UNS Surakarta, students demonstrated high mastery across all CER elements, with the Claim component showing the greatest improvement (up to 89%).
- ***Engagement and Performance:*** Multiple regression analysis indicated that 60.4% of the variance in academic performance could be explained by learning motivation, participation, and conceptual understanding developed through the program.

INDONESIA

Research in Focus

Programme Effectiveness

The study investigated the effectiveness of STEM-based Problem-Based Learning (PBL), explicitly integrating the Claim-Evidence-Reasoning (CER) framework, in developing scientific argumentation skills. Participants reported that project activities made science more accessible and relevant to their daily lives.

Data Collection Instruments

Data collection instruments featured CER-based scientific argumentation tests, classroom observations, student project evaluations, and reflective journals.

FACT

Students successfully developed all CER components: at School A, **89%** produced clear claims, **93%** provided empirical evidence, and **85%** established reasoning connections; School B showed slightly lower but still strong performance (76%, 81%, and 72%, respectively)

The findings demonstrate that STEM-based PBL, when implemented with deliberate pedagogical support, can effectively develop scientific argumentation abilities in school settings, offering potential for broader integration and implementation.

Key Perspectives

Significant Improvement

Experimental classes demonstrated significant improvements in CER competence compared to control classes, with statistically significant differences observed at both schools

Instructional Quality

A critical mediating factor, with consistent teacher scaffolding, rich classroom discourse, and systematic modeling being essential for developing higher-order reasoning skills

Effective Integration

The intervention proved highly effective, yielding a high *N-Gain* of 0.724 at School B and a moderate-high *N-Gain* of 0.618 at School A

INDONESIA

Strengths of the Study

Practical Application of Frameworks Enhances Lesson Quality

- Teachers found that the PD provided practical tools, such as CER templates and modelling structures, which made lesson planning clearer and more impactful

Strengthened Confidence and Innovation in Learning

- The initiative inspired greater confidence, experimentation, and creativity, empowering teachers to try out new formats like argumentation tasks and combine hands-on activities with reasoning prompts

Enhance Instructional Transformation

- Teachers reported an instructional transformation where their planning improved because they began focusing more on how students think (metacognitive awareness)

Improve Reasoning Skills

- This shift led to a reasoning-first approach, meaning planning started with reasoning rather than just learning outcomes

Challenges

02

Recources

Limited lab tools and insufficient science kits made the modeling component of the instruction difficult to implement effectively

03

Curriculum Constraint

There was difficulty managing the coverage-over-depth tension, as teachers had to rush through the syllabus due to curriculum pressures and impending exams

01

Time Limitation

Teachers reported that time limitations were a major issue, as implementing CER takes longer than traditional lessons, and the rigid school timetable often does not allow enough time for students to finish full CER cycles

04

Student Readiness & Contextual Barriers

- Teachers found that weak language skills made CER challenging & struggled to write clear explanations even if they understood the underlying concepts
- Students were often not used to giving reasons & needed more scaffolding before engaging in full reasoning

KAZAKHSTAN

KAZAKHSTAN

RESEARCH PERSPECTIVES

INTRODUCTION

BACKGROUND

The Kazakhstan study was conducted within the framework of the Strengthening Teaching Education Program (SEA-TEP), developed by the "Caravan of Knowledge" corporate foundation and the SEAMEO STEM-ED Regional Centre. The research aimed to modernize STEM instruction by focusing on three key methodologies: Claim-Evidence-Reasoning (CER), Project-Based Learning (PBL), and Sage Modeling. These approaches were chosen to align the national education system with the Society 5.0 strategy, which emphasizes balancing economic progress with digital technology to resolve social issues.

KEY FEATURES

- **Significant Improvement in CER Application**

  A statistically significant improvement in the use of the CER methodology after the completion of the course ($t = -2.179$, $p = 0.042$), indicating that participants became more systematic in applying CER in their lessons

- **Strong Correlation Between Modeling and Engagement**

  A strong poitive correlation was found between the use of Sage Modeling and student activity ($\rho = 0.758$, $p < 0.001$). This reinforces the idea that digital modeling tools can transform traditional lessons into dynamic learning experiences

METHODOLOGY

The research employed a mixed-methods design, combining quantitative analysis of pre- and post-course data with qualitative observations, teacher reflections, and video observations.

SAMPLING

50 Teachers and university educators participated, which was part of the "Strengthening Teaching Education Program" . The programme aimed to help educators reflect on and revise their teaching practices by providing methodological resources focused on CER, PBL, and modeling.

KAZAKHSTAN

DATA COLLECTION & ANALYSIS

The research aimed to evaluate changes in teachers' approach to lesson planning and classroom instruction following the course:

Analysis of Lesson Plans

Lesson plans were assessed based on criteria such as the clarity of learning objectives, the application of CER and modeling methods, student-teacher interaction, assessment strategies, and student engagement

Analysis of Classroom Practice

Implementation effectiveness was examined through lesson video recordings, focusing on lesson structure, teacher reflection, student engagement, and the use of Sage Modeling

Survey

The survey was administered to 50 educators to assess changes in pedagogical approach and student engagement. Based on the research criteria, items were rated on a 5-point Likert scale.

Interview

Interview session was conducted to provide depth understanding to the statistical findings. These questions target the "identity shift" of the teacher and the challenges of classroom implementation

RESULTS

The final research dataset was derived from **68 valid observations** of lesson planning and classroom implementation activities

Descriptive statistics for Lesson-Planning Components and Student Engagement

Variable	Median	Mean	Std. Deviation
Clarity of Objectives	5.000	4.809	0.396
CER and Modeling	3.000	3.239	0.955
Interaction	3.000	3.209	0.978
Assessment Strategies	3.000	2.343	1.582
Student Engagement	3.000	3.075	0.990

Correlations between Lesson Components and Student Activity

Variable	Student activity (ρ)	p-value
Clarity of objectives	0.138	0.265
CER and modeling	0.728	<0.001
Interaction	0.838	<0.001
Knowledge assessment	0.599	<0.001

KAZAKHSTAN

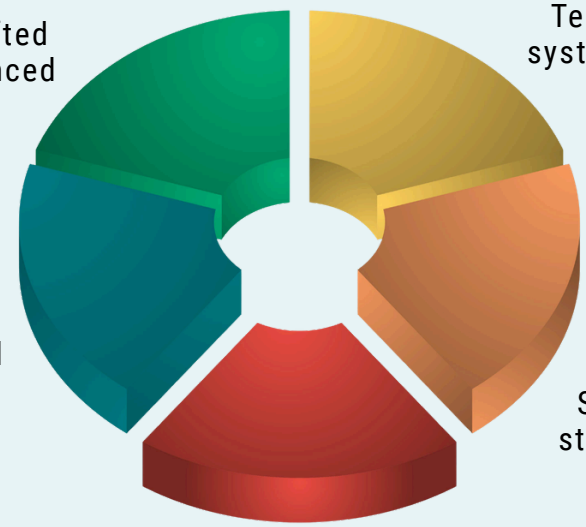
Key Strengths of the Study

Measurable Shifts in Instructional Practice

Evidence shows teaching shifted toward inquiry and tech-enhanced instruction.

Stronger CER Implementation and STEM Reasoning

Teachers applied CER more systematically in planning and teaching.



Clear Predictors of Student Engagement

Interaction, CER, modeling, and assessment predict stronger engagement.

Modeling-Powered Engagement and Teacher Reflection

Sage Modeling linked to higher student participation and teacher reflection.

High Motivation and Professional Engagement to Sustain Change

Strong interest in STEM/STEAM supports continued innovation.

Challenges

Resource and Equity Gaps

Limited equipment and rural constraints hinder consistent implementation.

System and Policy Misalignment

Standards, training, and classroom realities need tighter alignment and local resources.

Need Sustained Support

Continued coaching, training, and networking are required to maintain gains.

Feedback Discrepancies Issues

Self-ratings differ from expert reviews; observation-based feedback is needed.

MALAYSIA

MALAYSIA

Introduction

The implementation of the Southeast Asian Teacher Education Programme (SEA-TEP) in Malaysia was a strategic initiative designed to modernise teacher capacity by integrating Claim-Evidence-Reasoning (CER), scientific modelling, and three-dimensional (3D) learning into the STEM curriculum. Spearheaded by SEAMEO RECSAM in Malaysia, the programme aimed to shift teaching practices from traditional, lecture-based content transmission to student-centered, inquiry-based facilitation

Methodology

Intervention Development

↓

Implementation and Observation

↓

Evaluation and Adaption

Key Facts

Students' Participation in the Study

Using a qualitative case study approach with data from 141 participants.

Key Themes of the Analysis

Srengthened pedagogical confidence, structured lesson design guidance, collaborative reflection and peer learning, and the enablers and constraints affecting classroom integration

Improvement of Skills

The findings show that SEA-TEP enhances teachers' conceptual and practical application of CER and modelling frameworks.

Sampling

141 Individuals participated

70 Matriculation colleges educators

44 Primary school teachers

27 Pre-service teachers

Data Analysis

The data underwent inductive content and thematic analysis to identify key themes describing teacher experiences, challenges, and opportunities.

Sampling Method

Researchers utilised convenience sampling (a non-probability technique) based on availability, proximity, and willingness to participate. Additionally, purposeful sampling was employed to ensure all participants had relevant exposure to the professional development activities

Key Facts

- Interactions through Professional Learning Communities (PLCs) allowed teachers to co-construct ideas and troubleshoot challenges
- Teachers observed that students became more active and curious, creating a positive feedback loop that motivated continued use of inquiry-based methods

MALAYSIA

Key Findings

STRENGTHENING PEDAGOGICAL CONFIDENCE AND PRACTICE

The CER and modelling approaches in STEM reflect a shift in mindset from content transmission to deeper conceptual facilitation, highlighting the importance of prompting students to reason and argue scientifically.

STRUCTURED GUIDANCE THROUGH LESSON DESIGN

The PD activities support teachers by providing guidance tools such as template-based structures, lesson-planning guides, and other scaffolds that help reduce workload and anxiety while enhancing lesson coherence.

COLLABORATIVE REFLECTION AND PEER LEARNING

The programme embedded opportunities for sharing and feedback, which fostered professional learning communities and allowed teachers to refine their instructional ideas and CER questions

ENABLERS AND CONSTRAINTS IN CLASSROOM INTEGRATION

The CER and modelling approaches in STEM shift in mindset from content transmission to deeper conceptual facilitation, highlighting the importance of prompting students to reason and argue scientifically.

FACT

Approximately 34% of participants cited increased confidence as a primary outcome, noting they were less hesitant to handle open-ended student questions

OPINION

Participants' belief in the feasibility of scaling the programme rose markedly from a pre-test mean of 1.93 to 4.43 on a 5-point scale

EVIDENCE

Quantitative results revealed statistically significant improvements across all domains, with mean gains in CER subcomponents (Claims, Evidence, Reasoning) exceeding 2.4 points ($p < .001$)

INSIGHT

Educators demonstrated high self-efficacy in 3D Learning, particularly in prioritising core ideas and facilitating interdisciplinary discussions

MALAYSIA

Strengths of the Study

The initiative effectively enhanced teachers' conceptual understanding and practical application of CER and modelling. Opportunities experienced by participants included:

01

Improved Confidence and Innovation

Teachers felt empowered to experiment with pedagogy, try new strategies like modelling, and redesign full topics

02

Enhanced Lesson Quality

The practical application of the CER framework was found to make students' answers more organized and improved lesson clarity

03

Better Assessment & Planning

The provided rubrics helped align assessment with CER, making expectations clear

04

Shift to Reasoning-First Instruction

Teachers reported planning now starts with reasoning section in their lessons

Challenges

Despite the benefits, teachers faced several significant barriers and challenges when translating the frameworks into classroom practice including:

Time Limitation

Teachers reported that CER takes longer than traditional lessons, and the school timetable often does not allow enough time for students to finish full CER cycles

Curriculum Constraint

There is difficulty in covering the syllabus while implementing full CER or modelling activities, especially when faced with upcoming exams

Resource Issue

Limited lab tools and science kits make the modelling component difficult, forcing teachers to adapt by using alternatives like photos

Student Language Skill

Weak language proficiency and the fact that many students are English as a Second Language (ESL) learners make CER challenging, as students struggle to write clear explanations even if they have good ideas

Cultural & Development Barriers

Students are often not used to giving reasons, requiring a cultural shift in learning and greater scaffolding for younger learners

THAILAND

THAILAND

Introduction

The initiative emphasised STEM education to enhance student performance by integrating Claim-Evidence-Reasoning (CER) and modeling-based instruction. These pedagogical techniques align with the Thai National Curriculum, which focuses the development of 21st-century skills including argumentation, critical thinking, and collaboration.

Aims

The primary research objective was to evaluate the effectiveness of these instructional methods and identify specific success factors and barriers within the Thai educational context

Sampling

307

Number of teachers trained

259
In-service teachers

23
Pre-service teachers

25
undergraduates and graduate students

Methodology

The research was framed as evaluative research using a mixed-methods approach.

Research Design and Approach

The approach combined quantitative techniques, including propensity score analysis and surveys, with semi-structured interviews, and focus groups. The research framework was designed to assess both the pedagogical effectiveness of the implementation and the practical experiences of the educators involved

Sampling Method

Participants were drawn from three major institutional collaborations; Chulalongkorn University (CU), Naresuan University (NU), and King Mongkut's University of Technology Thonburi (KMUTT). Specifically, CU provided pre-service teachers, NU involved in-service teachers and undergraduates, and KMUTT included in-service teachers, pre-service teachers, and graduate students.

Instruments

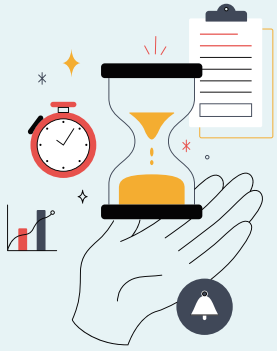
The team utilised two primary quantitative instruments: a Self-efficacy in STEM teaching scale (demonstrating a reliability of 0.87) and a Teachers' knowledge in STEM teaching survey (demonstrating a reliability of 0.84). Qualitative data were gathered through semi-structured interviews and direct field experience insights to capture the challenges and successes of the participants

THAILAND

Key Findings

1 Quality Improvement

CER- and modeling-based instruction showed strong potential to improve the overall quality of science education in Thailand



2 Competency Gains

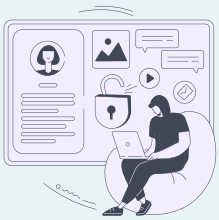
Participants developed high self-efficacy (*Mean*=4.38) and strong pedagogical knowledge (*Mean*=4.22) in STEM teaching

3 Instructional Tools

Teacher questioning emerged as a critical guiding tool for stimulating student reasoning and deeper thinking

4 Student Impact

Classrooms saw a measurable increase in student motivation, engagement, and collaborative learning



5 Capacity Building

The initiative successfully trained 307 educators and led to the development and monitoring of multiple STEM classrooms

6 Learning Support

The project established a free online course on 3D learning and CER to support continuous teacher development

Fostering Communities

The study emphasised the necessity of Professional Learning Communities (PLCs) for sharing best practices, which provides a blueprint for long-term instructional sustainability and continuous development.

THAILAND

Strengths of the Study

Utilisation of propensity score analysis within a mixed-methods framework to evaluate pedagogical effectiveness, providing a more robust statistical foundation for their findings

Teachers' positive attitude toward teaching using CER and modeling approaches demonstrates their intention to continue using these approaches despite any challenges.

Documented a visible shift in classroom environments, noting increased student motivation, active engagement, and collaborative learning

Successfully fostered a high-level partnership between three major institutions, creating a diverse representation in the study

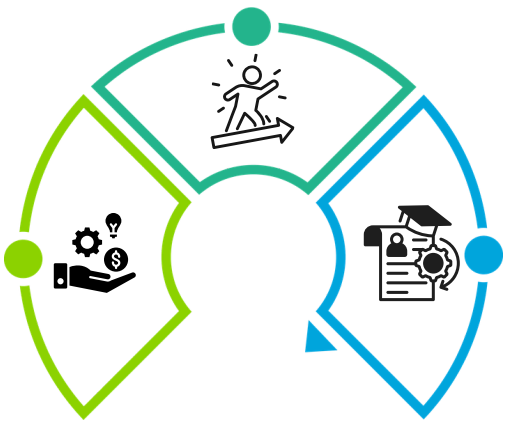
Challenges

LOW TEACHER CONFIDENCE IN CER & MODELING

CER and modeling demand refined pedagogical knowledge, and teachers often experience uncertainty about whether their instructional decisions are appropriate.

RESOURCE CONSTRAINTS

Insufficient laboratory equipment and materials in schools to support student learning.



CURRICULUM MISALIGNMENT

The National Curriculum is misaligned and not designed to support the CER and modelling framework, causing teachers to spend extra time adjusting content.

RECOMMENDATIONS

Enhancing Teacher Capacity and Reflection

Expand coaching cycles, introduce structured teacher reflection tools, peer lesson study, and long-term mentoring to build consistent, expert-level pedagogical practice across participating countries.

Strengthening Curriculum Flexibility and Instructional Time

Collaborate to revise curriculum pacing guides, embed CER/modeling as forms of assessment, and allow flexible scheduling to support deeper inquiry without compromising syllabus requirements.

Improving Student Readiness ThroughmScaffolding Support

Provide multilingual CER scaffolds and gradual-release strategies, incorporating comprehensive instruction on reasoning from early grades to build a culture of explanation and critical thinking.

Addressing Resource Gaps

Promote community-based resource sharing, strengthen digital resource libraries, and secure partnerships with private-sector and local organisations to support sustainable resource provision.

Supporting Shifts toward Inquiry-Based STEM Learning

Promote learning transformation through leadership training, policy endorsement of inquiry/STEM practices, recognition systems for innovative teaching, and cross-country professional learning communities

SUMMARY & CONCLUSION

Strengthening STEM Teacher Education in Southeast Asia

The SEA-TEP programme has proven to be a valuable regional initiative that advances STEM education through structured pedagogies, collaborative professional learning, and research-driven implementation. The evidence across all five countries shows that integrating CER and modelling supports deeper student understanding and promotes more meaningful inquiry-based learning. Moving forward, sustained efforts are needed to address resource gaps, enhance teacher reflection and methodological mastery, and ensure greater institutional support for inquiry-oriented STEM teaching. Strengthening curriculum flexibility, building long-term professional learning communities, and scaling evidence-based practices will further solidify SEA-TEP's role as a transformative model for STEM teacher development in Southeast Asia.

SUMMARY

The SEA-TEP programme researches across Cambodia, Indonesia, Kazakhstan, Malaysia, and Thailand, providing a comprehensive understanding of how teachers engage with integrated STEM, *Claim–Evidence–Reasoning* (CER), and scientific modelling frameworks. Across the five countries, the study reveals consistent strengths, including increased teacher confidence in applying inquiry-based approaches, greater clarity in lesson design, and strong professional collaboration fostered through SEA-TEP training.

Teachers also reported notable improvements in student engagement, reasoning skills, and the ability to connect classroom learning with authentic, real-world contexts. However, the research also highlights recurring challenges, such as time and curriculum constraints, resource limitations, inconsistent methodological implementation, and varying levels of student readiness. Despite these limitations, the cross-country findings demonstrate that SEA-TEP has had a positive influence on pedagogical practices and strengthened capacity in STEM teacher education across diverse contexts.

ACKNOWLEDGEMENT

SOUTHEAST ASIAN TEACHER EDUCATION PROGRAM RESEARCH

Regional Perspectives on SEA-TEP Initiatives

Advancing STEM Teacher Education in Southeast Asia

"... We extend sincere appreciation to all SEA-TEP country partners from Cambodia, Indonesia, Kazakhstan, Malaysia, and Thailand for their collaboration and commitment throughout the study. We are grateful to the teachers, students, and university faculty whose participation and insights made this research possible. Special thanks are also to all partners for their continuous support, guidance, and dedication to advancing STEM teacher education across the region. Their leadership and coordination were essential in ensuring the successful implementation of this research... "

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APPENDICES & REFERENCES

ABOUT SOUTHEAST ASIAN TEACHER EDUCATION PROGRAMME (SEA-TEP)
https://www.seameo-stemed.org/sea-tep/

SEA-TEP FINAL PROGRAMME REPORT
httpshttps://www.seameo-stemed.org/wp-content/uploads/2023/11/SEA-TEP-Policy-Brief-Final.pdf://www.seameo-stemed.org/sea-tep/

POLICY BRIEF: SOUTHEAST ASIAN TEACHER EDUCATION PROGRAMME (SEA-TEP)
https://www.seameo-stemed.org/wp-content/uploads/2023/11/SEA-TEP-Policy-Brief-Final.pdf

DIALOGUE SESSION ON REGIONAL COLLABORATION IN ACTION: INSIGHTS FROM THE SEA-TEP RESEARCH INITIATIVES
https://drive.google.com/drive/folders/1t-oGa-Is87UALcUF6s8IADRN1IdZWELT?usp=drive_link

SHARING SESSION AT SEA-TEP FINAL SHARING AND REFLECTION WORKSHOP
https://drive.google.com/drive/folders/1eb7M4XQMxtub9kGCGqpGGRrfEReyfzVq?usp=drive_link

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