Role of SEAMEO RECSAM in Inclusive and STEM Education Development

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Abstract

SEAMEO RECSAM is committed to developing science and mathematics education in the ASEAN community. The centre constantly monitors the latest developments in STEM education and conducts 21st-century learning skills training workshops. This helps the centre stay in the front line to pursue the knowledge, skills, and values needed to effectively respond to changing global contexts, particularly with regard to the complexity of the Southeast Asian economic, sociocultural, and political environment, and develop teachers imbibed with the ASEAN ideals to live in a harmonious community. To meet the challenges of the future, much of the centre's training programmes focus on improving humans' basic character, developing creative human capital with critical-thinking and problem-solving skills, and enriching the ASEAN community's science and mathematics knowledge. Its latest endeavour emphasises STEM education to bring about awareness and enhance the workforce to further economic sustainability and improve the well-being of the society at large. The centre has embarked on various initiatives to develop teachers' and students' skills and interest in STEM. The centre also conducts training, research and development (R&D) efforts, international conferences, seminars, and congresses while serving as an information centre that disseminates state-of the art practices in inclusive education.

Introduction

Since its inception in 1967, SEAMEO RECSAM has been assisting ASEAN countries in major development efforts to improve educational manpower for the advancement of science and mathematics education in the primary- and secondary-school levels. As such, the centre has been continuously offering full scholarships to teachers and educators in the region to improve their skills and help them better adapt to the changing educational environment.

The centre contributes to improving science and mathematics education through various programmes and activities, including training, R&D efforts, international conferences, seminars, and congresses. It also serve as an information centre and clearinghouse to the whole Southeast Asian region. To ensure the relevance of its activities, the centre's programmes are formulated in consultation with senior education representatives from SEAMEO member countries and experts from associate and affiliate countries. SEAMEO RECSAM has made significant strides to date and is now in the process of completing its "10th Five-Year Plan for 2015–2020."

SEAMEO RECSAM envisions to be the leading centre for quality science and mathematics education. It fulfills its mission by:

- Designing and implementing high-quality professional development programmes
- Conducting R&D activities to inform stakeholders about pedagogies and policies
- Convening international conferences, seminars, and workshops to pool experts in science and mathematics education
- Serving as a clearinghouse for information on science and mathematics education in the region

The centre also maintains alignment with current trends in science and mathematics education as shown in the following time line:

- **1990s:** Action research, cooperative learning, problem solving, inquiry-based learning, higher-order thinking, abacus, misconceptions in mathematics
- **2000s:** Lesson study, ICT, smart school, performance assessment, distance learning
- **2010s:** Lesson study, assessment related to TIMSS and PISA outcomes, HOTS, entrepreneurship, project-based learning, problem-based learning, inquiry-based learning
- **Current engagement:** 21st-century skills, STEM education, HOTS, PISA, TIMSS, teaching mathematics through problem solving, lesson study, inquiry-based learning

Role of SEAMEO RECSAM in Supporting and Contributing to the Southeast Asian Community

The ASEAN Community in 2015 was characterised as a political-security, an economic, and a sociocultural community. It was formed to improve the lives of the people in the region, reflected by economic and cultural development, social progress, peace and security, collaboration, mutual assistance in training and research, improved living standards, the promotion of Southeast Asian studies, and cooperation. SEAMEO RECSAM, as a regional centre, can indirectly help by turning teachers and educators into human capital with the following attributes:

- Resilient in facing future challenges

- Well-equipped with 21st-century skills and competencies (OECD, 2009)
- Can cultivate sustainability-related values and attitudes
- Competent and well-versed in languages and ICT tools to convey ideas and thoughts
- Act autonomously based on rational decisions
- Have the ability to interact well with others in the community
- Can acquire knowledge, skills, and jobs while staying competitive
- Responsible and contribute to the society

Hence, the centre's course of actions has been focusing on two significant areas—promoting inclusive education to the community and promoting STEM education to stay abreast of the current trends in and needs of the society.

Promoting Inclusive Education in Communities

SEAMEO RECSAM conducts the following programmes to promote inclusive education within the ASEAN community.

Professional Development Programmes

These programmes cater to in-service teachers from ASEAN countries. They aim to:

- Emphasise ideas and practices that support teachers who include students with diverse needs in the classroom
- Apply appropriate teaching and learning strategies to develop individual strengths with high and appropriate expectations for each child
- Support students through good inclusive practices such as collaboration, teamwork, innovative instructional practices, peer strategies, and others
- Encourage collaboration and communication to deliver and share ideas for better understanding and improvement
- Value diverse communities in most ASEAN societies (Community-building starts in school where all students learn to live alongside peers. They learn together, play together, and grow and are nurtured together.)

- Design mathematics and science courses to raise awareness of the role of ASEAN educators in developing the future generation so they are well-equipped with the necessary knowledge, skills, and values to help build the ASEAN community

SEA-BES Project

The SEA-BES Project is a regional curriculum initiative that aims to develop common, shared, and agreed-upon standards for what every ASEAN learner should know, be able to do, and value in science and mathematics. The centre believes that the CCRLS in Science and Mathematics can be used to improve the quality of SEAMEO member countries' national curricula by creating equity in provision and increasing learning expectations for all students so they can productively contribute to their individual countries and the region. The CCRLS in Science and Mathematics aims to provide world-class learning standards in science and mathematics, including 21st-century skills, that can be used as benchmark in SEAMEO member countries to ensure that all students have access to fundamental knowledge, skills, and values to become socially responsible, globally competitive, and sustainable.

The project is made possible by the active participation and involvement of experts and educators across Southeast Asia and beyond. CRICED of the University of Tsukuba has taken a lead role in linking and extending collaborations with others to produce SEA-BES. CRICED has also been continuing its support for producing a mathematics learning standards guidebook based on the CCRLS in Science and Mathematics. We hope to emphasise development in three components—inculcating values, attitudes, and other positive human characteristics; promoting mathematical-thinking and scientific processes; and acquiring fluency in the subject matter. These components are interconnected and competence in them can be developed in classroom activities based on appropriate contexts.

Promoting STEM Education through STEM- and SDGs-Related Projects

The centre has embarked on the following programmes to promote STEM education through STEM and SDGs-related projects.

SSYS

The Search for SEAMEO Young Scientists (SSYS) is a regional platform where young scientists from Southeast Asia and beyond gather to share and disseminate information on their scientific and mathematical research projects. Since its inception in 1997, SSYS has been held once every two years with a specific theme where students are encouraged to apply their scientific and mathematical knowledge to solve technological problems in order to address sustainability. The theme of the biennial project has always focused on sustainable development as shown in Table 12.

Table 12: SSYS Themes

Year	Theme
2018	Youth Creativity for Harmonising the SDGs
2016	Youth Innovation for Sustainability

Table 12: SSYS Themes	
Year	**Theme**
2014	Disaster Risk Reduction (DRR) for Sustainable Development
2012	Beyond 2012: Greening the Environment for a Sustainable Future
2010	Sustainable Solutions for the Local Community

The three basic elements of sustainable development are ecological, economic, and sociocultural sustainability as outlined in the "2030 Agenda for Sustainable Development." These three aspects must be well-blended to promote ecological balance and improve the quality of human life. These concerns imply a change in learning. SSYS aims to raise the awareness of the youth about their role and responsibility towards attaining sustainable development for their local community. The knowledge and skills they will acquire and develop will give them confidence to pursue endeavours related to sustainable development.

CoSMEd

The International Conference on Science and Mathematics Education (CoSMEd) is a platform that brings educators and researchers together to discuss and address issues in 21st-century science and mathematics education. For instance, the themes and strands of the Sixth and Seventh CoSMEds shown in Table 13 were mostly related to improving awareness of STEM education to contribute to achieving the SDGs.

Table 13: Information on the Sixth and Seventh CoSMEds		
Details	**Sixth CoSMED 2015**	**Seventh CoSMED 2017**
Date	16–19 November 2015	13–17 November 2017
Theme	Revitalising Science and Mathematics Teaching and Learning Culture towards Sustainable Living	Humanising STEM Education to Achieve the SDGs in the 21st Century
Strands	• Teaching and Learning Practices • Pedagogical Innovations • Teachers' Professional Development • Assessment and Evaluation • STEM Education Across Contexts • Equity and Equality	• 21st-Century Teaching and Learning Innovations • Continuous Professional Development • Curriculum and Assessment • Humanising STEM Education and Career Development • Science and Mathematics Education for Special-Needs Students

STEM Education Initiatives

SEAMEO RECSAM plays a significant role in promoting STEM education through research projects and training teachers and educators from SEAMEO member countries. From our perspective, STEM education is an approach to teaching and learning that integrates the content and skills related to STEM. Students are actively engaged in inquiry, exploration, problem solving, creative and critical thinking, logical reasoning, collaboration, and investigation and creating models; artifacts; and relevant, authentic, meaningful, and useful projects. In view of this, the centre undertakes various initiatives as STEM education holds particular importance and relevance in forging sustainable development. As UNESCO Director-General Koïchiro Matsuura stated, "Education—in all its forms and at all levels—is not only an end, but is also one of the most powerful instruments we have for bringing about the changes required to achieve sustainable development" (UNESCO, 2005).

To date, the centre has spearheaded the following initiatives:

- Workshop on Enhancing Science and Mathematics Teachers' Pedagogical Content Knowledge on STEM Education (20–22 January 2015) by Associate Professor Tairo Nomura, Saitama University, Japan, in collaboration with the SEAMEO Secretariat and MEXT, Japan

- Workshop on Differentiated Instruction and STEM: Enhancing Mathematical Thinking (9–10 March 2015) by Professor Beverly Ferrucci, Keene State College, U.S.

- Workshop on Early STEM (19–20 September 2015) by Mr. Hideo Nakano, SEAMEO RECSAM Specialist for Educators of the Institute of Childhood Education Studies and Community Education (CECE), Kuala Lumpur, Malaysia

- Promoting STEM Education through Corporate Social Responsibility (CSR) Programmes (14 May 2016) by a SEAMEO RECSAM specialist in the local community

- SEAMEO RECSAM also partnered and collaborated with the Ministry of Education (MoE) in Malaysia and local universities for the following:

    - Research on STEM education that aims to test teachers' self-perceived readiness to integrate STEM into their teaching and learning practices and determine the demographic factors that influence their self-perceived readiness to integrate STEM in teaching and learning

    - Implementation of STEM education through seminars such as "STEM Education for 21st-Century Skills: Brightening Awareness of STEM Education as Part of the National Agenda" (14–15 May 2015) by Professor Dr. Lynn D. Dierking, Oregon State University, U.S. and primary and secondary education experts from Malaysia and "Enhancing STEM Thinking to Meet the Challenges of the 21st Century, Including TIMSS and PISA" (20 May 2015) for the principals of secondary schools in the Gombak District in Selangor, Malaysia

STEM Education Developments

SEAMEO RECSAM also embarked on the following to promote STEM education in the region:

- **Malaysia-UNESCO International Bureau of Education (IBE) Needs Assessment Workshop (18–20 January 2016) for Strengthening STEM Curricula for Girls in Africa and Asia and the Pacific (Phase 1) under the Malaysia-UNESCO Cooperation Programme (MUCP):** This initiative intends to strengthen STEM curricula for girls focusing on educational content, methods, and structures to foster sustainable development.

- **Capacity Development Workshop (26–30 September 2016) for Strengthening STEM Curricula for Girls in Africa and Asia and the Pacific (Phase 2) under MUCP:** This project seeks to strengthen STEM policies, curricula, and pedagogies in four beneficiary countries from Africa—Nigeria and Kenya—and Asia and the Pacific—Cambodia and Indonesia—mainly through sharing Malaysian expertise and experiences with regard to the inclusion of women in STEM fields.

- **Workshop on enhancing STEM learning in secondary-level mathematics and science classrooms for 500 Malaysian teachers (five batches with 100 teachers per batch in 2017) organised by the Teacher Education Division of MoE, Malaysia and conducted by specialists from SEAMEO RECSAM:** This primarily aims to provide teachers with the necessary knowledge and skills in conducting STEM classes.

- **Workshop on STEM using low-cost materials for secondary-level science and mathematics teachers and educators and lecturers of teacher education institutions (TEIs):** This aims to introduce participants to effective hands-on activities using low-cost educational materials for making teaching aids to improve STEM teaching and learning.

- **Colloquium on Challenges and Opportunities for Implementing STEM Education: Perspectives from the U.S. (28 October 2016):** This was conducted at SEAMEO RECSAM by Dr. Margaret Chmiel from the Smithsonian Science Education Centre.

- **Workshop on Fostering Imagination and Critical Thinking in the Engineering Design Process: A Challenge to STEM Education (6–8 February 2018) by Dr. Tairo Nomura, Director, STEM Education Research Centre and Associate Professor, Faculty of Education, Saitama University, Japan:** This was conducted in collaboration with MEXT, Japan and the SEAMEO Secretariat.

- Promotion of STEM education through competitions such as the Penang Science Olympiad 2016 (27 August 2016) and the STEM Study Contest (23 September 2017), which aim to:

    - Develop confidence in using technology to enhance students' problem-solving skills, imagination, and critical thinking in STEM lessons

    - Develop skills required in the engineering design process and model and product development through practical work and hands-on activities

    - Provide a platform for project- and problem-based learning using STEM approaches to solve real-life issues

    - Promote collaborative learning using real-life problems that can be integrated with STEM knowledge and skills

- Raise awareness on the relevance of classroom learning in STEM fields and skills needed in the job market

- Serve as a learning forum for the exchange of new ideas, knowledge, and valuable experiences amongst students and teachers

Why STEM Education?

In the 21st century, scientific and technological innovations have become increasingly important as we face the challenges of both globalisation and becoming a knowledge-based economy. To succeed in this new information-based and highly technological society, students need to develop capabilities in STEM to levels much beyond those considered acceptable in the past (National Academies of Science, et al., 2007). STEM is multidiscipline-based and so incorporates the integration of other disciplinary knowledge into a new whole. STEM education refers to a process for teaching and learning that offers students opportunities to make sense of the world and take charge of their learning or, in short, obtain meaningful learning. In a STEM environment, students engage in real-world problems and experiences through context-, problem-, project-, and inquiry-based learning activities so they can develop HOTS. The role of STEM education cannot be underestimated in preparing students for future challenges. Innovation is the key to economic growth and STEM education is the key driver of innovation. STEM education provides the foundation for students to acquire further skills as they make their lifetime transitions into the labour market.

The Way Forward

At the core of meeting the needs of the ASEAN community is making sure that teachers and educators stay abreast of educational developments around the world. The "SEAMEO Agenda" calls for educational reforms to promote well-balanced regional development that augurs well with the prominence of STEM education in the 21st century. As a training institution, SEAMEO RECSAM needs to build its skills, capacities, and resources to participate in the delivery and achievement of the 17 SDGs that aim to end poverty, protect the planet, and ensure prosperity for all (UN, 2015). Hence, well-designed projects and courses need to be developed and implemented to ensure success. The centre also hopes to enhance the awareness of and develop responsible citizens to play their respective roles in schools and institutions.

Conclusion

SEAMEO RECSAM believes that education is essential in attain sustainability and so has been promoting comprehensive cooperation for inclusive development amongst the SEAMEO member countries. It has been striving to improve the quality of science and mathematics education in the region and beyond through its various programmes and activities. Keeping future challenges in mind, much of the centre's training programmes focus on improving one's basic human character, developing creative human capital with critical-thinking and problem-solving skills, and enriching the science and mathematics knowledge of the community. As such, it has embarked on various initiatives to develop teachers' and students' skills and interest in STEM teaching and learning, as STEM education will play a vital role in bringing about a workforce that will affect the sustainability of the economic development and well-being of the society at large.

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