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EMBRACING INCLUSIVITY IN EDUCATION, SCIENCE AND CULTURE TOWARDS A FUTURE-READY SOUTHEAST ASIA

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Bridging Gaps in STEM Education: Developing Inclusive and Multidisciplinary Learning Materials with a Focus on Problem-Solving and Low-Cost Resources

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Background and Rationale



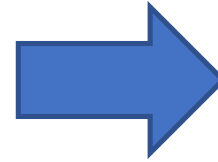
The policy of the Ministry of Education, Culture, Research and Technology (MoECRT) of Indonesia regarding student involvement in Projects to strengthen the Pancasila student profile (P5) supports the relevance of STEM-based learning.



Source: <https://www.resourcefulindonesian.com/mapping-indonesia.html>

- The problems and implementation of STEM in schools can vary greatly (Arlinwibowo, et al., 2020).
- This causes a gap in schools' ability to organize STEM-education.
- The application of STEM is generally still considered to require high costs because it uses high-level technology and engineering

- Teachers are not ready pedagogically or professionally to implement STEM-based learning.
- Schools do not yet have adequate facilities and infrastructure.
- Student profiles are very diverse so teachers have difficulty managing students



Teachers should put more effort into identifying suitable projects

Arlinwibowo, et al (2023)

- Inclusive STEM is a mechanism to improve STEM education and achieve more benefits diverse students into STEM majors and careers.
- the essential elements of teaching inclusive STEM which include personalized learning, Problem-based Learning (PBL), rigorous learning, careers, technology and life skills.

LaForce, et al (2016)



Online Regular Course on STEM for Mathematics Learning, 9 to 27 October 2020

Source: SEAQiM's Documentation

- SEAQiM continues to develop a database of teaching materials that teachers can use in learning and as a reference for developing their own learning
- The low-cost STEM-based teaching materials that are developed should use problems in the real world, enabling students to think rigorously through inclusive learning



- This paper reports the development of low-cost STEM teaching materials that have been carried out by SEAQiM in 2020, 2021 and 2023.
- SEAQiM has developed STEM learning materials for mathematics classes in accordance with the Emancipated Curriculum by prioritizing two main aspects:
 - 1) fostering connectivity between subjects to improve problem solving skills
 - 2) utilizing the low cost of materials rather than rely on advanced technology

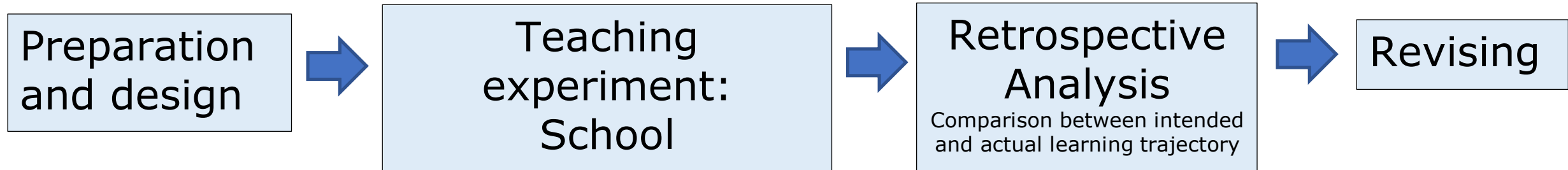
Reviewing a SEAQiM STEM learning materials activity on wind-powered boats

Source: <https://www.aminef.or.id/stem-and-computational-thinking-learning-materials-development-through-fulbright-specialist-program/>

The project aims

to produce STEM teaching materials for inclusive and multidisciplinary learning with focus on problem-solving and low-cost resources

Methods



Design research (Gravemeijer & Cobb, 2006; Eerde, 2013)

- In the Teaching Experiment stage, activities were practiced in class.
- In the Retrospective Analysis phase, researchers reflected on the results of teaching experiments.

Data source:

- recording of the teaching process and examples of student work.

Data analysis:

- document analysis combined with literature study

Population:

- mathematics teachers and secondary school students in Yogyakarta.

Sampling technique :

- Convenience sampling (Merriam & Tisdell, 2016).

The students were real-life student teachers who voluntarily signed up to participate in the study

Discussion of Findings

2020 Regular Course on STEM for Mathematics Learning

Developing lesson plan session of the course

2021 STEM+CT Learning Materials for JHS Mathematics Classroom

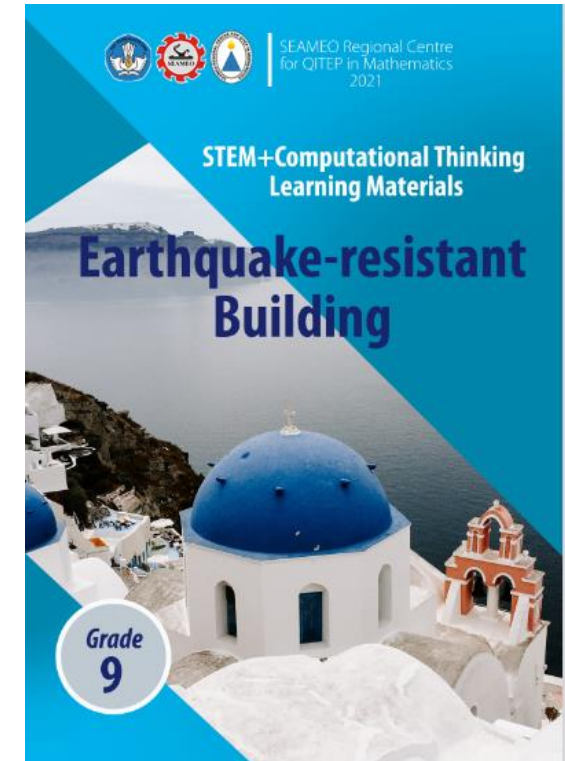
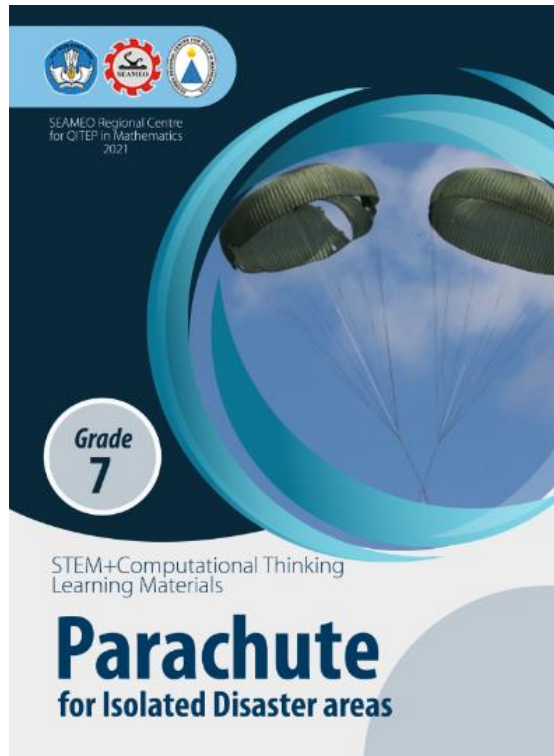
Research to develop integrated STEM learning infused with CT and applicable in math classroom

2023 STEM+CT Learning Materials for all educational stage

investigate CT skills that appear in such lesson

STEM teaching materials

2021 STEM+Computational Thinking Learning Materials for Junior High School Mathematics Classroom



2023 STEM+Computational Thinking Learning Materials for all educational stages

	Title of the lessons	Educational stages
	Bungee-jumping	Junior high school
➔	When the lake runs dry	High school
➔	Happy and healthy diet	High school
	Paper Helicopter	Primary school
➔	Pendulum Swing	Junior high school
➔	Wind-powered Boat	Junior high school
	Paper Speaker	Primary school

- During the teaching experiment it was observed that all students were able to participate actively and solve the problem by using interdisciplinary connections.

- The choice of STEM-based learning titles developed by SEAQiM focus on current problems in the real world that can be solved through a multidisciplinary approach and interdisciplinary connections.
- The materials used in this STEM project are low-cost
- Further study is still needed regarding its influence on computational thinking abilities.

Conclusion

- Students actively engage with the materials and successfully make interdisciplinary connections. Moreover, the learning materials are applicable in schools with diverse economic backgrounds.
- The integration of computational thinking in STEM learning is quite promising, so the next research is about computational thinking components that can be developed through STEM-based learning.

Policy Recommendations

Teachers are supported with integrated STEM learning materials that emphasize problem-solving and employ cost-effective resources, thereby promoting equitable access to quality STEM education

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