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The Marine Biome STEM Education Learning Activity: Mollusca Shell Recycling

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Abstract

The paper was clarified the practice of STEM education based on the learning activities of recycling the marine-Mollusca-shell. The STEM learning activity was adopted from the Sutaphan and Yuenyong's (2019). The presented result was provided (a) the knowledge of classification the Mollusca by using the external structure of shell and (b) the experiences of using STEM education to improve ability of practice in problem-solving skills. In addition, it was also allowed the students teachers the chances to discuss how they integrate among related subjects for learn the contents and skills through the STEM education. In conclusion, it was showed that STEM education could guide the learners to explore on how to solve problems or create new produces and also improve their skills to be the learner of the 21st century education.

Keywords: STEM education; Mollusca shell; Recycling

1. Introduction

As Cambodia is aiming to shift the country's economic focus to an industrial-based economy and to move from a lower-middle-income country by 2030 to a higher-middle-income country by 2050, qualified human resources in STEM-related fields must play a significant role, especially in this knowledge-based society of the Industrial 4.0 era. Judging from current trends and future projections, the shortage of graduates in STEM fields is a critical issue that needs to be addressed (Sovansophal & Shimizu, 2020). STEM education is attracting increasing public interest and policy attention and being promoted at different educational levels in Cambodia (Eam et al., 2021). The goal of the basic education is the core curriculum in Cambodia that is used to develop policies on education in science, technology, engineering, and mathematics for the purpose of development (Yonezawa et al., 2016). STEM is a way of teaching integrated subjects of science, technology, engineering, and math that can assist students to solve the real social problems and be competitive in the new job market (Watkins & Mazur, 2013 and Hafni et al., 2020).

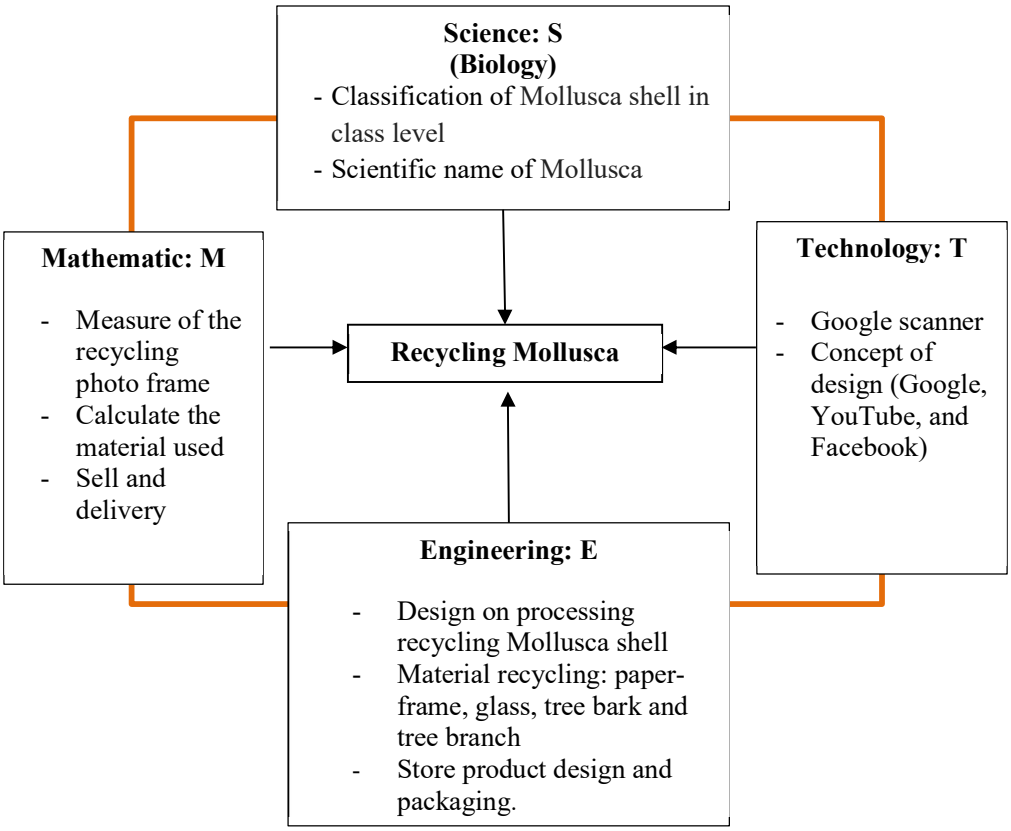
In recent decades, education in many countries around the world has grown exponentially. Teachers use technology in teaching, communicating with students, and monitoring student learning activities (Phirom et al., 2021). Thus, the transformation of the curriculum from the traditional curriculum to STEM education has also significantly contributed to helping students develop the appropriate skills for the 21st century (Alam, 2022). Through STEM learning activity, students could learn to develop many skills including problem-solving, creativity, critical analysis, teamwork, independent thinking, initiative, communication, and digital literacy (Cambodia 4.0 Center, 2022). In addition, White (2014) was also stated that the importance and benefits of STEM education for students include: helping students enjoy learning, building teamwork, building logical thinking, helping increase job opportunities, helping increase human resources, and helping Cambodia prepare for the industrial revolution 4.0. Thuse, STEM education is very important because it can provide students with the required skills for new jobs as well as help Cambodia remain competitive in the era of the industrial revolution. 4.0. However, some authors said that STEM means only science and mathematics, even though the products of technology and engineering have greatly influenced everyday life (Bybee, 2010). And, it is challenge for traditional classrooms, the literatures (Adita and Yuenyong, 2021; Fachrunnisa et.al., 2021; Koes-H et.al., 2021; Sutaphan and Yuenyong, 2023; Teerasan and Yuenyong, 2019; Villaruz et.al., 2019) suggested how to provide STEM education unit from the issues of social problems and entrepreneur problems.

Therefore, STEM learning approach was decided to use for study in topic of "Mollusca Shell Recycling" which is conducted in science subject of biology. The Mollusca shell was collected from the marine biome that is an environment characterized saltwater environment. The marine biome is home to an amazing array of living organisms, from the enormous blue whale to microscopic cyanobacteria (Brown et al., 2012). Among those organisms, the marine Mollusca is also a phylum of invertebrate organism that presented with soft-bodied, usually wholly or partly enclosed in a calcium carbonate shell secreted by a soft mantle covering the body (Salvini, 2023). Generally, it was found that Mollusca shell usually remain as the waste on the beaches. This waste caused the visitors to feel uncomfortable for spend time to relax there. This is a reason that need to study and to deal the faced problem with simple way of recycling the shells to create the new products. The process of recycling is converting waste materials into new materials and objects (Villalba et al., 2002). So, the collected Mollusca shells were classified and recycled to be used for daily life and were also explored for knowledge of species classification and especially, the experience of practice in STEM education.

2. Developing of Recycling Mollusca Shell in STEM Education and Learning Activities

STEM education activities are based on the concept of STEM learning methods in the context of learning, which is also the educational activity of exploring and solving real-world problems (Guarin et al., 2019). The purpose of this STEM is based on research studies (Yuenyong & Sutaphan, 2019). In addition, for STEM education is always included the issues based on project, inquiry, and design (Williams, 2019). According to Sutaphan and Yuenyong (2019), the STEM teaching approach consists of seven stages: (1) identification of social issues; (2) identification of potential solutions; (3) need for knowledge; (4) decision-making; (5) development of prototypes or products; (6) testing and evaluating the solutions; and (7) socialization and completion of the decision stage. The lesson plan for recycling Mollusca shell and the activity by using STEM education to guides students to apply the specific knowledge in the conceptual framework is presented below:

Diagram1: Conceptual framework of STEM activities



Adapted: Theerasan &Yuenyong, 2019

2.1 Purposes of the Lesson Plan

- Classifications the Mollusca to the class level.
- Recycling the Mollusca shells for use in real life.

2.2 The Activities of Recycling Mollusca Shell with STEM Education

The learning activities of recycling Mollusca shell with STEM was adopted from Sutaphan and Yuenyong (2019). The lesson plan was developed the new design by the team that is showed in Table 1.

Table 1: Lesson Plan of Recycling Mollusca Shell with STEM Education

Stage	Activity
1. Identification of social issues	- Social problem: visitors would like to visit the beaches but it was noticed that Mollusca shell usually present along the beach. It causes to feel uncomfortable to walk, aesthetics and especially they are waste on beach environment (Khankhaje et al., 2017). - The teacher asked the questions with the pictures of Mollusca shells on the beach, “How do we do with Mollusca shell?” - Students answer the question.

Stage	Activity
	- The teacher shows the problem. "How to recycle Mollusca shells for daily life?" - The teacher divides the students into 3 groups with 7 members in each group, provides Mollusca shells to the students, and processes them into products according to their ideas. 
2. Identification of a potential solution	- Students discuss the proper way to recycle based on Science, Technology, Engineering, and Mathematics (STEM). • Science (Biology): Classify in the class level (Bivalvia and Gastropoda) and scientific name (if possible). • Technology: Concept of design by Google, YouTube, and Facebook. • Engineering: Store product design and packaging. • Mathematic: Measure the design, calculate the material used, and calculate the selling price.
3. Need for knowledge	- Students need to gather relevant information to create new products through analytical and innovative research. - Students discuss and find out on social media to generate new ideas.
4. Decision-making	- Students present their ideas in front of the whole class about the product model created and receive feedback on the design before starting to develop additional products.
5. Development of the product	Steps to learn about Mollusca shells Classify to the group of class level by observing and also assign a scientific name for the species (if it possible). Steps to recycle Mollusca shell were assigned at less in 4 types - Seashell picture frame - Glass jar decoration with seashell - Driftwood craft with seashell - Key chains and necklace
6. Test and evaluation of the solution	Organizing exhibitions by evaluating: - Classification of specimens by class level and their recorded picture - Quality and attractive appearance - Creative ideas for other materials and the importance of using Teachers and visitors may ask about: - The process of learning from scientific names - Purpose of Recycling Mollusca Shell - Knowledge gained from the processing of Mollusca shell - Soft skills (time management, communication, problem-solving, critical thinking, teamwork, creativity, leadership, and reflection) - Hard skills (applying skills to real life)
7. Socialization and completion decision stage	- Each group explains its processing and finished products. - Show classification and characterization.

Stage	Activity
	- Demonstrate sharing what students have learned from this process. - Show the product to the community. Student's product *Seashell picture frame*  *Glass jar decoration with seashell*  *Driftwood craft with seashell*  *Key chains and necklaces* 

3. Discussion and Conclusion

The Mollusca shells were collected from the Otres beach which is located in Sihanoukville. According to the result of classification based on external shell structure, it was found that there were two classes of Mollusca: Gastropoda and Bivalvia. Furthermore, the shells were designed to four different types of decorative products: seashell picture frames, glass jar decorations with seashell, driftwood crafts with seashells, and key chains and necklaces.

Generally, the dead mollusk was an impact on ecosystems (Esposito et al., 2022). On land, dead mollusks become waste on the beach and have a foul odor that makes the beach unattractive (Sturm et al., 2006). In addition, it also affected marine ecosystem by cutting off the food chain in the sea and releasing toxin into the sea (Islam et al., 2004). The amount of Mollusca shell contributed to the increased waste (Khankhaje et al., 2017). According to Zhan et al. (2022), millions of shells are produced as waste each year, severely damaging coastal ecosystems. Thus, this article shared educational activities in STEM education by recycling the Mollusca shells to design new products in daily life. Table 1 showed the implementation of STEM education on recycled Mollusca shells that was adopted from Sutaphan and Yuenyong's (2019) methods. The collected Mollusca shells were recycled into decorative products such as seashell picture frames, glass jar decorations with seashell, driftwood crafts with seashells, and key chains and necklaces for use in real life. This is a process of problem-solving to reduce the waste of Mollusca shells on the beaches and preserve the comfortable mood for coastal environments. In addition, the process of learning activities allowed student teachers and educators to apply their learning in STEM education that is integrate among subjects of science, technology, engineering, and mathematics.

In conclusion, this design learning activity is created a model of solutions to solve the environmental problems in coastal areas. Therefore, it was showed that STEM education could help learners to practice and improve their skills of the 21st century education.

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