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The Recycling Corn Husks-A STEM Decorative Item Project in PTEC Student Teachers

Kimsron SRIENG*, Seavleng NY, Sam Ol KONG, and Kanha LONG
Faculty of Science Education, Phnom Penh Teacher Education College, Cambodia
*Corresponding author's email: srieng.kimsron@ptec.edu.kh

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Abstract

The paper presented the learning activities of recycling corn husks STEM education learning approach on decorative item project. The learning activities were designed based on Sutaphan and Yuenyong (2019) context-based STEM education learning approach. This learning activities aim to show the experiences of student teachers fostering deep thinking in investigating and doing the current new challenges (regarding the growth of the corn husks waste using decorative recycling) in their community using STEM education learning approach and the classroom research and project as the model. The paper will discuss on student teachers' experiences in applying STEM knowledge through these activities. In addition, student teachers can apply this approach in their actual classroom in the future.
Keywords: STEM education, Corn husk, Recycling

1. Introduction

STEM (Science, Technology, Engineering, and Mathematics) education has received priority in the policy agendas of many countries around the world (Rothwell, 2013). As Cambodia is enduring a moving in the economic development trends in this local and world industrial revolution 4.0, it has been highlighted that the country has a greatly demand for graduates in STEM fields (Sovansophal & Shimizu, 2020). But for all that, currently the country meets serious challenges in promoting the retort of students into these fields in higher education (Sithole et al., 2017).

Accordingly, Science, Technology, Engineering, and Mathematics (STEM) education Policy was developed (MoEYS, 2016a). The policy emphasized that as Cambodia is a developing country with a growing economy, its inhabitants need to be encouraged to explore the demand of 21st century skills and thus produce more human resource in STEM fields in order to move the Cambodian economy forward (ADB, 2022). However, to be more competitive in the region and in the world, Cambodia still has a great demand for graduates in STEM fields (UNESS, 2010; Un & Sok, 2016). Consequently, MoEYS, as also stated in the ESP 2014–2018, politically aims to increase the overall enrollment in STEM fields in both public and private higher education institutions

(MoEYS, 2014). However, according to the statistics compiled by the department of higher education, the percentage of student enrollment in these fields still remains low (Ek & Muth, 2023). In short, according to the Cambodian Development Resource Institute (CDRI) (Sothy, Madhur, & Rethy, 2015) and MoEYS (2017) despite higher market demand likely to transform and modernize Cambodia's industrial sector by 2025, not many students are enrolling in STEM related fields but rather in non-STEM fields. There is lack of worldwide accepted STEM education definition and approach to integrated STEM (English, 2016). Yet, the acronym STEM which was introduced by National Science Foundation (NSF) in 2001 to refer to science, technology, engineering, and mathematics curriculum has gained considerable momentum since then (Breiner et al., 2012). Later, NSF also employed STEM as an acronym for broad fields of study at higher education (Green, 2007). In the same token, STEM education is a way to develop critical thinking, enhance scientific literacy and promote innovations all of which are characteristics of skilled manpower aspired by the nation (Kärkkäinen &Vincent-Lancrin, 2013). With specific focus given to 4C such as communication, collaboration, creativity and critical thinking (Waluyo & Wahyuni, 2021). In a broad definition, STEM majors include not only the common categories of mathematics, natural sciences, engineering, and computer and information sciences and 21st century skills, but also such social behavioral sciences as psychology, economics, sociology, and political science (Sovansophal, & Shimizu, 2020). However, many recent efforts are aimed at improving STEM education mainly in mathematics, natural sciences, engineering, and technologies (Sovansophal & Shimizu, 2020). Thus, STEM fields include mathematics, natural sciences (including physical sciences and biological/agricultural sciences), engineering/engineering technologies, and computer/information sciences (Chen, 2013; Chen, 2009; Crisp et al., 2009; Green, 2007; MoEYS, 2009; 2016b; Ulicna & Royale, 2015). In the other continuum, non-STEM fields in this study, include social/behavioral sciences, humanities, business, education, economic, and management (Chen, 2013; MoEYS, 2009; 2016b; Ulicna & Royale, 2015).

Moreover, the National Strategic Development Plan (NSDP) 2014-2018 and the NSDP 2019-2023 highlight the goal of improving education quality in Cambodia, especially STEM education. The strategies include strengthening and enlarging science subjects by implementing science-based teaching methods using computers, laboratories, and other approaches such as inquiry-based learning, concept-based learning, and problem-based learning and improving the quality of teaching and learning to be aligned with 21st-century skills (MoEYS, 2019). Cambodia is in the lower ranks in the Association of Southeast Asian, especially in math and science, and lacks of innovation capacity and human resources (Leng et al., 2021). But Cambodians' students enrolled in STEM-related majors for bachelor's degrees increased from 26.83% in 2016 to 30.69% in 2021 (MoEYS, 2022). STEM Education was originally called Science, Mathematics, Engineering and Technology and was an initiative created by the National Science Foundation (NSF) (Sanders, 2009). A true STEM education should increase students' understanding of how things work and improve their use of technologies (Bybee, 2010)

2. Why STEM in school?

According to surveyed with freshman college in learning STEM-related fields showed that STEM teachers, STEM clubs, STEM internships and STEM engagement activities such as science fairs, and parents had a great influence on students' decisions about majoring in STEM (Dawes et al., 2015). By Gottfried and Williams (2013), studied the connection between mathematics and science club participation and the probability of STEM major selection in colleges have found that mathematics club participation provided very significantly correlated with increasing of likelihood choosing major of STEM education in college. Moreover, another research has also showed that involvement in pre-

college of mathematics and science courses had promoted enrichment activities which was positively relevant to support motivational beliefs as empower self-efficacy, value, and interested in mathematics and science courses in post-secondary years (Sass, 2015). Additional research has indicated that developing expectancies for success and interests in mathematics and science in pre-college years strongly increases the likelihood of students persisting in STEM fields (Tai et al., 2006).

To help realize the Cambodia Industrial Development Policy 2015-2020, as indicated in the STEM education policy (2016), Ministry of Education, Youth and Sport also emphasizes that being a developing country and growing economy Cambodian nation is in demand of graduates in STEM fields. However, some concerns have continuously been raised with regards to the students' uptake in these fields of study at higher education (CDRI, 2015; MoEYS, 2017). Regarding Kim et al. (2019) Science, technology, engineering and mathematics (STEM) collectively known as one of the richest sources of employment and economic growth will be jobs that require skills. In Cambodia, we preferred to educate in STEM-related talent to compete worldwide and we want to see how it works in the future. STEM has become prioritized development agendas to promote economic and societal development of the country as stipulated in the Industrial Development Policy of Cambodia 2015-2025 - science and mathematics are part of the STEM multi-dimensional strategy and play a crucial role.

3. Developing Recycling corn husks STEM Education Learning Activities

Corn husk is produced as a by-product through the processing and gathering of corn. And it is the second largest crop production in agriculture over the world (Ratna et al., 2022). Non-wood crops provided some advantages such as short time of growth cycles, moderate irrigation for water accessed, not too much fertilization requirements, and less lignin amount to alleviate energy and low chemicals supplies during pulping (Hurter & Riccio, 1998). Corn husk is a lignocellulosic material which stands for the leafy external shell of ear of the maize as it flourishes on the plant. The commonly used way to dispose is to burn or bury them, which is not beneficial for the crops and results in pollution and resource waste (Yang et al., 2016).

According to Iken and Amusa (2004), corn or maize (Zea mays) is a major important cereal being cultivated in the rainforest and the derived Savannah zones of Nigeria. Corn represents a significant grain crop that provides stable food to many populations (Farhad et al., 2009). Recently, huge amounts of corn husks are either thrown a way as waste or burnt and these are applications with low added value, causing disposal as well as environmental pollution problems (Chitra & Vasanthakumari, 2012). Corn husk, which is the outer collective layers over the corn cob, is significantly considered as bio-waste as it is the non-consumable part of the corn (Reddy & Yang, 2005; Zhou et al., 2014). 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. These studies adopted Sutaphan and Yuenyong (2019) STEM Education steps of teaching and learning activities. This teaching strategies consists of 7 steps of learning activities including (1) Identification of social issues, (2) Identification of potential solutions, (3) Need for knowledge, (4) Decision-making, (5) Development of prototype or product, (6) Test and evaluation of the solution, and (7) Socialization and completion decision stage. The Recycling corn husks STEM Education Learning Activity was developed regarding Sutaphan and Yuenyong (2019) steps of teaching as showed in the Table 1.

3.1 Purpose of study

- Recycling the corn husk into decorative for use in daily life
- To have student teachers experience fostering deep thinking in investigating and doing the current new challenges, and applying 7 steps of Sutaphan and Yuenyong (2019) context-based STEM education learning approach in learning activities.

3.2 The Activities of Recycling Corn Husk with STEM Education

The learning activities of recycling corn husk with STEM education learning approach was developed by adopting from Sutaphan and Yuenyoug (2019) context-based STEM education learning approach. There are 7 stages showed in Table 1.

Table 1: Overview of Recycling Corn Husks STEM Education Learning Activity

7 steps of Sutaphan and Yuenyoung (2019)	
Stage1: Identification of social issues	- In the city, the husks left over from the corn seem to be worthless, however the husks can be processed into ornaments. - Remnants of corn husks can be harmful to the environment, but processing into ornaments is a good activity for the environment.
Stage2: Identification of potential solutions	After observing these problems, our team decided to participate in the recycling of corn husks into decorative items, as well as to take care of the environment. In this production, our team has selected some materials such as: corn husks, scissors, yarn, hair clamps and color.
Stage3: Need for knowledge	This research also explored how to make all of the corn husks by having innovative ideas in learning activities through analytical and innovative processes. And the discussion was made based on the information collected from Google, YouTube and the patterns of making from previous documents as the references before to capitalize on apply and further refine. The information to be considered related to STEM and Innovations. For instance, how we can make decision on shape, size, color of flower and the techniques to design flowers.

7 steps of Sutaphan and Yuenyoung (2019)	
Stage4: Decision-making	- This process was to present and collect ideas - For this project, the student teachers prepared slides, sketched flower patterns to present in the class in order to describe what student teachers was preparing to do, including materials and flower patterns. - During and after the presentation, the team received questions and suggestions from classmates and teachers such as shape, size, color, attractiveness, innovation and applied technology.   
Stage5: Development of prototype or product	- Peel a squash, grate it and squeeze the juice. - Soaking corn husks (pink, yellow, purple, green) and drying in the sun. - Coloring corn husk process: Boil 1.5L of water and put food color in a $\frac{1}{4}$ spoon. Stir food color in boiling water for about 1 minute, then add the corn husks and leave until the corn husks are the desired color. Extract the colored corn husks and put them in the sun to dry. - The process of decoration corn husks into flowers: Straightening the corn husk (hair straightening flat iron). Trim evenly (leaves, petals). Green bark designed into leaves. Use other colors to make a bouquet (length depends on the type of flower). Wrap the green part of the leaf with a whisk to form a stalk. Then tie them together with stalk to form the flower.

7 steps of Sutaphan and Yuenyoung (2019)	
Stage6: Test and evaluation of the solution	- Corn husks do not shrink easily. - Flowers can be stored longer, similar to the other production. - To do this, choose only red corn husks. Selection of corn husk only 2-3 outer layers. Clean the soil with water and dry for 2-3 hours. Corn husks soaked in rice and dried in the sun for 3-4 hours. After drying in the sun, leave it overnight to easily break (because if it breaks immediately, it can be difficult).
Stage7: Socialization and completion decision stage	- Student teacher presented in class about processing and final products with the significance of products that are used in daily life and what they have learned from this process. - The final products were exhibited in science fair in school where students, student teachers, lecturers and public. - During the exhibition, the products were presented and judged by committee on creativity, sustainability, innovation, STEM and technology integration and the applicable teaching and learning activities process. 

4. Conclusion

Based on the process of processing corn husks, it can be observed that the process of processing corn husks into ornaments is in creative and innovative ways where can be challenging and applying in learning according to the any kinds of flower that were created. Normally, the amount of corn husk was an impact on environment. Therefore, this article shared educational activities in STEM education learning approach by reduce waste, contribute to the preservation of the environment, and can be sold in the market. Table 1: recycling corn husks STEM education learning activity was adopted from Sutaphan and Yuenyoung's (2019) methods shown that student teachers experienced of fostering deep thinking in investigating and doing the current new challenges (regarding the growth of the corn husks waste using decorative recycling) in their community using STEM education learning approach and the classroom research and project as the model. Corn husk was recycled into flowers that following 7 steps in learning activities about social issues, potential solutions, knowledge of flower (size color height and technique to design in basket), decision-making, prototype or product, evaluation of the solution, and completion decision which link to school context and educational reform in Cambodia. In addition, the processing of learning activities allowed student teachers understand STEM education included subjects such as science, technology, engineering, and mathematics and its linkage. As well, student teachers find out that it is easier to implement the project step by step more effectively and have fun working together to make it happen.

In conclusion, this study contributes to the development of solutions to waste problems that affect the environment in the region. In addition, STEM education learning approach encourages and assists students in practicing skills such as collaboration, communication, problem solving, and innovation. STEM education improves the skills of 21st century education. Furthermore, student teachers can apply this teaching and learning approach in their actual classroom in the future.

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