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Implementation of STEM Education to Enhance Wildlife Awareness: A study of Promoting Siamese Crocodile

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Abstract

The processing of creation Siamese crocodile feature displays the practical knowledge and skills of sculpture concept of science, integration of technology to promote wildlife awareness and sustainability solutions. This study aims to highlight the concept of recreation Siamese crocodile from clay sculpture to promote wildlife awareness based on STEM Teaching and Learning strategies in school setting. The study has developed teaching approach consists of the 7 stages of the Sutaphan and Yuenyong (2019) context-based STEM education approach such as (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. This study showed that the overall of the average student learning activities, critical thinking skill, creativity skill, and ecological sustainable conservation and protection were very high. The findings also provided that the students' performances on conducted activities revealed their problem-solving capacity with significant of incorporation STEM education into real-world projects for scientific way, advanced technology, and environmentally sustainable. Therefore, the STEM Teaching and Learning strategies in school setting should be widely integrate in classrooms.

Keywords: Wildlife, Awareness, Siamese Crocodile, 7 stages of STEM model

1. Introduction

The rapidly increasing threats to biodiversity over the world, which are driven by human activities such as pollution, deforestation, and climate change, become underscored the urgent need for improve wildlife awareness and environmental issues among younger generations (Ali & Rahman, 2024). Education plays an initial role in sharpening student attitudes and behaviors toward nature (Srieng et al., 2025), and promote wildlife conservation topics into classroom activities are promising pathways to foster sustainable environmental stewardship (Ballantyne & Packer, 2009). In this era, STEM (Science,

Technology, Engineering, and Mathematics) education has model as a crucial interdisciplinary way to implement into classroom that improves student learning activities, critical thinking, provides problem-solving, and relevant to real-world application of knowledge (Bybee, 2013). Integrated STEM education to insight ecological need and wildlife issues provides a compelling fruitful to motivate students in meaningful studying experiences that move beyond the way of the traditional environmental education (Arbuzova & Alexandrova, 2024). In addition, Sutaphan and Yuenyong (2019) have proposed a theoretical framework for a STEM education teaching approach which centered on inquiry from the context based. The framework integrates key concepts from problem-based learning, project-based learning, inquiry-based learning, design-based learning, and real-world problem-solving, drawing particularly from the Science, Technology, and Society (STS) approach. This theoretical framework for STEM education teaching strategies emphasizes real-world problem-solving through a context-based learning approach which consists of seven stages (1. Identification of social issues, 2. Identification of potential solution, 3. Need for knowledge, 4. Decision-making, 5. Development of prototype or product, 6. Test and evaluate the Solution, and 7. Socialization and completion decision stage) for effective learning where students apply scientific knowledge to design solutions for social issues (Sutaphan and Yuenyong, 2019). Yuenyong (2019) investigated the challenges and issues involved in implementing STEM education, aiming to deepen teachers' understanding of STEM concepts, identify obstacles in school-based STEM initiatives, and address concerns related to developing STEM education communities in Thailand. The study also emphasized the project's effectiveness in cultivating a professional learning community focused on STEM education. Therefore, building community of practice to increase teachers' understanding of STEM concepts, reforming curriculum and developing appropriate assessment methods for STEM education are significant in education.

The integrating of STEM-based studying activities shares learners with opportunities to investigate wildlife-related challenges regarding hands-on activities, data analysis, and develop critical thinking processes (Le et al., 2023). For example, students can explore animal species and populations, design and construct habitat models of wildlife or engineer path ways to decrease human-wildlife conflict, thereby designing both scientific literacy knowledge and conservation ethic skills (Routray & Mohanty, 2024). This multidisciplinary concept not only improves academic learning performance but also improves a sense of responsibility attitude in which connected to the global nature (Littledyke, 2008). STEM education, which integrates science, technology, engineering, and mathematics, is crucial to Cambodia's socio-economic advancement. As the country seeks to shift from a labor-intensive economy to one driven by knowledge and innovation, STEM serves as a fundamental pillar in preparing the workforce with essential skills such as critical thinking, problem-solving, and technological competence (MoEYS, 2021). Fence, the integrating varieties of teaching methods are needed in Cambodian teacher education context to bring expertise for teachers for equipping into classroom.

2. Developing STEM Education Learning Activities to Promote Wildlife Awareness

Creating effective learning activities in STEM education to improve wildlife awareness suggests a carefully integrated into real-world experiences, interdisciplinary knowledge concept, and creative expression thinking (Long et al., 2024). Begin with engaging approach is to arrange a project where learners first visit a local wildlife zoo (Davidson et al., 2010) to observe, investigate and explore about threat wildlife species such critical endangered, in danger of extinction, vulnerable species and then involve in a hands-on learning activity which students can recreate these wildlife animals throughout daily recyclable waste (i.e. plastics, tree leaf, …etc.) or clay sculpture model (Sim, 2015).

Based on these learning activity, there would blend STEM project with environmental education and cultivates student's emotional connection into nature, thereby engage students' interest in the activities of wildlife conservation (Cudworth, 2021).

Zoo-based learning strategy handles a useful context for experiential education. It provides students to see wildlife species such critical endangered, endangered, vulnerable species firsthand, highlight wildlife species habitats, and investigate the ecosystem challenges they face (Falk et al., 2009). Throughout these learning activities, they can evoke emotional curiosity and engagement that are very important in promoting wildlife empathy and joining conservation-oriented attitudes (Clayton et al., 2009). Regarding field study in the zoo, learners apply what they have studied by choosing an endangered wildlife animal to recreate sample features by using either clay or plastic waste. This design concept incorporates various aspects such environmental science, engineering, math, and art (Srieng et al., 2024) which aligned with the primary principles of STEM activities in education focused on critical thinking and problem-solving creatively according to interdisciplinary concept (Bybee, 2013).

Throughout this learning process, learners are encouraged to feedback on the consequences of people activity on wildlife animal species and involve more motivated senses to contribute to activities of conservation efforts (Akande, 2023). Ultimately, these strategies of customized studying activities have enhanced personalizing of STEM education experience, providing learners to express their participatory values and cultivates a personal connection with wildlife species. As learners are empowered to creatively act and collaboratively on environmental challenges, students are more involvement to grow an appreciation long-lasting for biodiversity conservation and a desire to prevent wildlife (Monroe et al., 2019).

2.1 Purpose of study

This study aims to highlight the concept of recreation Siamese crocodile from clay to promote wildlife awareness based on STEM education, integrated science, technology, engineering, and mathematics subjects. The study is to spread wildlife awareness among student teachers throughout the project application of STEM education. By involving wildlife-related themes into STEM studying activities, this research seeks to showcase how investigation and inquiry-based approaches can improve students' understanding concept, attitude performance, and actions toward activities of conservation of wildlife.

2.2 The activities of recreation Siamese crocodile from clay through STEM education

The learning activities of recreation Siamese crocodile from clay project implemented based on the 7 stages of the STEM education study approach from Sutaphan and Yuenyong (2019). Existing literature demonstrates how to develop STEM education units that address social and entrepreneurial problems (Sutaphan & Yuenyong, 2023; Teerasan & Yuenyong, 2019; Villaruz et al., 2019). Furthermore, several studies have implemented this approach by utilizing the teaching strategy proposed by Sutaphan and Yuenyong (2019) (Adita & Yuenyong, 2021; Fachrunnisa et al., 2021; Koes-H et al., 2021, Kong et.al., 2024; Long et.al., 2024; Mordeno et.al., 2019).

This study intends to insight the problem of decreasing Siamese crocodile over the world as now this species becomes endangered species. The potential solution was recreating Siamese crocodile feature from natural clay (Ramanujam & Brooks, 2014). The decision-making was accordingly the product processing, environmental issue awareness, and communities both natural and human benefit (Frank, 2023). The prototype process was designed by hand-made and the prototype was promoted during the school STEM fair. Finally, the result has evaluated on apparent, quality, attractiveness, and environmental issues.

Table 1: Summarize 7 stages of the STEM education learning approach

Stage	Activity
(1) Identification of social issues	▪ Siamese Crocodile (Crocodylus siamensis) has a medium-sized feature; generally, males has a total length around 4 meters (Smith 1919; Brazaitis 1973a). ▪ Adults have yellowish, dark olive, or brownish-green to black with dark cross-banding on the tail and the ventral surface has yellowish-white (Brazaitis 1973b). ▪ Siamese crocodile lives in a wide-range of freshwater habitats, such as slow flowing rivers or streams, seasonal oxbow lakes, lakes, swamplands, marshes, and sometimes, swift-moving upland streams (Sam et al., 2015) ▪ In 1996, Siamese crocodile has listed as Critically Endangered on the IUCN Red List (IUCN, 1996). Regarding the hitherto unknown populations in the wild, (e.g. Laos, Cambodia, and Indonesia) led to implement conservation actions (Simpson & Bezuijen, 2010). ▪ Globally, the main causes of endangerment happen due to habitat destruction, harvesting to stock commercial crocodile farms, and direct persecution (Platt et al. 2004).
(2) Identification of potential solutions	After realizing the problems, the team decided to recreate Siamese crocodile feature from natural clay. The team proposed the potentail design of recreation feature based on these aspects: ▪ STEM (science, technology, engineering, and mathematics) ▪ Raw materials: clay (create feature), color spay (color after creation), and wooden board ▪ Social: proposing and trying educational potential solution for critical thinking and problem-solving to align with 21st century skill. ▪ Environmental issue: The product of recreation Siamese crocodile feature ehances social awareness on critical endangered species by willing to conserve and empower environmental sustainability that aligns to Sustainable Development Goals (SDGs).
(3) Need for knowledge	This study gathers Siamese crocodile information and insight how to create Siamese crocodile feature from clay. Therefore, the team conducted field study to the zoo and also collect more data from YouTube, research gate, Google scholar that related to the concept on STEM approach. ▪ Science: prototype the Siamese crocodile. ▪ Technology: explore the concept of creation Siamese crocodile feature. ▪ Engineering: design the production model of creation Siamese crocodile feature by using handmade. ▪ Mathematic: calculate the length, size, wide, and thickness of Siamese crocodile feature.
(4) Decision-making	▪ After the team collected the related information, the team has proposed project plan to the supervisors in the classroom. ▪ The team designed the feature model and drafted shape and size of Siamese crocodile feature. ▪ The sample length is 126cm, the width is 35cm, height is 11.50cm, and tail is 56cm. The head length is 30cm and width 29cm, mouth is 17cm, foot is 13cm.

<table>
<tr><td>(5)
Development of prototype or product</td><td>The processing of creation Siamese crocodile feature:
▪ Raw material: well-prepared and selected fine clay for creation Siamese crocodile feature.
  
▪ Creation sample feature: take fine clay to design and develop the Siamese crocodile feature sample.
  
▪ Clay Moisture Removal: After the team has created the sample feature of our critical endangered species, the team put it under the sunlight in order to remove moisture from the clay. The team has used dark green color skin of the crocodile to make it similarity from nature.
   </td></tr>
<tr><td>(6)
Test and evaluation of the solution</td><td>These indications were used in the testing and evaluation of the creation Siamese crocodile feature
▪ STEM: the prototype has well response to STEM designed and knowledge.
▪ Social Awareness: the prototype has promoted about Siamese crocodile appearance sample to society; especially, student can recognize how the specie look like and its significant in nature.
▪ Environmental Solution: enhance conservation activities through stop trading wildlife and protect it habitat.
▪ Promoting Wildlife Awareness Activities: improvement students idea about wildlife and engagement in education wildlife projects.</td></tr>
<tr><td>(7)
Socialization and completion decision stage.</td><td>▪ At the school STEM fair, the prototype has showcased. The team described its significant and how it was processed.
▪ The sample was discussed and shared a lot from participants.
▪ The team should use social media to promote our critical thinking and problem-solving skills so that we can build more environmental sustainable development.</td></tr>
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3. Conclusion

The processing of creation Siamese crocodile feature displays the practical knowledge and skills of sculpture concept of science, integration of technology to promote wildlife awareness and sustainability solutions throughout an effective STEM education

approach (7 stages of STEM approach). This project not only promote wildlife awareness, but it also enhances wildlife background through providing hands-on activities in studying opportunities to students. The creation of Siamese crocodile feature involves the concept of scientific principles like selecting good clay, sculpture design model, removal moisture step, and heat transferring step, which integrates with concept of engineering related to sculpture processing technique. According to the conducting of the 7 stages of STEM education approach, students develop their problem-solving skill, thinking skills, innovation practice, and application to real-world issues regarding the scientific and mathematical concepts. This study engages critical thinking skill, collaborative skill, creativity skill, and environmental sustainable through empower the significant of wildlife in daily life. The study shows the essential incorporation STEM activities into real-world projects to provide student involvement and develop initiated skills for scientific principle and advanced technology in the future and also showed that the overall of the average student learning activities, critical thinking skill, creativity skill, and ecological sustainable conservation and protection were very high. The findings also provided that the students' performances on conducted activities revealed their problem-solving capacity with significant of incorporation STEM education into real-world projects for scientific way, advanced technology, and environmentally sustainable. Therefore, the STEM Teaching and Learning strategies in school setting should be widely integrate in classrooms.

4. References

Adita, A. and Yuenyong, C. (2021). STEM Learning Activity through Tempeh Making Process. Journal of Physics: Conference Series, 1835 (1), 012050 (2021).

Akande, M. (2023). Sustainable solution for plastic waste management and education campaigns to mitigate plastic consumption and foster behavior change.

Ali, I., & Rahman, A. (2024). Environmental Degradation: Causes, Effects and Solutions. *International Journal for Multidisciplinary Research*, *6*(3), 1-10.

Arbuzova, E., & Alexandrova, N. (2024). Ecological Mindset in Education: Integrating Sustainable Practices into Educational Programs. *Reliability: Theory & Applications*, *19* (SI 6 (81)), 1194-1201.

Ballantyne, R., & Packer, J. (2009). Introducing a fifth pedagogy: Experience-based strategies for facilitating learning in natural environments. *Environmental education research*,*15*(2), 243-262.

Brazaitis, P. (1973a). Identification of Crocodylus-Siamensis Schneider. *Zoologica*, *58*(1), 43-45.

Brazaitis, P. (1973b). The identification of living crocodilians. Zoologica scientific contributions of the New York Zoological Society. 59:59-88

Bybee, R. W. (2013). The case for STEM education: Challenges and opportunities.

Clayton, S., Fraser, J., & Saunders, C. D. (2009). Zoo experiences: Conversations, connections, and concern for animals. *Zoo Biology: Published in affiliation with the American Zoo and Aquarium Association*, *28*(5), 377-397.

Cudworth, D. (2021). Promoting an emotional connection to nature and other animals via forest school: disrupting the spaces of neoliberal performativity. *International Journal of Sociology and Social Policy*,*41*(3/4), 506-521.

Davidson, S. K., Passmore, C., & Anderson, D. (2010). Learning on zoo field trips: The interaction of the agendas and practices of students, teachers, and zoo educators. *Science Education*, *94*(1), 122-141.

Fachrunnisa, R., Suwono, H., Yuenyong, C. Sutaphan, S., Praipayom, N. (2021). Eco-friendly fashion: A STEM sandpit project in Indonesian senior high school. *Journal of Physics: Conference Series*, 1835 (1), 012046

Falk, J. H., Heimlich, J. E., & Foutz, S. (Eds.). (2009). *Free-choice learning and the environment.* Rowman Altamira.

Frank, R. (2023). Sculptural Applications in Wildlife Rehabilitation. *CSPA Quarterly*, (38), 70-81.

Koes-H, S., Nisa, I. K., Faiqatul, H.E., Wahyuni, T., Yuenyong, C., Sutaphan, S. (2021). The development of lesson plan of the water pressure booster pump STEM education. *Journal of Physics: Conference Series*1835 (1), 012049

Kong., S. O. Chheun, S., Phon, S., Proeung, S., Mul, S., Doem, D., Then, S., & Rom, N. (2024). The Ecosystem STEM Education Learning Activity: Terrarium and Aquarium Model. *Asia Research Network Journal of Education*, *4*(1), 16–23. retrieved from https://so05.tci-thaijo.org/index.php/arnje/article/view/264818

Le, H. C., Nguyen, V. H., & Nguyen, T. L. (2023). Integrated STEM approaches and associated outcomes of K-12 student learning: A systematic review. *Education Sciences*, *13*(3), 297.

Littledyke, M. (2008). Science education for environmental awareness: approaches to integrating cognitive and affective domains. *Environmental education research*,*14*(1), 1-17.

Long, K., Vong, R., Roeurn, S., Chorn, S., Nak, P., Kong, S. O., & Srieng, K. (2024). The Marine Biome STEM Education Learning Activity: Mollusca Shell Recycling. *Journal of Innovation, Advancement, and Methodology in STEM education*, *1*(1), 38-45.

MoEYS. (2021). *Cambodia STEM Education Policy 2020–2025*. Retrieved from: https://dopomoeys.com/wp-content/uploads/2022/06/Final_STEM_Policy-brief_Issue-1-2022-ENG.pdf

Monroe, M. C., Plate, R. R., Oxarart, A., Bowers, A., & Chaves, W. A. (2019). Identifying effective climate change education strategies: A systematic review of the research. *Environmental Education Research*, *25*(6), 791-812.

Mordeno, I.C., Sabac, A.M., Roullo, A.J., Bendong, H.D., Buan, A. and Yuenyong C. (2019). Developing the Garbage Problem in Iligan City STEM Education Lesson Through Team Teaching. *Journal of Physics: Conference Series*, 1340 (1), 012046

Platt, S.G., Sovannara, H., Kheng, L., Thorbjarnarson, J.B. andRainwater, T.R. (2004). Population status and conservationof wild Siamese crocodiles (Crocodylus siamensis) in theTonle Sap Biosphere Reserve, Cambodia. *Natural History Bulletin of the Siam Society*, 52(2): 133-149

Ramanujam, E. M., & Brooks, J. S. (2014). Wildlife art and illustration: stone sculpture and painting-some experiments in Auroville, Tamil Nadu, India. *Journal of Threatened Taxa*, 6 (10).

Routray, S. K., & Mohanty, S. (2024). Integrating sustainability into STEM curricula. *IEEE Potentials*.

Sam, H., Hor, L., Nhek, R., Sorn, P., Heng, S., Simpson, B., ... & Daltry, J. C. (2015). Status, distribution and ecology of the Siamese crocodile Crocodylus siamensis in Cambodia. *Cambodian Journal of Natural History*, *2015*, 153-164.

Sim, G. (2015). *Learning about biodiversity: investigating children's learning at a museum, environment centre and a live animal show* (Doctoral dissertation, UCL Institute of Education).

Simpson, B. K., & Bezuijen, M. R. (2010). Siamese crocodile Crocodylus siamensis. *crocodiles status survey and conservation action plan. 2nd ed. Darwin: Crocodile Specialist Group*, 120-126.

Smith, M. A. (1919). Crocodylus siamensis. *Journal of the Natural History Society of Siam*, *3*, 217-222.

Srieng, K., Seavleng, N. Y., Kong, S. O., & Long, K. (2024). The Recycling Corn Husks-A STEM Decorative Item Project in PTEC Student Teachers. *Journal of Innovation, Advancement, and Methodology in STEM education*, *1*(2), 57-65.

Srieng, K., Sina, O., Lok, S., Chhoen, C., Srun, S., & Kong, S. O. (2025). From Bananas to Chips: A STEM Journey to Explore Food Processing Concept. *Journal of Innovation, Advancement, and Methodology in STEM education*, *2*(2), 97-104.

Sutaphan, S. and Yuenyong, C. (2019). STEM Education Teaching approach: Inquiry from the Context Based. *Journal of Physics: Conference Series*, 1340 (1), 012003

Sutaphan S. and Yuenyong, C. (2023). Enhancing grade eight students' creative thinking in the water stem education learning unit. *Cakrawala Pendidikan: Jurnal Ilmiah Pendidikan*, 42(1), 120-135.

Theerasan, C. and Yuenyong, C. (2019). Developing the Floating Restaurant STEM Education Learning Activities for Thai Secondary School Students. *AIP Conference Proceedings*.2081, 030023-1–030023-6.

Yuenyong, C. (2019). Lesson learned of building up community of practice for STEM education in Thailand. *AIP Conference Proceedings*. 2081, 020002-1– 020002-6.