

STEM ASEAN Project to Promote 21st Century Teaching and Learning

Norlizawaty Baharin^{1#} & Nurzatulshima Kamarudin²

¹Sultan Alam Shah School, Putrajaya.

²Faculty of Educational Study, Universiti Putra Malaysia, MALAYSIA.

[#]corresponding author < norlizawatybaharin@gmail.com >

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Abstract

The initiative of integrating science, technology, engineering and mathematics (STEM) in educational curriculum in schools is one of the efforts by the Ministry of Education Malaysia to encourage students' interest and involvement in STEM. One of the fundamental keys 21st century pedagogical approach to effective learning, meaningful learning and deep understanding of knowledge is the integration of STEM in school lessons. This knowledge is then applied into project-based learning approach introduced in this study. STEM ASEAN is a project initiated among three schools in ASEAN countries that involves collaboration and creation of STEM based presentations in accordance to the given topic. This article illustrates the projects that were carried out with the help of a systematic schedule that has been planned and mutually agreed in implementing this project. Case study approach supported by Technology-enhanced Learning was used for data collection and analysis. The schools involved are Sultan Alam Shah School Putrajaya, Taman Bukit Maluri Secondary School and Panntagon International School of Myanmar. The topic for this project was 'Endangered Species in ASEAN Countries'. The students were formed into 11 groups and each group was required to choose an endangered animal found in ASEAN countries. Once the endangered animal was chosen, research through information gathering and collaborative learning was carried out. Collaboration and info sharing were facilitated through Skype and Microsoft OneNote software. After finishing the tasks, the groups created simple presentations as true evidence to exemplify their understanding of their research. This project indicates that collaboration in STEM learning can be carried out even among different countries. Although there are various challenges such as different cultures and languages, the use of technology can solve the problem.

Keywords: STEM education; Endangered species; Collaboration; Technology-enhanced learning; Blended-learning platform

Introduction

Background and Overview

Ministry of Education (MoE) Malaysia introduced Science, Technology, Engineering, and Mathematics (STEM) education in schools since 2013 (Ministry of Education, 2013). STEM education applies the real world context by connecting education sector, community and industry to enhance STEM literacy and human capital in driving the nation's economic development. Currently, there are high interests and tendencies among students and teachers towards STEM education. Various approaches and teaching strategies have been proposed to provide students with the ability to master STEM related subjects. STEM education provides students with the opportunity to apply concepts and knowledge from various disciplines in an integrated way in order to solve problems in the real world. Students are actively involved in learning activities that encourage them to seek and gain deep understanding of the activity that is carried out while increasing the students' motivation and creativity (Kuo, Tseng, & Yang, 2019).

In 2014, technical science-literature students' ratio of 60:40 was converted to 60:40 ratio of STEM-not STEM students. In addition, there are various initiatives that have been implemented by MoE to strengthen STEM education in Malaysia. Among them are enhancing teachers' skills and abilities through teachers' participation in STEM Education Colloquium and related international conferences. While students' interest in the field of STEM is enhanced through various programs including the Scientific Skill Assessment Program, STEM Club in school, School Lab Competition, STEM Education Gamification, STEM Reality TV Show, STEM education resources development, multimedia use in STEM subjects, as well as conducive infrastructure provided by the government (Ministry of Education, 2018).

Rationale and Objectives

In middle school level, STEM focuses on the students' ability to think, gather information, understand, elaborate, collaborate and make presentations or simple projects based on their understandings of given information such as information from online resources. STEM approach is an alternative to link STEM subjects and relevant context provision to the learning process (Kelley & Knowles, 2016). STEM approaches of 21st century teaching and learning such as problem-solving, project-based learning and scientific inquiry-based learning are the keys to effective learning, meaningful learning as well as deep understanding of knowledge among students (Voet & De Wever, 2016). The learning experience acquired through these approaches can give students ideas of the lessons they are learning in classroom which would further enhance their problem-solving skills. This skill can be improved by exposing students to situations and real world problems that require a solution such as animal extinction. Students should be given the opportunity to experience activities that involve problem solving skills such as opportunity to plan their own investigations that allow acquisition of meaningful learning.

The main purpose of this project is to encourage students to develop problem solving skills, develop awareness towards global issues in ASEAN countries, exchange ideas in solving complicated problems, and create better solutions. Students can benefit from having good problem solving skills as problems are encountered on a daily basis. The significant of these STEM-based projects is to enable nurturing of thinking skills development such as critical

thinking, creative thinking, intuitive thinking, scientific thinking, good interpretation, efficiency, and high level understanding of a matter. Students with these useful skills will become an asset to the society in the future (Bell, 2010; Higgins, 2013).

‘Endangered species’ which is the assigned topic in this study, will challenge the students to use the search engine to search and gather relevant information on the internet to fulfill their task. Internet-related technologies, such as web search has been used in many schools as part of their teaching and learning activities due to the rapid development of the web and internet. Based on previous research, the use of search engine development tools is effective to facilitate students’ learning (Chau, Wong, Zhou, Qin, & Chen, 2010). In addition, students are positive about the potential of the internet and believe that it can promote and enhance learning (Yang & Chen, 2007). Nowadays, information literacy skill is important to students in order to search, retrieve, evaluate and synthesize various types of information. In order to navigate library resources using online search engines, technology skills are also needed by the students (Kingsley et al., 2011). While developing the skills mentioned, students can also learn about endangered animals, the cause of the problem, the prevention method and all the general information relevant to the selected species. Hence, this is similar to killing two birds with one stone in which students can develop required thinking skills while increasing awareness and knowledge about endangered animals especially in ASEAN countries.

Review of Related Literature Guiding Framework of Practice

According to Encyclopaedia Britannica (2018), endangered animal means any species that is at risk of extinction because of sudden decrease in its population or loss of its critical habitat. In addition, any species of plant or animal that is threatened with extinction could be categorized as endangered species (Encyclopedia Britannica, 2018). Among the endangered species chosen by students are; orangutan, sun bear, Sunda pangolin, marbled cat, Sumatran rhino, elephant, hornbill, Komodo dragon, and Asian tiger. Commercial timber extraction, small-scale logging (both legal and illegal), conversion of forest to palm oil or wood-pulp plantations, forest fires along with the concurrent increase in access to formerly remote areas are increasingly threatening the integrity of the remaining forests, thus putting the survival of its inhabitants at stake. Orangutan for example, specifically Sumatran orangutan is not only endangered due to loss of habitat but also due to illegal hunting and trade (Nijman, 2009).

The STEM education approach must be student-centered, preferably with cooperative learning in small groups, includes teachers as facilitators, involves problem solving experience in real-world contexts as well as acquisition of understanding through hands-on activities. STEM education efforts can be further strengthened through curriculum innovation, pedagogical innovation and assessment innovation (Lilia Halim & Mohamad Satar, 2016). ‘STEM ASEAN – Endangered Species Project’ is an effort to promote 21st Century teaching and learning innovation through introduction of STEM education approach. The STEM education approach needs to include elements such as problem-solving, critical thinking, creative thinking and scientific thinking skills that can enhance the high-order thinking skills among students as well as enable effective, meaningful, and in-depth learning of knowledge. The learning experience gained through STEM-based activities can give students an idea of the lesson they are learning in the classroom and further enhance their problem-solving skills. In practice, however, technology has rarely been employed to promote critical thinking or higher-order problem solving in everyday classroom settings (Kim & Hannafin, 2011).

The Ministry of Education (MoE) Malaysia has outlined the key features of STEM pedagogical approaches to guide teachers to implement STEM teaching and learning in schools. Teachers should encourage students to integrate knowledge, skills and value of STEM subjects to solve tasks or problems in the context of the daily lives of the community and the environment. This can be achieved by engaging students in open exploration, working productively in groups, encouraging students to provide solutions that are justified with reasons, as well as increasing students' sensitivities to real world issues and problems (Curriculum Development Division, 2017). Hence, STEM learning should focus on real world issues. Students need to identify what social, economic, and environmental issues are happening and find solutions to those problems.

Normally students will discuss about the project after the official schooling time. Hence, this project can be considered as informal learning designed to generate creative and innovative thinking which is expected to have positive impact among students. According to Campaign for Learning (2016), learning is an active involvement process with experience and involves the development or strengthening of skills, knowledge, understanding, awareness, values, ideas and feelings as well as increases the capacity to think. According to Falk & Dierking (2000), students prefer to exhibit different knowledge and understandings in informal learning as it is easier to relate to what the students are experiencing. There are five dimensions of informal learning which are listed as; non-deductive, socially collaborative, embedded in meaningful activity, initiated by learner's interest or choice, and removed from external assessment (Callanan, Cervantes, & Loomis, 2011). It is shown that informal science learning experiences can diversify the learners' interest and motivate them to learn science. Informal science learning also can make significant contributions in providing appropriate learning opportunities (Hofstein & Rosenfeld, 1996). But informal learning program like the STEM ASEAN project also faces several issues. One of the biggest problems regarding students' projects is the difficulty of reliable assessment as there is a lack of valid criteria for assessment (Hofstein & Rosenfeld, 1996). However, such projects provide significant learning opportunities for students.

Methodology

Case study approach supported by technology enhanced learning was used for data collection and analysis. Data collection included observation and document analysis (Facebook projects, online discussion, and students' works). STEM ASEAN is a collaborative STEM-based learning project among three schools in ASEAN countries. STEM-based learning can motivate students to face new challenges and increase their readiness as well as willingness to learn (Jamaludin & Hung, 2017). The schools involved are Sultan Alam Shah Putrajaya School (SAS), Taman Bukit Maluri Secondary School and Panntagon International School of Myanmar (Refer to the following Table 1). This project is voluntary based which means that the selection of schools involved is solely based on the willingness of teachers to provide their commitment and cooperation so that the project is completed. Even the students' involvement in the project is also voluntary. The topic for the project is 'Endangered Species'. The students from all three schools are formed into 11 groups and each group is required to choose one endangered species that is found in ASEAN countries. Students work in groups of three students per group. They help and support one another with ideas and information related to the topic given. Students from SAS lead the groups, students from Taman Bukit Maluri Secondary School guide the members in using OneNote platform, and students from Panntagon International School of Myanmar contribute ideas and knowledge to make the project a success. The students need to work within the timeline given (Refer to Table 2).

Table 1
Grouping for STEM ASEAN Project*

Groups	Sultan Alam Shah School	Taman Bukit Maluri Secondary School	Panntagon International School Myanmar
1	Qimi	Adriana	Aw
2	Fadhli	Yan	Yin
3	Ariff	Kumar	Amoung
4	Hafiq	Kevan	Kyi
5	Naufal	Lim	Yati Oo
6	Syahmi	Rui	Tinzar
7	Adam	Zheng	Su San
8	Irfan	Fathur	Myint
9	Ilyas	Roshan	Kyaw
10	Muhammad	Sayyid	Minn
11	Ahmad	May	Thura

*Students in the groups are listed with pseudonyms.

Table 2
Timeline for 'STEM ASEAN-Endangered Species Project'

Date	Programs
October 22 nd , 2016	Teachers from three schools met to discuss about the project
October 26 th , 2016	Closed STEM ASEAN Facebook (FB) Group page was created
January 12 th , 2017	Students introduced themselves and made acquaintance with their team members
February 13 th , 2017	OneNote online platforms were created on STEM ASEAN FB group
February 18 th , 2017	Grouping for STEM ASEAN project was posted in FB group page
February 20 th , 2017	Students familiarized themselves with their group members and discussed about their project
February 27 th , 2017	Students chose the desired endangered species
March 1 st , 2017	Students worked collaboratively using OneNote online platform
April 11 th , 2017	Skype session was conducted between Alam Shah School and Taman Bukit Maluri National Secondary School
May 2 nd , 2017	Students uploaded their presentation slide on OneNote online platform

The following Table 3 shows the Syntax of 'STEM ASEAN-Endangered Species Project' Model. The syntax is based on the phases contained in the key elements of Project Based Learning.

Table 3
Syntax of “STEM ASEAN-Endangered Species Project” Model

Phase	Student Activities	Teacher Activities
Project description	Step 1 : <ul style="list-style-type: none"> Describe the project 	<ul style="list-style-type: none"> Explain the project Create STEM ASEAN FB group Coordinate students Give motivation
Introduction	Step 2 : <ul style="list-style-type: none"> Make introduction in STEM ASEAN FB page Make acquaintance with group members Choose one endangered species 	<ul style="list-style-type: none"> Create OneNote online platform Set up groups for STEM ASEAN Direct students in their investigation
Background knowledge	Step 3 : <ul style="list-style-type: none"> Research the problem 	<ul style="list-style-type: none"> Guide and direct student in finding information about research problem
Generated ideas	Step 4 : <ul style="list-style-type: none"> Determine possible solutions Intensive discussion among group members 	<ul style="list-style-type: none"> Guide and direct students to find information about research problem
Develop and plan solution	Step 5 : <ul style="list-style-type: none"> Develop and plan solutions Upload presentation slides on OneNote online platform 	<ul style="list-style-type: none"> Assess, collaborate and supervise
Generalize	Step 6 : <ul style="list-style-type: none"> Summarize, evaluate and reflect the plan 	<ul style="list-style-type: none"> Give reflection and assessment

The phases involved were; project description, introduction, background knowledge, ideas generation, development and plan solution, as well as generalization. Each phase also provided guidance on the activities and roles required by students and teachers. Students’ activity was explained clearly through the description of phases of activities in Table 4.

Table 4
Description of the Phases of Student Activities for “STEM ASEAN-Endangered Species Project”

Phases	Description of Indicators
Determine the project Step 1 : Describe the project Step 2 : Make introduction in STEM ASEAN FB page, make acquaintance with the team members and choose one endangered species	<ol style="list-style-type: none"> 1. Find general ideas 2. Find important and attractive details 3. Find out about group members 4. Decide the endangered species 5. Brief discussion between group members
Introduction to the context of study Step 3 : Research the problem	<ol style="list-style-type: none"> 1. Questions about real world problems 2. Discuss the context of research 3. Manage time efficiently and effectively 4. Simulate professional discussion and collaboration
Activity Planning Step 4 : Determine possible solutions and intensive discussion among group members	<ol style="list-style-type: none"> 1. Read 2. Research 3. Observation 4. Internet access
Activity Process Step 5 : Develop and plan solutions, and upload presentation slides on OneNote online platform Step 6 : Summarize, evaluate and reflect the plan	<ol style="list-style-type: none"> 1. Planning and task distribution 2. Intensive discussion 3. Produce presentation slides about the chosen endangered species

After choosing an endangered animal by groups, the students need to do research by gathering information and collaborate in analyzing the information. Skype, Facebook and Microsoft OneNote are used as a collaborating tool. The way individuals communicate and interact has been revolutionized by the use of Facebook. Facebook allows the users to share, collaborate, and form social connections. Also, research has proven that Facebook has the potential to motivate students to learn, where it also affects the cognitive and affective learning outcomes (Mazer, Murphy, & Simonds, 2007; Saini & Abraham, 2019). Students’ achievement and engagement levels also show significant improvement by the use of Facebook-based instructional approach (Saini & Abraham, 2019). In addition, the use of social media such as Skype, Facebook, and even mobile apps could facilitate deep learning and the creation of knowledge in e-learning (Mnkandla & Minnaar, 2017). As an output, students study the selected species and compile all the information on OneNote software. After gathering information, students create presentations using power point regarding the selected “Endangered Species”. By the end of the study, the students who join the project are expected to improve their problem solving skill, critical thinking skill, creative thinking skill, ICT literacy, and information interpretation skills.

Findings and Discussions

The main focus of data collection in this research is to get the answers based on the use of Facebook, Skype, and OneNote Online Platform as educational tools to encourage students to develop problem solving skills, develop awareness towards global issues in ASEAN countries, give ideas in solving complicated problems, and create solutions. This is important because the concept of technology utilization and blended learning guided the researcher during data collection and managed to be presented in the form of project findings. Hence, case study approach supported by technology enhanced learning was used for data collection and analysis. As mentioned earlier, data collection included observation and document analysis (Facebook projects, online discussion, and students' works). During implementation of the project, the teacher facilitated students' activities and discussion, monitored students' progress and provided formative feedback on each phase using online discussion, individual comments, and face-to-face assistance. As an observer, the researcher focused to get an overview of the whole project and observed students' learning processes with occasional follow-ups. The teachers involved often discussed and monitored students' progress even among students from other schools to ensure the project was in line with the schedule.

Students were able to work collaboratively using OneNote online platform. Furthermore, students were also able to create the cover page as well as find relevant images and information from the internet. All groups were also able to create introduction about the selected endangered species, name the participating students, create Facebook group, write a list of endangered animals, and create presentation about the chosen species. In the presentation slides of each group, the information inserted by students stated the reasons why the species were chosen, the level of extinction of the chosen species, reasons that the animal is extinct, the factors leading to extinction as well as measures to reduce and overcome the problem of extinction. This information was sought by the students within their groups with the guidance by their respective teachers as in Figure 1, Figure 2, and Figure 3. The following Figure 1 shows the introduction about endangered species that was uploaded by student on OneNote online platform. The introduction part also contains participating students, Facebook group, grouping, and list of endangered animals.

The screenshot shows a OneNote page titled "Endangered Species". The left sidebar contains a table of contents with the following items: Intro, Cover Page, Introduction, Participating Students, Facebook Group, Groupings, List of Endangered Animals, humpback whale, Orangutans, Sunbear, Indian Phyton, Sunda Pangolin, Marbled Cat, Sumatran Rhino, Elephants, Hornbill, Komodo Dragon, and Asian Tiger. The main content area has a heading "Introduction" and a sub-heading "About endangered species". The text defines an endangered species and mentions the IUCN Red List. Below the text is a table titled "List of Critically Endangered Animal" with columns for Common name, Scientific name, and Conservat.

Common name	Scientific name	Conservat
Amur Leopard	<i>Panthera pardus orientalis</i>	Critically Er
Black Rhino	<i>Diceros bicornis</i>	Critically Er
Bornean Orangutan	<i>Pongo pygmaeus</i>	Critically Er

Figure 1. Introduction about endangered species that was uploaded by student on OneNote online platform.

Figure 2 shows the cover page that was created and uploaded by students on OneNote online platform.

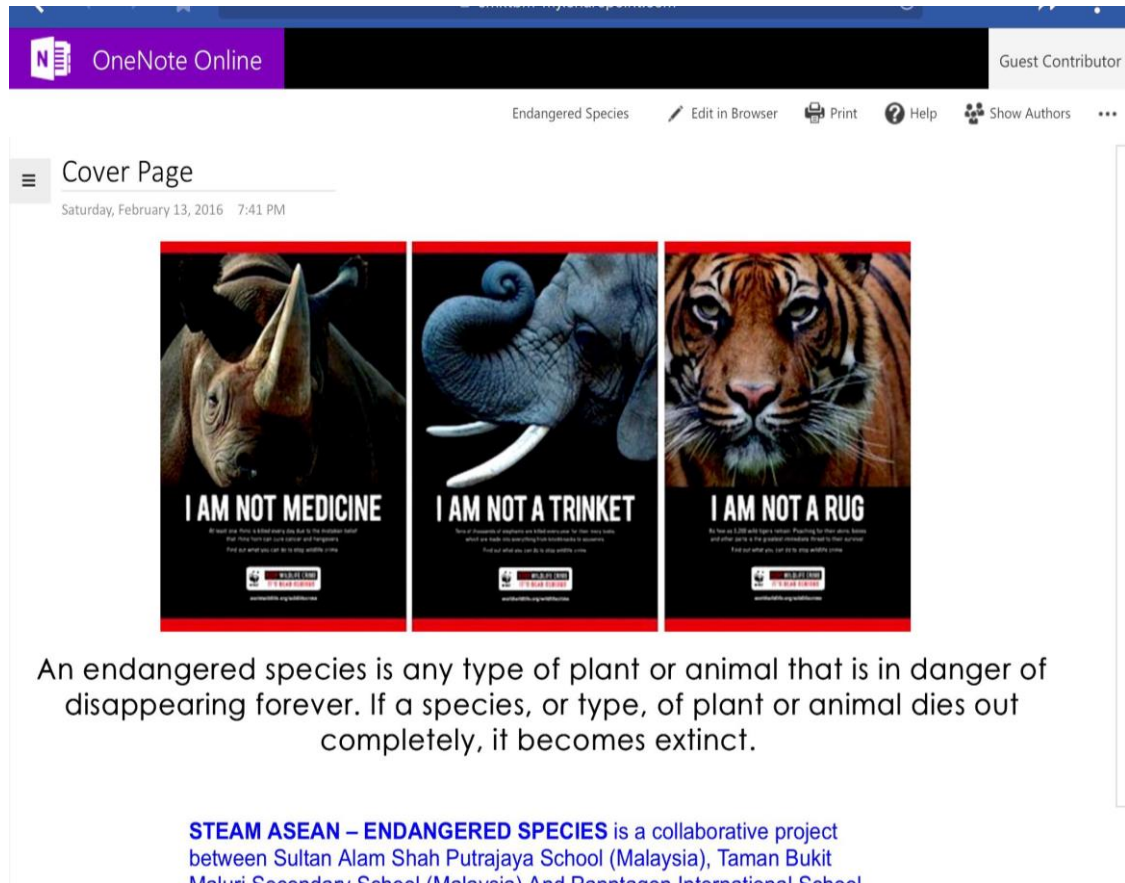


Figure 2. The cover page created and uploaded by students on OneNote online platform.

While Figure 3 shows the introduction of Komodo dragon that was uploaded by student on OneNote online platform.

The screenshot shows a OneNote page titled "Introduction" for the Komodo Dragon. The page is viewed on an iPad at 5:11 PM. The URL is smktbm-my.sharepoint.com. The page content includes a table of contents on the left, a search bar, and the main text of the introduction. The text describes the Komodo dragon (Varanus komodoensis) as a large species of lizard found in the Indonesian islands of Komodo, Rinca, Flores, Gili Motang, and Padar. It is the largest living species of lizard, growing to a maximum length of 3 metres (10 ft) in rare cases and weighing up to approximately 70 kilograms (150 lb). The text also discusses island gigantism and the biological significance of these lizards.

Figure 3. Introduction about Komodo Dragon, one of the endangered species uploaded on OneNote online platform.

The following are discussions of significant aspects of this project.

Project-Based Learning Approach in STEM ASEAN project

At Sultan Alam Shah Putrajaya School, the STEM activities has been applied in formal and informal education outside of the classroom. One of the examples is STEM Showcase program which is a conceptualized 'problem-based learning' and 'project-based learning'. In accordance to the program, students are required to execute a research on a topic of interest and then produce a poster presentation. Students are also involved with the STEM program through collaboration between Sultan Alam Shah School with other institutions such as the National University of Malaysia (UKM) through the program 'Bitara STEM UKM' and Robotic Programs with Tabung Haji Malaysia. The experience gained during the STEM program encourages the students to volunteer in joining the STEM ASEAN project.

This STEM ASEAN project is based on a pedagogical principle that the students gain knowledge through experience and production of something new. This project applied a 'project based learning' approach in which students need information and skills to engage, investigate and respond to problems and challenges that need to be solved in a given time

period. Project-based learning is a classroom-based learning that can stimulate cognitive, creativity and students' ability to express ideas in solving problem. Project-based learning is highly significant with the concept of 21st century learning that involves creation of a product. Study showed that students have greater application of creative thinking in project-based learning model (Mihardi, Harahap, & Sani, 2013). Project-based learning creates a learning environment that fosters creativity and teamwork, and teaches students to find innovative solutions to problems that are always changing.

Project-based learning involves long-term period, integration of multiple disciplines across the curriculum, student-centered learning and link of lesson with real life situations. The 5 key components in project-based learning are preparation, implementation, presentation, evaluation and correction (Lou, Chou, Shih, & Chung, 2017). Project-based learning also makes learning environment more fun and makes students more motivated (Goldstein, 2016). Studies show that students studying science through project-based learning perceived the environment in their class to be more enjoyable and satisfying with stronger support from teachers and positive teacher-student relationships (Hugerat, 2016). Project-based learning also enhances students' creativity, strengthens student capabilities in STEM-based learning, increase students' imaginations and also their curiosity (Lou et al., 2017).

Innovation in STEM Education

Innovation was found when collaboration was still possible despite the physical distance between the participating groups. In this case, successful collaboration was seen with the usage of Skype and OneNote as collaborating tools. This project was practical because the students found and gathered information by themselves rather than being taught to find or search for information. In addition to that, students were required to create presentation in any form such as video, PowerPoint slides or article. The presentation was a clear example of applying skills to discover and interpret new information in creating a new product which entitled it to be called a practical activity. Originality was found when students created their own work based on their research. This led to pure understanding of knowledge that could be elaborated and possible self-created project related to the acquired information.

The project is interesting as it involves the usage of latest information and communications technology (ICT) such as Facebook, Skype and OneNote online platforms. In addition, this research indicates that by the use of social networking sites such as Facebook and Skype as learning tool, it will give a better and favourable learning experience. This is because students develop strong feelings of social connectedness by using social networking sites (Hung & Yuen, 2010). Also, it is interesting because students can communicate and discuss through Facebook, get acquainted and have live discussion with group members using Skype and collaborate in completing tasks using OneNote online platform. Students' interaction is viewed during the discussion and decision making in choosing their desired endangered species, as well as during their collaboration in completing the project.

By using OneNote Online Platform, students were able to view the list of endangered species that were selected by other groups, collaborate to fill the project timeline section, write introduction about selected endangered species, insert photos and videos, as well as upload presentation and acknowledgment. Furthermore, the students were also able to learn and see the development of other groups, thus giving the students the challenge and the motivation to complete their group assignments. Using the OneNote online platform as a mechanism for collaboration increased the quality of digital literacy and digital skill achievement among the

students. The students initially encountered problems while using the OneNote online platform but as the project progresses, the students became more proficient with the technology.

The relevancy of the project towards schools in Malaysia and other countries

This project is relevant as many ASEAN countries have similarities in terms of biodiversity and ecosystem. Therefore, issue such as endangered species is relevant to be discussed among school level students from ASEAN countries that enable students to collaborate, discuss, exchange views, share ideas and expertise on ways to overcome the issue. The project STEM ASEAN can be quite challenging for some students as it requires application of ICT skills. However, all students involved in the project have sufficient ICT skills. The students are also expected to master the required skills if they manage to fulfill the task given.

The project is relevant to an extent that it can be replicated, expanded and duplicated by applying various relevant topics occurring in ASEAN countries. Besides, this project can also be implemented by attracting participation from more member countries of ASEAN as well as involving larger groups of students. More serious topics can also be discussed among the students including ways to maintain ecosystem and sustainable economy in ASEAN countries. The items that are required in this project are internet connected computers and committed students who can carry out a research. Hence, it can be concluded that only a small cost is necessary for this project aligned with the concept 'A low cost project that can lead to projects that are worthy'. As the students develop the project, they will also gain interest of the topic thus leading to an innovation or solution to the related problem.

Conclusion

Implications and Limitation

This project is significant because it is an innovation in STEM education as STEM concept is highly relevant in education institutions in Malaysia and other countries. This project is significant as it provides different platforms to promote science learning among students, even though not all students were highly interactive and assiduous during their participation. It is also important to note that the design was not implemented optimally, contributing to certain weakness in the project. Although there is weakness in the implementation of this project, it should not be seen negatively, but it can guide the teachers to implement project-based learning that emphasizes on the collaboration with appropriate tool utilization. During the project, even though there were less-skilled English speakers to discuss using online platforms and conduct live communication using Skype, with constant encouragement, the language barrier problem could be overcome. Students who enjoy innovative and high-tech learning seem to benefit from internet learning. Teachers play an important role where they devoted time, energy, and ideas to frame, plan and implement project phases to ensure that projects are in line with the plan. Teachers were also required to prepare themselves with essential knowledge and skills throughout the project, including the use of Facebook, Skype, and OneNote online platforms. Without teachers' knowledge and efficiency, the effectiveness of the project will be reduced. That being said, the support from the teachers, as well as the school management, infrastructure facilities, internet facilities and the students' ICT skills play significant roles in the success of this project.

This project was conducted as planned despite facing some challenges. All the teachers and students involved have given their best cooperation and commitment to ensure that this project completed smoothly. This project also has its limitation. It was conducted with a limited number of schools and participants. It should also be noted that the activities were carefully designed to promote 21st century teaching; learning innovation, STEM concept, collaboration among students, exciting opportunities, and learning engagement. This project recommends the use of Facebook, Skype and OneNote online platform as instructional and learning tools for institutions in Malaysia and other countries to enhance collaboration, communication, interaction, motivation, and engagement among students.

Challenges in Collaborative Learning and Recommendations for the Way Forward

There were a few challenges during the STEM ASEAN project. One of the challenges was age difference. Students from the three schools that were involved in the project were from different age group. All students from Sultan Alam Shah School Putrajaya that are involved in the project are 15 years old, all students from Taman Bukit Maluri Secondary school are 16 years old while students from Panntagon International School of Myanmar are of various ages (2 students aged 10 years old, 2 students aged 11 years, 2 students aged 12 years and 5 students aged 13 years). Due to the huge age gap of the students among the three schools (youngest from Panntagon International School of Myanmar and the eldest from SMK Maluri Cheras), the project had taken into account the difference in age. Thus, after discussions with the teachers, it was agreed to choose appropriate titles that could be discussed by students of all ages that is endangered species. However, there is a significant age gap in the respondents due to difficulties in obtaining same age level students, forcing the teachers to adopt voluntary students to engage in this project. However, future projects are recommended to use students of equal age to ensure students' cognitive abilities are at the same level. In addition, there was a challenge in terms of medium of communication and collaboration. In order to overcome this challenge, the medium for communication and collaboration was taken into account to enable accessibility from all students. As a result, it was agreed that the appropriate final outcome of the project was to produce presentation materials in digital format (OneNote online platform).

National language is a clear indicator that represents the national identity of a country. National language is a driving force behind unity of the nation's people. Giving respect to national language means that it should be the preferred communication language at every level. National language for Malaysian is Malay Language (*Bahasa Melayu*) while for the people from Myanmar is Burmese. It is a definite fact that the students feel more comfortable and confident to communicate in their respective national languages. However, due to language barrier between students from Malaysia and Myanmar, English is used as the main medium of communication as it is mutually understandable by both parties. Therefore, students communicated and discussed through Facebook, Skype and OneNote online platform especially with their peer group from Myanmar using English. Due to the fact that the selection of students were not based on their skill of speaking and writing in English but based on interest and volunteerism, there were a few students who felt less confident in communicating with their friends from other schools. However, the problem was overcome with the encouragement given by their teacher and friends.

In addition, different school cultures were also one of the factors that became a challenge towards the project. For instance, Sultan Alam Shah School is a boarding school and the students finish their classes at 3.20 pm with scheduled time slots of organized activities, while SMK Maluri Cheras is a day school with more flexible time. Other than that, presence of ICT

facilities such as computers and Internet connection were also proved to be a challenge for the project. For example, the involved students from Sultan Alam Shah School relied entirely on computer facilities at the school computer labs that are only accessible during school sessions. Consequently, this aspect affects communication as well as discussions among group members.

In the future, this project can be improved by using more communication tools, more physical activities and more challenging world problem that can lead towards students' optimum achievement. Teachers also should ensure that all students are able to play active roles in the project and ensure that the project is completed within the estimated time. Moreover, teachers should also act as facilitators to monitor and guide the students so that they acquire all the skills needed throughout the implementation of the project (Estes, Liu, Zha, & Reedy, 2014). Besides, every discussion should be recorded for documentation purpose when the students communicate and discuss using social media.

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Appendix

STEM ASEAN Facebook which was created to promote discussion and collaboration between students

