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Cite as: AIP Conference Proceedings **2331**, 030034 (2021); <https://doi.org/10.1063/5.0041913>
Published Online: 02 April 2021

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Engaging University Students in Multidisciplinary, Project-Based Learning through the Southeast Asia Mobility (SAM) Program

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Abstract. The purpose of this study was to engage university students from Malaysia, Thailand, and Indonesia in the Southeast Asia Mobility (SAM) program which aims to develop 21st century skills through multidisciplinary, project-based learning. The program was designed using different phases: design thinking was conducted in Malaysia, the implementation of prototype was conducted in Thailand, and the development of business model canvas was conducted in Indonesia. The research used a qualitative methodology with a 21st century skills' instrument as precoding followed by interviews, observations, reflective journals, and peer assessment. The program involved 46 students from three universities in three different countries. The data were analysed through initial coding of the 21st century skills and merged with coding from other data sources. Participants started by exploring the problems occurring in the university's cafeteria. Then, they developed the project using the Internet of Things (IoT) sensors, transducers, simple sensors, and applications. The results indicate that students were stimulated to develop their 21st century skills in critical thinking (4.17), collaboration (4.36), communication (4.18), creative and innovation (4.23), self-direction (4.16), making global connections (4.32), making local connections (4.28), and technology skills (4.35). The students developed critical and problem-solving skills through multicultural communication skills. In addition, they developed ICT skills by engaging in a multidisciplinary project. The students learned to collaborate, develop empathetic communication skills, and cultural awareness. The multicultural environment of Indonesia, Thailand, and Malaysia gave motivation to the students to learn about cultural awareness, prepare their competency to face global challenges, and to apply their knowledge with students from different cultural backgrounds.

INTRODUCTION

ASEAN's (The Association of Southeast Asian Nations) vision of education is to put people at its centre. Every ASEAN country is challenged and works hard to achieve this vision for education. According to [1], ASEAN members should be highly competitive, cohesive, dynamic, innovative, and integrated with enhanced connectivity to accomplish this vision. Establishing positive differences in a student's life and producing productive citizens who work and live in dynamic societies are the moral purpose of education [2]. When teachers understand the moral purpose of education, they reflect and act on what is needed to achieve that goal.

The gaps between students' understanding of current world conditions and what students need to find out so they can compete in professional work are not always aligned [3]. In order to close the gap and provide them with the

competency and understanding to be successful people, they need to acquire 21st century skills. 21st century skills refer to digital literacy, collaboration, empathy, communication, creativity, critical thinking, and citizenship [4]. Silva [5] emphasises that what university students can do to implement their understanding is really different with how many contents that they have. Based on Trilling and Fadel's [6] research, graduated students lacked most of those needed skills in today's workplace. Southeast Asian countries must work together to close the gap between student understanding and current world conditions in order to develop their capacity to meet the needs of a 21st century workplace.

Challenging learning activities should be constructed using an active learning approach such as project-based learning that enable students to know and recognize the cultural and societal aspects of ASEAN countries [7]. Project-based learning is a method based on an approach originated by Piaget, which considers that learning is not only about knowing something or gathering facts but also an activity where students continuously construct their understanding of the world based on their experiences [8]. Today, this approach to learning is recognised as a constructivist pedagogy where students participate in teamwork, collaborate to solve problems, and build a learning community through offline and online communication with students from another country. Constructivist pedagogy can give a positive change in the development of both communication and collaboration skills. Integrating information, communication, and technology (ICT) with project-based learning is crucial to achieving that goal.

The Southeast Asian Mobility (SAM) project, using a multidisciplinary project-based learning approach, was conducted in Indonesia, Malaysia, and Thailand and involved science and engineering students as indicated in Table 1. The 46 science and engineering students from those countries were divided into 10 groups determined by their different cultural backgrounds. Teamwork ability could be developed while they engage in a multi-cultural environment and different learning styles of students in the group activities. The big impact cannot be shown if the program was conducted in a group that does not have differences in nationality or culture. Multicultural groups that have different attitudes, norms, national cultures, and behaviours will influence individual group members. The science and engineering students from the three participating countries were able to increase their 21st century skills from connections made within and between the groups. The outcome of the study can help to support a system that encourages students to get more knowledge about the ASEAN culture and society through project-based learning and to develop their 21st century skills in readiness to be a leader within the ASEAN collective.

TABLE 1. Three phases of the SAM project in Malaysia, Thailand, and Indonesia.

Phase	Activities
1 st Phase Design Thinking	Design thinking was learned by all science and engineering students from 3 countries in Malaysia. They identified problems in the university cafeteria based on customer interviews and brainstormed the solution.
2 nd Phase Prototype Implementation	All students developed a prototype solution that was implemented in Thailand. They learned some technologies to create their own prototype using the sensor of the Internet of Things (IoT), simple sensors, and also transducers to create food ordering applications.
3 rd Phase Business Model Development	All of the science and engineering students implemented and learned Business Model Canvas (BMC) and presented their prototype to impress potential buyers in Indonesia.

The SAM project involved science and engineering students to do the cafeteria project. The students used design thinking to inspect the problems through interviews. The participants designed interview questions that they used to interview customers in cafeterias at Universiti Teknologi Malaysia (UTM), as shown in Fig. 1., using the design thinking skill they had been taught.



FIGURE 1. The interview conducted by science and engineering students in UTM's cafeteria

After conducting the interviews, participants developed solutions to the problems identified by the interviewees and implemented their ideas as prototypes in the second phase of the project. Three groups of participants used IoT for designing their prototype whilst the other groups created a prototype using Micro Controller for making applications as shown in Fig. 2.



FIGURE 2. The science and engineering students created the prototype

After each group created a prototype, phase 3 of the project which consisted of developing a business model canvas was undertaken. As demonstrated in Fig.3, the business model canvas is a method for capturing, providing, and creating benefit and producing the essential income to cover business charges. The project participants learned how to observe the customer's point of view as revealed in the previous phases, and to implement their ideas using the business model canvas.



FIGURE 3. The science and engineering students presented their business model canvas

METHOD

This study guided 46 students from three countries; Malaysia, Thailand, and Indonesia through a multicultural situation using three phases of project-based learning. Data were collected using multiple qualitative research methods such as a 21st century skills questionnaire, students' reflective journals that were collected and analysed, project observation that were recorded and analysed, and several participants were interviewed individually to understand their opinion about the project-based learning activity. Self and peer assessments were also conducted and data were analyzed based on the revealed pattern by the data sources.

RESULT AND DISCUSSION

The students' 21st century skills development during the program was assessed using a 21st century questionnaire. This questionnaire is from the West Virginia Department of Education and is used to describe students' 21st century skills when doing professional development in project-based learning. The questionnaire was conducted prior to starting the program (pre-task) and after finishing the program (post-task) in each of the 3 phases. Figure 4 and Table 2 show the data with an increasing trend from the 1st phase until the 3rd phase. In the 3rd phase, students had the highest result for the eight 21st century skills measured. At the pre-task phase, students believed they had low 21st century skills. After starting the program, students felt that their skills had increased. The highest results of students' skills development were collaboration and using technology. Based on the result of the 21st century skills questionnaire, the SAM program, through project-based learning, continuously developed the students' 21st century skills.

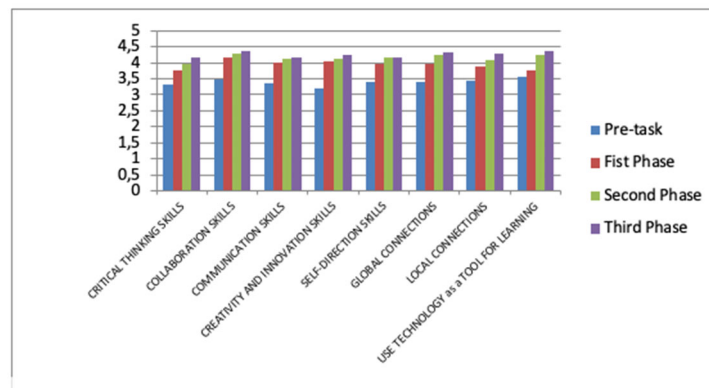


FIGURE 4. Students' twenty-first century skills result

TABLE 2. The result of students' twenty-first century skills.

Students' Twenty-First Century Skills	Pre-task	First Phase	Second Phase	Third Phase
Collaboration	3.48	4.18	4.29	4.36
Critical Thinking	3.31	3.77	3.97	4.17
Technology Use	3.54	3.78	4.24	4.35
Creativity and Innovation	3.18	4.06	4.13	4.23
Self-direction	3.41	3.96	4.15	4.16
Global Connection	3.41	3.97	4.25	4.32
Local Connection	3.43	3.9	4.1	4.28
Communication	3.36	3.99	4.13	4.18
Average Result	3.39	3.95	4.16	4.26

Cultural Awareness

Participants worked in multicultural groups throughout this project, thereby developing their cultural awareness. A reflective journal entry from Group 1 shows that they chose their group name based on a Thai cultural idiom. Participants also encouraged each other to practice their foreign language ability despite their limitations. The diversity in age, ethnicity, race, and gender are significant components that give a contribution to students' learning outcomes and their worldviews. Studies propose that learning in diverse cultural contexts influences the development of cultural competency [9, 10]. Hall and Theriot [11] encourage students to maximize their multicultural education before they enter the real world of work.

"We are members of group 1, also known as '555+'. The name of our group comes from a popular internet slang in Thai for 'lots of laughs'. We are the laughs for people who are sad, the laughs that will make them all feel happy again, the laughs that will take away their problems, and make them enjoy their lives." (Group 1's Reflective Journal)

"In Malaysia, We were asked to solve problems in the cafeteria. We used English while chatting together. But we also tried to communicate in other languages such as Chinese and Malay with the people in the cafeteria." (Group 6's Reflective Journal)

Empathy, Collaboration and Communication

Participants' empathy increased as they communicated and collaborated with other team members. They defined being empathic as appreciating each other's opinions and being open-minded, a definition supported by [12] that defines empathy as someone's capability to feel the others' feelings and know the others' needs. Participants were able to successfully develop their collaboration and communication skills because the project emphasized the importance of those skills in all phases. Collaboration was introduced in the project by seeking each participant's opinion and allowing each member to participate equally [12,13]. All groups discussed and agreed to ideas before taking action which required each member to listen actively to their team members and to compromise.

"We started to develop our application which named Food Fit. During the development process, we had a lot of discussions. From that activity, we learned to appreciate each other's opinions and to be more open-minded." (Group 1's Reflective Journal)

"We have a lot of laughter when we find some miscommunications among us, we also embrace our different strengths and start to be aware of the importance of good communication." (Group 4's Reflective Journal)

Creative and Critical Thinking Skills

Participants in this project described creativity as thinking outside the box. They used creative thinking to identify problems in the first phase of the project and to solve problems in the second phase as demonstrated by how each group find different solutions to the university cafeteria problems. Ten groups brought ten different ideas to the table.

"From the first phase of the SAM Project, we get many lessons, including two heads are always better than one, and that brainstorming for ideas in a team is more efficient than doing it alone. We learn how to give out of the box solution in problem solving. In every product, the most important part that needs to be considered in it is the user-centric. From the second phase of SAM Project, we got many lessons as following: Creativity and critical thinking skills to apply and adjust our ideas into a prototype and do the evaluation with the team members and other participants." (Group 3's Reflective Journal)

Kivunja and Trilling and Fadel [14, 6] suggest that students can develop their critical thinking by using inductive and deductive reasoning, analyzing parts of a whole whilst engaging in systems thinking, and learning how to give judgments as an outcome of interpretation, investigation, evaluation, and consideration. Participants were encouraged to use critical thinking skills to create a product to solve the cafeteria problems. The breaking of assumptions during a discussion and the process of trial and error to create a good product may prove to be an effective approach for

increasing students' critical thinking skills as the process engages the character of critical thinkers who are curious, open to a new thing, and easy to adapt [15-17].

"We chose to combine many ideas into two of our flagship project which we named FRT (Foldable Resizable Table), a table design that can be folded and changed so that it can be used by more people, and FRC (Foldable Resizable Chair) with a cat compartment which is a chair designed to complement the design of the table that we made and equipped with a compartment for cats' place so as not to disturb the user, as user can give food directly to the cat in the compartment." (Group 3's Reflective Journal)

Information, Communication, and Technology (ICT)

The SAM project helped students learn how to use information accurately, how to be in charge of their information, and how to evaluate it wisely. Kivunja concurs with Trilling and Fadel's study [14, 6] which suggests that students need to learn to utilize ICT as a media to communicate, arrange, research, and also evaluate facts to successfully bring a good impact in today's world. Students initiate to develop their knowledge of concepts and issues in a mode of virtual connection when they got the opportunity to implement some of the technologies in their learning process and professional application [18]. Using ICT in 21st century learning gives students a chance to learn how to solve problems with their critical and creative thinking skills [19] as shown from students' reflection below.

All participants in the 7 groups created food applications to solve the problems identified by customers in university cafeterias. Students used an online application to discuss solutions with group members who could not participate in person, demonstrating that they have the ability to use technology to solve problems regardless of where they are. Mitrovic [20] defines electronic skills as the capability to utilize and develop technology to contribute to society. Participants performed these skills as showed by the students' reflective journal below.

"In the 2nd phase, two members of our group did not come, but we are still communicating by skype. So, I hoped that distance does not become a reason for us to not keep communication." (Group 7's Reflective Journal)

"After we interviewed UTM students, we found many problems. Finally, our group focused on the problem of a long queue and the problem of food delivery service. Therefore, we create 'ALLOY' app. It is the application where you can search for any menu from the cafeteria and home cooks. It will show the price, location, rating of hygiene, and rating of that restaurant. You have to confirm your order by writing down your address. The restaurant owner can see every order by using this application too. The important comment for our group is making it different from other existing apps, so we will discuss more details and create some special features." (Group 4's Reflective Journal)

CONCLUSION

Engaging University Students in a Multidisciplinary Project-Based Learning through the Southeast Asia Mobility (SAM) program was successful in developing students' 21st century skills related to cultural awareness, empathy, communication, collaboration, creativity, critical thinking, and ICT skills. Students worked together in multidisciplinary and multicultural groups where they actively communicated and collaborated with other team members, thereby developing their cultural awareness and empathy. Students demonstrated a positive attitude in using their creativity and critical thinking as they worked towards solving the projects' problem. Students' ICT abilities indicated a significant improvement between the first phase and the third phase as students were required to used technology throughout the project.

ACKNOWLEDGMENT

We would like to thank Universitas Negeri Jakarta, Indonesia for the research grant, lecturers and students from UNJ, Jakarta; UTM, Malaysia; and KMUTT, Thailand for ongoing collaborations.

REFERENCES

1. ASEAN Secretariat. ASEAN 2025: Forging Ahead Together [Internet]. 2015 [cited 2018 December 18]. Available from: [http:// asean.org/storage/2015/12/ASEAN-2025-Forging-Ahead-Together-final.pdf](http://asean.org/storage/2015/12/ASEAN-2025-Forging-Ahead-Together-final.pdf)
2. M. Fullan, *The new meaning of educational change* (Teachers College Press, New York, 2001), p. 1.
3. Council of Foreign Relations. New survey finds critical gaps in college-aged students' global literacy [Online]. 2016 [Accessed 2020 June 12]. Available from: <https://www.cfr.org/news-releases/new-survey-finds-critical-gaps-college-aged-students-global-literacy>
4. J. Voogt and N. P. Roblin, *J Curriculum Stud.* **44** (3), pp. 299-321 (2012).
5. E. Silva, *Measuring Skills for 21st Century Learning* (Phi Delta Kappan, 2009), pp. 630-34.
6. B. Trilling and C. Fadel, *21st century skills: learning for life in our times* (Jossey-Bass, San Francisco, 2009).
7. J. Khlaisang and K. Mingsiritham, *Int J Emerg Technol Learn* **11**, pp. 103-13 (2016).
8. Fachrurrazy, *Teaching English as a foreign language for teachers in Indonesia* (State University of Malang, Malang, 2014), p. 53.
9. P. Guy-Walls, *J Soc Work Educ* **127** (4), pp. 569–80 (2007).
10. D. Lum, *Culturally competent practice: A framework for understanding diverse groups and justice issues. 4th ed.* (Cengage Learning, Belmont, CA, 2010).
11. J. C. Hall and M. T. Theriot, *Multicult Perspect* **18**(1), pp. 35-41 (2016).
12. Mechelen MV, Schut A, Gielen M, Södergren AC. *Association for Computing Machinery*, p. 520-526 (2019). doi: <https://doi.org/10.1145/3311927.3325334>
13. P. Dillenbourg, *What do you mean by collaborative learning? collaborative-learning: cognitive and computational approaches* (Elsevier, Oxford, 1999).
14. C. Kivunja, *Int J High Educ.* **3** (3), pp. 81-91 (2014).
15. L. N. Duffy, G. A. Stone, J. Townsend, and J. Cathey, *SCHOLE: J Leisure Stud Recreat Educ*, pp. 1–15 (2020).
16. Facione PA, Facione NC, Giancarlo CAF. *New Dir High Educ.* **96**, pp. 67–79 (1996).
17. Lai ER, Bay-Borelli M, Kirkpatrick RZ, Lin A, Wang C. Critical Thinking: A Literature Review Research Report [Online]. 2011 [Accessed 2020 June 12]. Available from: <https://www.pearsonassessments.com/large-scale-assessments/research.html>
18. C. Kivunja, *Int J High Educ.* **2** (4), pp. 131-42 (2013).
19. A. Ridwan, Y. Rahmawati, and T. Hadinugrahaningsih, *MIER J Educ Stud Trends Pract.* **7** (2), pp. 184-94 (2017).
20. Z. Mitrovic, *S Afr J Inf Manag.* **12** (1), pp 1-7 (2010).