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The Collaborative Learning of Science Project to Supporting 4C's Skills for Learning in 21st Century.

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Abstract: The 4C's skills considered as a significant learning skills in 21st Century. These skills can be practiced in various learning approach, one of them is Science Project. In this study aimed to present the correlation between collaborative learning in Science Project course and development of 4C's skills in participants. The learning process required students work in group for a semester. To evaluate the effectiveness, participants were assessed 4C's skills including creative thinking, critical thinking, communication, and collaboration as well as integrative knowledge skill after finished Science Project course. Finally, the finding of this study ensured that Science Project could develop all of 4C's skills by themselves. Furthermore, It can be another alternative tools for design learning to develop student soft skill in the future.

Keywords: Science Project, 4C's skill, Collaborative Learning, 21st Century Skill

1. Introduction

In the latest decade, the educational trends continuously developed and transform in various perspectives toward technological development. In addition, learners could access knowledge and education easily through online databases. Due to its convenience, there are various soft skills that support learning and working called "21st Century skills, the skill, abilities that being required for success in 21st century workplace. Academic contents and knowledges considered as a core component of this skill, there are 3 main components. For instance, Learning and Innovation skill (4C's), Digital literacy, and Career and Life.

4C's skills considered as the soft skill can support both in academic and workplace. It comprises of Collaboration, Communication, Critical Thinking, and Creativity. The P21 Organization defined that 4C's skills as deeper learning competency (Sudjatmoko, Sofya, & Ritonga, 2021). According to 4C's skill definition, author on behalf of instructor and facilitator who managed the Science Project development in Grade 11th students, perceived the correlation between 4C's skills and skill need for Science Project development. Owing to the learning outcome of Science Project course anticipated learners to create innovation by analyze and criticize from real human demand. In addition, they were anticipated to work as teamwork.

4C's Skill's recognized as an important skill need for learning and working in 21st century inevitably. Many academic attempted to apply those skills into curriculum. According to the Engineering Science Classroom, the senior high school program which expertise in Science, and Engineering affiliate with King Mongkut's University of Technology Thonburi, Thailand. This Program offered Science Project course for Grade 11th-12th students in order to learn, explore, do project in laboratory experiments, documentary. From those courses, learners were anticipated to use various soft skills for working in group. Hence 4C's skills, For instance, Collaboration, Communication, Critical Thinking, and Creativity were significance for developing every process in Science Project.

2. Related Studies

2.1 Science Project

The concept of Science Project initially defined in 1973, defined as the educational activities for laboratory experiment in Chemistry, Biology course. Their definition continuously develops. Generally, Science Project were classified into four type. For instance, Experimental project, Engineering project, Display project, and Theoretical project. In Thailand, Government have attached great importance to science education since 1982. In addition, there are many Sciences Projects competition. For instance, SCiUS Forum, MWIT, Princess Chulabhorn Science school, and others domestic and international Science Project competition.

Science Project have played a central role in school for many decades. It's considered as a latest current course that continuously evolve. In addition, it could engage students in authentic science experience. Clark, and Dickson (2003) opined that Project can encourage sustained reasoning, connect classroom to personal problems, prepare students for lifelong learning. Amelia, Tegariyani, and Santoso (2021) founded that Science project could encouraged student's enthusiasm in various dimension; Hands-on learning, the chance to use scientific method, and scholarship and prize.

The evolution of Science learning have continuously developed, particularly last decade. Its approach based on the Project-based learning, and Problem-based learning. Nevertheless, their learning approach integrated with STEM. Muzana, Jumadi, Wilujeng, Yanto, and Mustamin (2021) opined that there're necessary for improving and developing Science learning approach continuously. According to the evolution of Science Project learning, 21st century skills were also used to apply in Science Project learning in Nowadays.

2.2 The 4C's Skills

21st Century's defined as an essential skill support learning in this century among the innovative change. 4C's categorized as a part of learning and innovative skill. It comprised of Critical thinking, Communication, Collaboration, and Creativity. Those concepts popularized to use in various part of educational sector, Critical thinking was focused, careful analysis of something to better understand it. Second, Communication skill defined as analyzing the situation means thinking about the subject, purpose, sender, receiver, medium. Third, Collaboration skill meant to allocate resources and responsibilities ensures that all members of a team can work optimally. Fourth, Creative thinking was expansive, open-ended invention and discovery of possibilities.

The importance of learning aimed to develop in each skill. Firstly, Critical Thinking's considered as a core skill both in the context of learning. In particular, learning activity. Weng, Cui, Ng, Jong, and Chiu (2022) opined that 4C's are necessary for learning in STEM, Education Maker to develop constructionism in digital education (Weng, Cui, Ng, Jong, & Chiu, 2022). 4C's Skill's considered as a main component of 21st Century skill. Putri, Bukit, and Simanjuntak (2021) studied each 4C skill that affect to Project-based learning, founded that the most effective skill that support PjBL is Critical thinking.

PjBL could improve the competency of 4C's skill's in Economics course. In addition to the individual project-based learning, 4C's skill's also optimized learning competency through Team based project. According to the correlation between 4C's skill's and Science Project learning, those skills also optimized the learning competency in various approaches. For instance, Problem-based learning, and Interdisciplinary learning.

3. Description of Science Project to Supporting 4C's Skills

3.1 Background and Overall Structure

The Science Project is a course for Grade 11th student of the Engineering Science Classroom, King Mongkut's University of Technology Thonburi. According to the course, learners have an

opportunity to do research with University's Professors. They used their creativity and observation skill to create the research topic. Moreover, the leaners were required to determine the scope of project, searching for information to do literature review, planning the experiment, recording the results, and analyzing a data and presenting. Learners used various technology to support their work for all process, such as searching for information on the internet (Science Direct, PubMed, ChatGPT, etc.), planning experiments on the Miro board, Padlet platform as well as make a presentation slide via Canva or MS power point. So, this course could be practiced the different learning skills in 21st Century. Sometimes, it can be called the 4C's skills. For instance, Creative thinking, Critical thinking, Communication, and Collaboration as well as integrative knowledge skill.

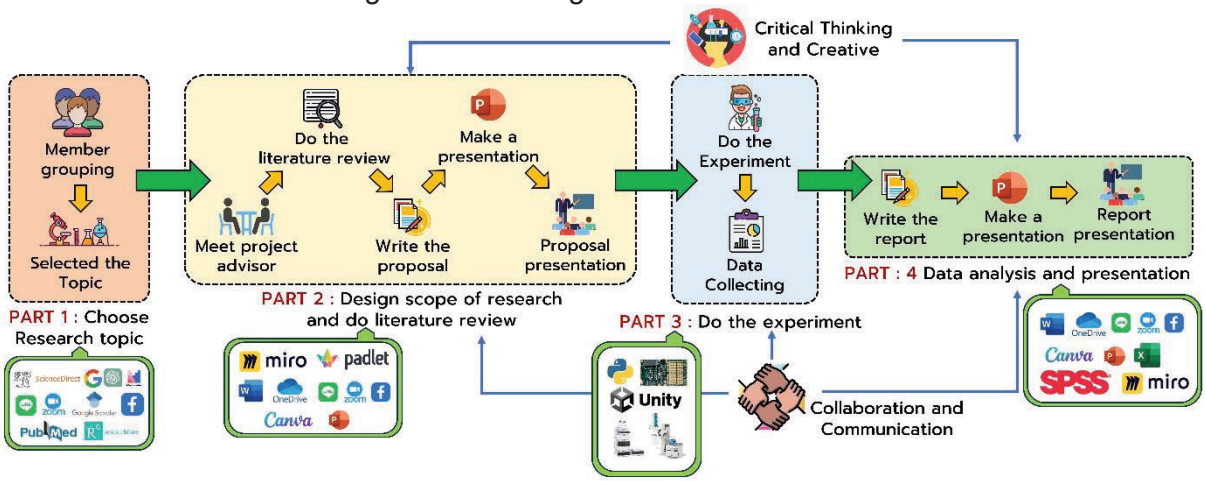

Figure 1. The Overall Structure of Science Project to Supporting 4C's Skills.

The learning process of Science Project course is divided into 4 parts. Part 1 start with group division, 3 person/group and choose the research topic. Part 2 start from research advisor's meeting to design and make a scope of research agreement and do a literature review. Then, each group would write a research proposal, and present to the research committee. Part 3 start with doing the experiment which's followed by their research proposal for collect the data. Finally, Part 4, analyzing the data to conclude. Then the learners have to write research report, and present to research committee which are presented in figure 1.

3.2 Design of Learning activity process

In the learning process design, all of learning activity that effected to 4C's skills practice would occur in the classroom and laboratory for 1 semester (approximately 18 weeks). The first activity until the last activity that effected to each skill would be explained in the table 1.

Table 1. *The Process of Learning Activity Management that Effect to 4C's Skills in Science Project Course*.

Period	Activity	Process	Practical Skill
Week 1-2	Part 1: Choose research topic.	Learners created group according to their interested topic. After that, selected research topic obtained from 2 method; University's lecturer, their own interest.	Communication, Collaboration skills, and Critical thinking
Week 3-8	Part 2: Design scope of research and do the literature review.	Learners met the research advisor to talk about the research topic for understand clearly, made design research scope's agreement, did the literature review for proposal writing. Finally, the learners would present a proposal to committee and peers.	Collaboration, Communication, Critical thinking, and Creativity skills

Table 1. *(Continue)*

Period	Activity	Process	Practical Skill
Week 9-15	Part 3: Do the experiment.	After completely presented the proposal, they would start the experiment for collect research data. When they completed experimental, they would analyze the data to do research conclusion.	Collaboration, Communication, and Critical thinking
Week 16-18	Part 4: Data analysis and Presentation.	After the experiment was done, the learners would analyze data to conclusion and write the research report. Then, sent the report to research advisor to edit some mistake. Finally, all of learners would present their research results to committee and peers for receive some suggestion or idea for research develop in the future.	Collaboration, Communication, Critical thinking, and Creativity skills

In this study, 4C's skills, for instance creative thinking, critical thinking, communication, and collaboration as well as integrative knowledge would be evaluated during before and after finished the Science Project course. Then, the data would be analyzed by statistic program.

4. Research Design

4.1 Participant

The participants of this study were all Grade 11th students in Engineering Science Classroom, King Mongkut's University of Technology Thonburi. All participants enrolled a Science Project course that consists of 81 participants.

4.2 Procedure

Science Project course processes were consisted of 4 part which were presented in figure 2.

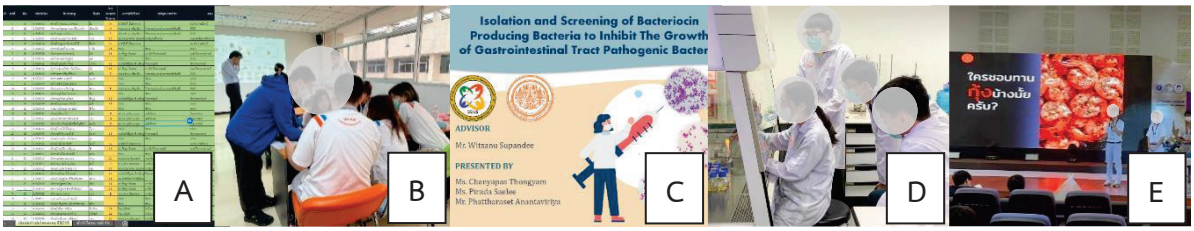

Figure 2. The Procedure of Science Project Course

In figure 2 showed all process of Science Project course. First, learners chose research topic (A). Then, learners met and discuss with research advisor in ordered to make research scope, did the literature review in ordered to make a research proposal (B). After that, learners made the presentation for research proposal (C). Then, learners did the experiment following the research proposal for collect data (D). Finally, learners analyzed the research data obtaining from an experiment and concluded it for write research report and make a presentation to committee.

4.3 Data Collection & Data Analysis

The technique used for collecting data in this study was student self-assessment. The questionnaires used are self-rating on a 5 scale (1-5). The data were collected during before and after the Science Project course. Then, the results were compared and analyze by statistic

program. The questionnaires were designed into 5 items that include the creative skill, collaboration skill, communication skills, critical thinking skill as well as the ability to integrate knowledge to problem solving that obtained from the Science Project course. For example, of question; before and after you did the Science Project, what is the level score of your creative skills? Additionally, 4C's skill development of learners was assessed by advisor and research committee ratings.

5. Result and Discussion

5.1 The 4C's Skill Development of Science Project

From the results showed that the students thought Science Project can develop their 4C's skills. Moreover, after the student did the experiment in Science Project, the ability to integrate knowledge to problem solving increased too which score 4.01±0.78 from 5. Finally, the skills that students thought they have developed the most after do the Science Project are collaboration skills is 35%, creative skill is 34%, communication skill is 20% as well as critical thinking skill is 11% (figure 3).

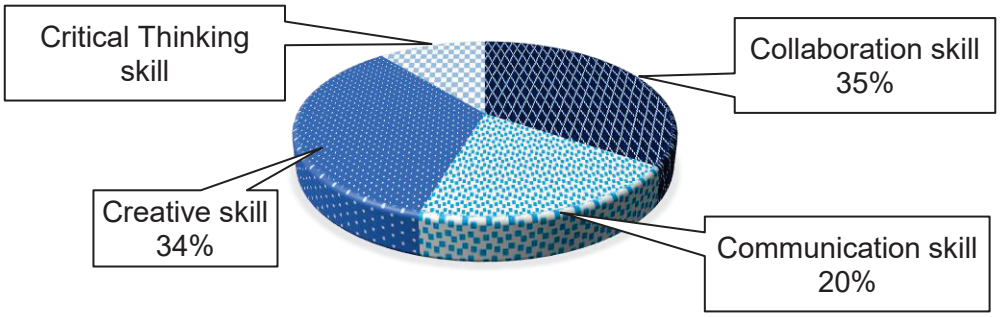

Figure 3. The 4C's Skills Development in Science Project Course

5.2 Self-Assessment Score about 4C's Skills Obtained from Science Project.

After the learners answered the questionnaire completely, the score of each skill before and after do the Science Project are presented in the table 2 and figure 4.

Table 2. *The Score of Each 4C's Skills Obtained from Self-Assessment of Student Before and After Done The Science Project.*

Items	Before (Mean±SD)	After (Mean±SD)
1. Creative skill The learners usually use creative skill for solve a problem that occur while their do the research, and creative skill was used to asking question during do the experiment as well as create the presentation through various platforms such as Canva and PPT.	3.33±0.77	4.14±0.65
2. Collaboration skill The learners thought that science project can develop their collaboration skill. Because while they were doing the research, they contacted to many people, such as research advisor and group member for work cooperate include brainstorm via online platforms.	3.57±0.91	4.13±0.77
3. Communication skill The learners developed a collaboration in group member during did the experiment, they had to increase communication skill. The learner used many applications for the communicate, such as Line, Facebook, Discord as well as zoom.	3.26±0.89	4.13±0.61

Table 2. *(Continue)*

Items	Before (Mean±SD)	After (Mean±SD)
4. Critical thinking skill The learners developed their critical thinking skill because when they had a problem during do the experiment, they had to use a critical thinking for analyze the problem and solve it. Sometimes, it also used in data analysis or search for reliable information through various online platform including Google scholar, Science Direct, etc.	3.44±0.87	4.17±0.71

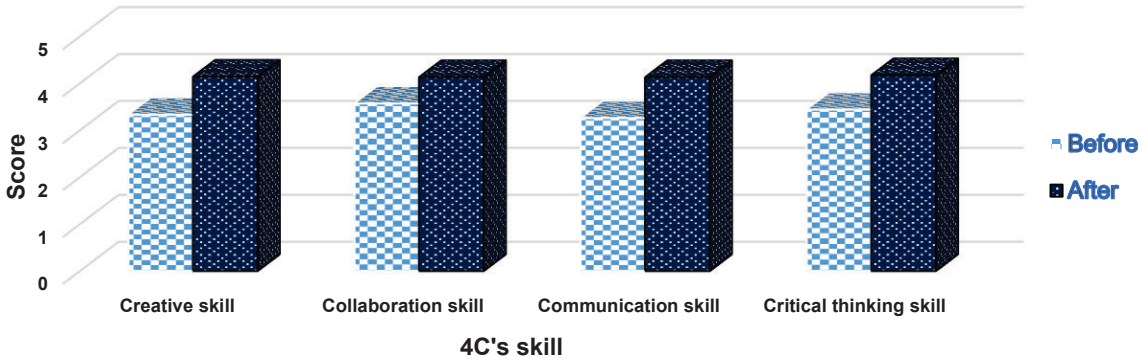

Figure 4. The Score of Each 4C's Skills Obtained from Self-Assessment of Student Before and After Done The Science Project.

6. Conclusion

From the results, author concluded that the learners could develop their 4C's skills, creative skills, collaboration skill, communication skill as well as critical thinking skill from do the Science Project. Moreover, the other significant skill that learners developed from doing the Science Project is an ability to integrate knowledge to solve other problems based on the reasonably. Therefore, learning design for student's 4C's skills development is an important role for learning in 21st century. Teachers should let them do some activities that allowed they think and solve problem with their classmate, rather than only focus on lecture-based learning.

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