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Enhancing 4Cs Skills of Secondary School Students Using Project-Based Learning

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Abstract

The purposes of this research were to create project-based learning (PjBL) activities and to improve the students' 4Cs skills using PjBL. The 4Cs of the learning skills assessment test and a record of student behavior serve as research tools. The mean and percentage are the statistics that were employed in the study. The results demonstrate that 1) students possess the 4Cs skills that passed the 70% criteria: communication skills (83.33%), critical thinking skills (70.83%), creativity skills (80.56%), and collaboration skills (85.42%). The examination of PjBL methodologies, with strongly suitable from three experts, includes step 1. Compose, step 2. Clarify, step 3. Comprehend, and step 4. Come Together.

Keywords: 4Cs skills, project-based learning, creativity, collaboration

1. Introduction

The educational paradigm has changed due to the fourth industrial revolution, which emphasized creating new knowledge and its innovative applications. Preparing a more innovative education system and increasing the competency of graduates with 21st-century skills is one of the crucial factors that must be considered to promote economic growth and the country's competitiveness in the fourth industrial revolution era (Zubaidah, 2018; Wahyuddin, 2022).

Nowadays, 21st-century skills are regarded as abilities that children should possess both now and in the future. According to Cyprian (2014), having 21st-century skills means being an innovator. The "4Cs" (creativity, communication, critical thinking, and collaboration) are among the 21st-century abilities that must be mastered for success in work, life, and citizenship. Partnership for 21st-Century Skills (P21) has proposed four categories of skills under the heading of "Learning and Innovation Skills": "Creativity and Innovation," "Critical Thinking and Problem Solving," "Communication," and "Collaboration" (Battelle for Kids, 2016). These abilities will prepare students for the complexity of life and work (Benek, 2022). According to the National Education Association's (2015) conclusion, developing citizens and employees equipped for the 21st-century plays a crucial role. The 4Cs skills must be thoroughly integrated into learning and teaching (Pardede, 2020). One of the recommended teaching methods in the curriculum to support the development of 4Cs skills is project-based learning (PjBL).

PjBL enhanced the 4 skills which had mentioned above. All skills are supported by sharing ideas, negotiating, and resolving conflicts. All need effective communication. Effective communicators play a key role and may help the success of group cooperation and problem-solving procedures (Bender, 2012). Hence communication skills should also be employed to present students' work or learning (Boss et al., 2013; Buck Institute for Education, 2019a, 2019c). In addition, people use their collaborative skills in PjBL. Accountability supports the team, respects others, and works with the group by coming to and keeping to agreements, planning work, and working as a whole team (Buck Institute for Education, 2019a). PjBL students had also urged to cooperate with the lecturers leading the project. Frequent contact, increasing student engagement, and classroom motivation predict

positive relationships between teachers and students (Pieratt, 2011; McCombs & Miller, 2007). It is possible to define critical thinking and problem-solving as the capacity to analyze queries and launch investigations to gather and assess data, make adjustments to alternatives, and consider the implications and alternatives (Buck Institute for Education, 2019c). Other markers are the capacity to define issues, make suggestions for remedies, put those suggestions into practice, and assess results. Boss et al. (2013) demonstrated that students might work toward an agreement as part of the problem-solving process, which "…takes patience, the capacity to listen to and learn from others, and a desire to match one's own needs with the people on the team" (Peterson, 1997). Creativity and innovation had primarily represented by the product, which is a student's solution to a problem that reflects an emerging state of knowledge. Examples include creating products, solving problems, improving products, and so on (Boss et al., 2013; Buck Institute for Education, 2019b). The definition of creative challenges, data attribution, data generation, concept selection, and presentations to users or prospects are all examples of creative and innovative skills (Buck Institute for Education, 2019b).

Since PjBL naturally promotes critical thinking, problem-solving abilities, teamwork, and leadership, it is seen as a potential strategy for developing skills for the 21st-century (Chu et al., 2017; Krajcik & Czerniak, 2018; Miller & Krajcik, 2019; Virtue & Hinnant-Crawford, 2019; Tsybulsky & Rozanov, 2021). PjBL is a teaching approach that involves students in the learning process and fosters their desire to explore important and relevant real-world topics or problems (Krajcik & Czerniak, 2018). PjBL has gained popularity in science education as a promising deep collaborative multidisciplinary learning method. This method involves students in real-world situations and "builds an iterative culture. Learners always prototype, reflect, redesign, revise, and evaluate," which is thought of as the core PjBL practices (Grossman et al., 2019). To ensure that students succeed in the rapidly evolving world of globalization, Cyprian (2014) argued that they should be exposed to PjBL. In other words, it makes it easier for people to develop information literacy, lifelong learning, collaborative skills, and critical thinking abilities (Alrajeh, 2021). Hence, the research objectives were to create science learning activities and to develop the 4Cs skills of secondary school students using project-based learning.

2. Method

2.1 Target Group

Eighteen secondary school students had collected as a target group using purposive sampling.

2.2 Variables Studied

The independent variable is former learning management using PjBL. The dependent variables are the developed PjBL managements and the 4Cs learning skills for grade 8 students after using the developed PjBL managements in science subjects.

2.3 Research Instruments

Three research instruments include:

2.3.1 PjBL on the main topic of substance separation in the science of grade 8. It consists of 8 learning management plans, which plan had taught in 2 hours (a total of 16 hours of the study period). Before using learning management plans, PjBL model suitability assessment was performed using a 5-point Likert scale (Harpe, 2015). Where a scale of 5 represented as strongly suitable, 4 represented as suitably, 3 represented as neutral, 2 represented as not suitable, and 1 represented as strongly not suitable.

2.3.2 The 4Cs of learning skills assessment on the main topic of substance separation. The scoring rubric is according to the criteria that assess all 4Cs skills, including communication, creative, analytical, and teamwork skills. There are 4 levels of score: 4, 3, 2, and 1, respectively. The total score is 16, and the criteria must pass 70 percent.

2.3.3 Student behavior observation forms on the main topic of substance separation. The data was written as a narrative of the student's learning behavior in groups and the student's outstanding behavior in different skills.

The above-mentioned 8 PjBL learning management plans, 4Cs of learning skills assessment, and student behavior observation forms were verified using the item-objective congruence index (IOC), where content experts rate individuals according to the degree to which they measure specific objectives listed by the test developer. A content expert will assess each item by assigning it a score for each objective, ranging from 1 (obviously measuring), -1 (clearly not measuring), or 0 (the degree to which it measures the content area is unknown).

2.4 Research Procedure

2.4.1 Review, analyze, and synthesize the theoretical framework of 4Cs skills.

2.4.2 Apply the theoretical framework of PjBL to encourage students to achieve the 4Cs skills to generate PjBL steps and activities according to the learning plan. Then, establish instructor roles and tasks.

2.4.3 Examine the first draft of PjBL activities.

2.4.4 The researchers asked three experts in science education, educational measurement and evaluation, and psychology education to check the correspondence between the items and components of the 4Cs.

2.4.5 Amend the PjBL activities based on expert opinions. Then, three experts revised the correspondence between 4C skills and PjBL design.

2.4.6 Implement PjBL activities (8 management plans, a total of 16 hours) to the target group and then collect data on the 4C skills of targeted students.

2.5 Data Analysis

The research data were analyzed using mean and percentage. The results of the 4Cs learning skill assessment higher than 70% were interpreted as passing the criteria. While the validity of PjBL activities was analyzed by a panel of three experts in science education, educational measurement, evaluation, and psychology education using the IOC. The IOC of the PjBL

activity plans had been categorized into two levels: correspondence of the PjBL and activities according to the learning plans and correspondence of learning plans to encourage students to achieve the 4Cs skills. The IOC verified the PjBL activity plans in two steps: (a) to ensure the content validity of the activity and (b) to clarify the quality of the activity. The items that had IOC scores lower than 0.5 were amended. While the items that had IOC scores higher than 0.5 were used.

3. Results

Development of learning activities in science on the topic of substance separation by using PjBL through the synthesis, according to Guilford (1956, 1967), shows the detail of the activities in Table 1.

Table 1. The process of project-based learning, which was designed by the researchers

Teaching steps	The meaning of each step	Teaching activities	The role of teachers
Step 1: Compose	Prepare students for the cerebral infraction, the state in which to be ready to learn.	Introduce the lesson as a mental education activity. Group the students according to the teacher's condition by using music.	The teacher acts as a facilitator to create an atmosphere of readiness.
Step 2: Clarify	Repeat the content for the students and start the activity to stimulate all 4 skills: creative thinking, analytical thinking, communication, and teamwork.	Repeat the content using 'the magic santol game' and 'the joyful coin game'. Those who want to answer the questions need to touch their ears. After that, the mission is called 'No No'.	The teacher acts as a facilitator, co-leaner, and coach. The teacher designs and facilitates the activity along with learning with the students.
Step 3: Comprehend	Present and summary the activity. This step lets the students help and design the presentation. After the presentation is completed, an evaluation will take place.	- Form a circle to talk with friends to see what they learned today. - Evaluate for development by using 2 stars and 1 hope.	The teacher acts as a mentor and coach using positive psychology. Admire the strengths of each group and let them see the success of their groups.
Step 4: Come together	Enter the news about the subjects to the students through various techniques to encourage the students to think and want to find out the answers.	- Storytelling - Roleplay - Being a reporter about extracting color from plants.	The teacher acts as a co-learner, facilitator, and coach. Facilitate the processes of question-answer, discussion, exchange of opinions, learning together with students, and inspire them.

After creating the synthesized learning activity, use it to create 8 learning plans on the topic of substance separation through conversation with teachers who have experience teaching science and research advisors.

Implement PjBL for 8 learning plans in grade 8; there are the details as follows:

Table 2. The results from the analysis of the 4Cs of learning skill assessment

4Cs Skills		**Percentage (%)**	**Criteria***
Communication	1. Speaking	86.11	Pass
	2. Reading	90.28	Pass
	3. Listening	84.72	Pass
	4. Writing	77.08	Pass
	5. Gesture	78.47	Pass
	Total Average	**83.33**	**Pass**
Critical thinking	1. Summary of knowledge	70.14	Pass
	2. Linking knowledge	70.83	Pass
	3. Classification	70.83	Pass
	4. Reasoning	71.53	Pass
	5. Problem-solving	70.83	Pass
	Total Average	**70.83**	**Pass**
Creativity	1. Fluent thinking	75.00	Pass
	2. Flexible thinking	75.69	Pass
	3. Originality	85.42	Pass
	4. Meticulous thinking	86.11	Pass
	Total Average	**80.56**	**Pass**
Collaboration	1. Planning the work	85.42	Pass
	2. Allocating the work	90.97	Pass
	3. Cooperation	87.50	Pass
	4. Giving opinions	85.42	Pass
	5. Solving problems within the group	77.78	Pass
	Total Average	**85.42**	**Pass**

Note. * Each 4Cs skill which higher than 70% represented a pass of the criteria.

It is found that the analysis of communication, critical thinking, creativity, and collaboration skills of grade 8 students after using PjBL on the topic of substance separation accounts for 83.33, 70.83, 80.56, and 85.42%, respectively. In conclusion, students have 4C skills higher than the criteria (70%) (Table 2).

4. Discussion

The development of learning activities in science by using PjBL to develop the 4Cs of learning skills for grade 8 students will discuss the following points.

(1) Development of learning activities in science using PjBL, divided into 8 learning management plans for 16 hours, student's project will focus on extracting natural dyes from plants. The learning management plans are divided into 4 steps: (1) Compose (2) Clarify (3) Comprehend and (4) Come Together. These learning management plans mainly focus on students because they have thought, designed, and searched for the answers themselves. Additionally, there are evaluations for development from teachers, students themselves, and peers. According to Ambrose et al. (2010), the teachers have responsibilities in each step such as coaching, mentors, facilitators, and learners alongside the students. Teachers fulfill the role of facilitators in creating an environment in the classroom where students are encouraged to take chances with their ideas, share their opinions, offer criticism of others' work, and make decisions to solve problems.

(2) Development of the 4Cs of learning a skill by organizing PjBL, which developed from PjBL for grade 8 students. According to the results, it was found that the students taught using PjBL had 4C learning skills higher than 70% of the set criteria. PjBL is a learning management plan focusing on developing creativity, critical thinking, communication, and collaboration skills. Step 1 of this learning management plan is Compose, which focuses on communication and creativity skills. The communication skill is focused on speaking and gesture. The creativity skill is focused on flexible thinking. The teacher uses open-ended questions from the media and situations the teacher assigned. At this point, prepare students to remain focused on the subject in front of them by using mental education activities, brain breaks, games, "what if" questions, or brain gyms (Watson & Kelso, 2014). Step 2 is Clarify, which focuses on all 4 skills, and the details are as follows: 1) Creativity skill focuses on fluent and original thinking; 2) Communication skill focuses on reading and writing; 3) Critical thinking skill focuses on the students' ability to classify and solve problems; 4) The collaboration skill involves planning and allocating work through group activities. Each group requires to have both male and female students. All members of the groups must participate in the activities to review the content of what they have learned. This activity focuses on active thinking through questions in the game with limited time. Therefore, the students must answer the questions correctly according to the specified time. The students need to do some activities or missions given by the teacher. Each student must try to understand all the content and conditions. The teacher encourages the students to understand the learning topic by explaining, playing, and giving examples to let the students learn and think independently. This activity focuses on creativity, communication, and collaboration skills by allowing students to exchange opinions, help each other, and work toward common goals. This part shows the fact that the students are engaged in activities under the conditions set by the teacher. The learners work through the problem-solving process with the teacher's assistance as a group. After a shared understanding, they are given rubric criteria to determine the level of the task's expectations. The learner should characterize the problem and explain where it came from once it has been discovered and realized (Payoungkiattikun et al., 2022).

Step 3 is Comprehend, which employs formative assessments using the 2-star and 1-hope techniques. Students evaluate their own work and remark on that of their peers, identifying two positive aspects of the work and one recommendation to improve it. This action gives everyone in the group a sense of importance. Learning has become more efficient because of students' ability to self-evaluate before, during, and after learning activities (Yusnaeni & Corebima, 2017). In addition, there is an idea to link the story at each stage according to the learning management activity in step 1, teachers use open-ended questions and information to review topics they have learned, which helps students acquire more 4C learning skills-according to Miriam and Chirstina (2017). Step 4 is Come Together, enter the news about the topics to the students using a variety of approaches to stimulate their thinking and desire to learn the solutions. Being a reporter about extracting color from plants was used for their project. Furthermore, storytelling and roleplay were also chosen in other learning management plans, in which storytelling is frequently used to share or exchange information and to improve a person's comprehension (Malita & Martin, 2010). The interaction between the storyteller and the listeners is connected through storytelling.

Hence, the 4Cs skills can be developed through PjBL, which results showed the average of 4Cs skills in the range of 70.83-85.42%. However, the critical thinking skill appeared to have a weak average of 70.83% due to the student's inability to evaluate the components involved in natural dyeing. The wrong mordants were chosen, which caused the fabric color to differ from what was intended. This problem became less prevalent when the procedure was adjusted by the teacher providing comments and having students identify the issue and develop solutions. Although, a few students persisted in using the same technique and made the incorrect choice of mordant, which led to a significant divergence from the anticipated pattern. The PjBL approach enables students to complete the assessment requirements for each activity with a distinct emphasis on skills. Thus, PjBL allows students to improve the 4Cs and focuses primarily on students. The use of positive psychology is another part that helps students become enthusiastic. PjBL shows the progress of each student, including thinking and expression. According to the specified topic in learning activities in the classroom, the teacher records the students' behavior from the observation. From the recording of students' behavior, it can be concluded that the students with creative skills are those who dare to think and express themselves. Answering open-ended questions often make the students have different views from others. There are always discussions and answers with the teachers during learning activities. In group activities, they tend to show different perspectives and add opinions to make others clearer about the topic. Additionally, they advise their classmates to do projects with resources they may find in their neighborhood.

The students with communication skills are assertive and usually the first ones to answer the teacher. They are not afraid to answer questions and listen attentively to everything in the class, which makes them able to convey work through writing and speaking. The students who have critical thinking skills are active listeners. They wait to answer questions and have a different order of thinking than their friends. They always have a systematic plan and notes on hand before work. When the teacher gives tasks or conditions, students with collaboration skills often plan and allocate their work within the group. They can adapt to their

surroundings to solve problems.

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