

Integration of 4Cs Skills into Learning by Using the Project Based Learning (PjBL) Model to Face the Challenges of the 21st Century: Systematic Overview

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Abstract—The world of education is currently growing, demanding very fast and significant changes in various fields including education. The learning model itself is learning that does not only involve technology in it. But rather to change the paradigm that students are not passive objects who must be able to use technology alone. This demand is certainly not an easy thing for teachers to fulfill. The current learning process is expected to be able to form students who have soft skills to face the 21st century, known as 4C (Communication, Collaboration, Critical thinking and Problem Solving, and Creativity and Innovation). This study aims to explain how to integrate 4Cs Skills into Learning by Using the Project Based Learning (PjBL) Model to Face the Challenges of the 21st Century. The PjBL model is one model that can bridge the achievement of 4Cs Skills in learning. In PjBL, students go through a broader process of inquiry to respond to complex questions, problems, or challenges.

Keywords—4Cs skills, model project based learning (PjBL)

I. INTRODUCTION

The world that is undergoing rapid change requires every individual to be prepared to face unexpected challenges in the future [1]. Today's conditions with intense competition, rapid dissemination of information, massive technological developments, and globalization have changed the way people live, interact, and work [2]. These changes may lead us to bigger changes in the future. The development of technology is one of the factors that can support and improve the quality of education and help educators and students in the learning process [3]. Bowes et al in Smaldino's book state that "Teachers are required to be proficient in the use of technology in their teaching," [4]. This is especially important when dealing with 21st century learners and teaching them skills, because teachers must not only efficiently use technology in the classroom, but also help students in effectively using these tools to enhance the learning process [4].

Critical thinking skills and creativity are essential to enable a person to solve problems, while collaboration and communication skills are important to enable him to interact and collaborate with others. The world of education is required to be able to prepare the next generation who can keep up with the times, and even become actors in the next development process. For education reform, the partnership for 21st Century Learning establishes a "Framework for 21st Century Education" and identifies 18 critical skills for student success [5]. According to Association [6], there are 18 different types of 21st century skills that must be provided to students, but aspects of the Learning and Innovation Skills-4Cs, namely critical thinking, communication, collaboration/cooperation, and creativity, are the most critical aspects of skills that students in primary to secondary education must master.

The PjBL learning model designed will be developed more operationally so that it is easy and interesting to apply to the learning process. The development of the PjBL learning model is based on contributing to the results of learning designs that are in accordance with the needs in the field that can develop problem-solving skills and are technology-based. Learners are trained to carry out scientific processes to develop process skills which are closely related to 4Cs Skills. The teacher acts as the largest source of information who always explains concepts and utilizes learning resources based on 21st century technology such as the internet and the surrounding environment. The PjBL model is one model that can bridge the achievement of 4Cs Skills in learning. In PjBL, students go through a wider inquiry process in responding to complex questions, problems, or challenges [7].

II. LITERATURE

A. 21st Century Learning

21st century learning is a conceptual framework that appears in line with the phenomena of life that exist and develop today in the 21st century. Statements in the context of 21st century learning in Indonesia itself have the right place in the context of achieving the 2045 golden generation through the implementation of an effective learning process, optimal, and innovative in today's modern paradigm [1,8]. The changing learning paradigm that is currently developing is implemented through the development of the 2013 revised 2017 curriculum which contains several things that can develop 21st century skills in the learning process, including HOTS, 4C skills and digital skills [3,9]. In the process, a series of lessons that have adapted the 2013 revised 2017 curriculum model can be seen in the conceptual framework of reference issued, namely government regulation number 13 of 2015 concerning the second amendment to PPa Number 19 of 2005 concerning National Education Standards [10].

B. 4Cs Skills

To make the 4Cs easy to achieve, the following definitions and criteria are given for each aspect [5,11,12]:

1) *Critical thinking*: Critical thinking and problem solving can be described in a variety of ways, P21 (Partnership for 21st) defines critical thinking as follows [5]:

a) *Reasoning effectively*: Adapting multiple modes of reasoning (inductive, deductive, etc.) to the context.

b) *Using systems thinking*: Examining how parts of a whole interact with one another to produce all outcomes in complex systems.

c) *Make judgments and decisions*: (1) effectively analyze and evaluate evidence, opinions, claims, and beliefs; (2) analyze and evaluate the major alternative viewpoints; (3) synthesize and make connections between information and opinions; (4) interpret information and describe decisions based on the results of the analysis; and (5) reflect critically on the learning experience and process.

d) *Solving problems*: (1) solve a variety of unexpected challenges in conventional and innovative ways; and (2) identify and ask significant questions that clarify different points of view and lead to better solutions.

2) *Communication*: Communication can be described in various ways, but P21 describes communication skills as communicating clearly, which includes the following criteria [11,12]:

- Good at expressing ideas and thoughts effectively both orally, in writing, and nonverbally in various forms and contexts.
- Effectively listen to describe meaning, knowledge, values, attitudes, and interests.

- Use communication for a variety of purposes (such as to inform, instruct, motivate, and persuade).
- Use multiple levels of media and technology and know how to measure their impact and efficiency.
- Communicate effectively in a variety of settings (including multilingual and multicultural).

3) *Collaboration*: Collaboration can be defined in various ways, but P21 defines communication skills as collaborating with others which include [11,12]:

- Demonstrated capacity to work effectively and responsibly with diverse teams.
- Practice flexibility and willingness to assist in making important decisions to achieve common goals.
- Take shared responsibility for collaborative work, and value individual contributions by each team member.

4) *Creativity*: Creativity can be described in various ways, but P21 defines creativity skills as follows [11,12]:

a) *Think creatively*: (1) employ a variety of idea generation techniques (for example, brainstorming); (2) generate new and useful ideas (both additional and fundamental concepts); and (3) elaborate, refine, analyze, and evaluate original ideas in order to improve and expand creative endeavors.

b) *Collaborating creatively with others to develop, implement, and effectively communicate new ideas includes the following*: (1) developing new ideas; (2) incorporating new ideas and perspectives into work and receiving feedback; (3) showing originality and inventiveness in work; (4) understanding the limitations of the real world to promote new ideas; and (5) viewing failure as a learning opportunity; understanding that creativity and innovation are a long-term process.

c) *Implementing innovation*: putting creative ideas into action in order to create a positive impact on the area of innovation.

C. Project-Based Learning

In developed countries like the United States, project-based learning is a widely used learning model. According to The George Lucas Educational Foundation, a comprehensive definition of project-based learning is as follows [7,13,14]:

- Project-based learning is curriculum fueled and standards based. Curriculum-driven and standards-based education is what project-based learning is all about. Project-based learning is a teaching method that requires content standards to be included in the curriculum. The inquiry process is initiated by posing a guiding question and guiding students through a collaborative project that integrates multiple subject areas across the curriculum. When questions are answered, students gain an understanding of the various

major elements and principles that comprise the discipline being studied [13,14].

- Project-based Learning elicits an answer from each student by posing a question or posing a problem. An important aspect of project-based education (PBL) is that the teacher or student develops an underlying question. Using this model, students can explore content in ways that are meaningful to them and to carry out cooperative experiments in accordance with their individual learning styles. This finally enables each student to respond to the guiding questions [7,15]. Students are tasked with investigating issues and topics that address real-world problems while integrating subjects from across the curriculum.
- Project-based learning entails an in-depth examination of a real-world issue, which is beneficial for students' attention and effort. This method requires students to construct "bridges" between disparate material subjects [7,13,16]. Thomas, the Buck Institute for Education, and the National Academy Foundation states the same thing: "Well-designed projects require students to: Tackle real problems and issues that affect people beyond the classroom," implying that a well-designed project requires students to overcome real problems and significant societal challenges that arise outside the classroom. So that projects built by students based on observations of real-world problems around them will provide meaning for them [7].
- Project-based learning is a method that encourages students to engage in abstract, intellectual tasks to investigate complex issues. Project-based learning is a method of instruction that emphasizes comprehension [13]. Students explore, assess, interpret and synthesize information in a meaningful way [13,16].

III. METHODOLOGY

A. Looking for Strategy

In identifying eligible articles, the author uses three strategies. First, the authors searched for articles in the top three publishers in the field of education (Science Direct, Taylor and Francis and SAGE Publications). The search used the search keywords "4Cs Skills" and "Model Project Based Learning (PjBL)" in any field and limited the search to the period January 2015 to December 2021, resulting in 350 articles.

Second, authors conducted a search using different keywords but had the same meaning. This is to ensure that there are articles that are relevant to the research objectives. The author uses keywords such as "Project learning". This search returned 7 articles. The author tries to find articles citing the Project-Based Learning theory which was first proposed by John Dewey in 1902. The search yielded 25 articles. The use of these various strategies is helpful in ensuring that all included studies are eligible.

B. Inclusion/Exclusion Criteria

The author identifies 6 inclusion criteria that will be included in the literature study of this research. This criterion was inspired by a previously conducted systematic literature review.

- 1) *Topic centrality*: Project-based learning is the main focus of the article, meaning the authors will exclude studies that include PjBL and 4Cs interventions as not the main topic.
- 2) *Respondents*: The research subjects must be students of Vocational secondary education (SMK). This means that the author excludes research where the respondents in the study are not students in the high school group.
- 3) *Study design*: The authors include empirical and theoretical studies, as the authors are interested in seeing how the concept of Project-based Learning is defined in both types of research. All research designs (case studies, experiments, etc.) are allowed.
- 4) *Year of publication*: The authors included all studies published in the period January 2015 to December 2021.
- 5) *Language*: The author only includes studies written in English.
- 6) *Publication status*: To ensure that the articles under study are of high quality, the publication status of the selected papers is research that has been reviewed and published in a reputable journal.

C. Selection Process for Submitting Articles

The authors selected 350 studies in a systematic way using the four search strategies described previously. In accordance with the criteria for inclusion/exclusion. The selection process is represented in Figure 1.

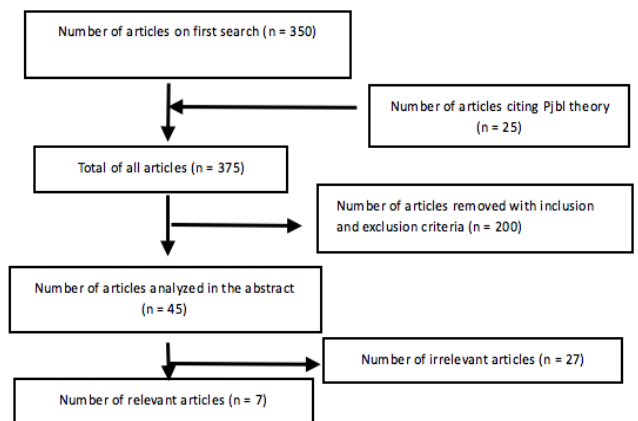


Fig. 1. Selection process.

First, the writer found 350 articles using three search strategies. Then the writer filtered all article titles using the selection stage diagram above and excluded 200 studies that did not meet the criteria based on article titles. This leaves a total of 45 articles. Next, the authors screened the studies by reading the complete abstracts of all articles. In this step, the

authors excluded 27 articles. This is to ensure the focus of this research on the integration of 4Cs Skills into learning using the Project Based Learning (PjBL) model to face the 21st century. So that this selection process resulted in 7 articles which will be analyzed in this study.

IV. RESULTS AND DISCUSSION

A. Journals and Publishers

The process of selecting articles by the author resulted in 7 studies. Referring to the inclusion and exclusion criteria, all articles in this study raised the topic of Integration of 4Cs Skills into PjBL Learning. The article data that became the author's findings are presented in the following table.

TABLE I. JOURNAL AND PUBLICATION YEAR

Article Code	Title	Journal	Publisher	Year
SG 01	Fundamentals of Automation Engineering: A hybrid project-based learning approach	International Journal of Electrical Engineering & Education (IJEED)	SAGE	2020
SG 02	Project-based Learning and Information and technology's integration: Impacts on motivation	International Journal of Electrical Engineering & Education (IJEED)	SAGE	2018
SD 02	A review of project-based learning in higher education: student outcomes and measures	International Journal of Educational research	Science Direct	2020
SD 03	Project Based Learning Methodologies Applied to Large Groups of Students: Airplane Design in a Concurrent Engineering Context	International federation of Automatic Control (IFAC)	Science Direct	2015
SD 04	A matter of connection: The 4 Cs of learning in pre- service teacher education for sustainability	Journal of Cleaner Production	Science Direct	2021
TF 05	Tales from PE: Using Project-Basee Learning to Develop 21st-Century Skills in PETE Programs	Strategies Journal	Taylor & Francis	2020
TF 06	Students' and teachers' critical thinking in science education: are they related to each other and with physics achievement?	Research in Science & Technological Education	Taylor & Francis	2021

From the table above, these 7 studies were published by 3 reputable and Scopus indexed journal publishers, namely Science Direct, Taylor and Francis and SAGE Publications. Seven studies were published in the International Journal of Electrical Engineering & Education (IJEED) [17,18], International Journal of Educational research [19], International federation of Automatic Control (IFAC) [20], Journal of

Cleaner Production [21], Strategies Journal [22], Research in Science and Technological Education [23].

B. Design, Location, and Research of the Subject

The following table presents the location, research design used by the authors and participants involved in the study.

TABLE II. STUDY OF DESIGN AND PARTICIPANTS

Article Code	Study of Design	Country	Participants
SG 01	Desain kuasi-eksperimental,	Belanda	54 students
SG 02	Quasi Experimental Design (pretest dan posttest with control group)	Aljazair	32 students
SD 02	Literatur Review	Belanda	76 papers
SD 03	Desain kuasi-eksperimental,	Spanyol	141 students
SD 04	Studi kasus tunggal eksplanatori	Jerman	122 students
TF 05	Desain Kuasi-Eksperimental	North Ireland	25 students
TF 06	Model multilevel	China	46.820 students

Among the 7 articles studied in this paper, 78% of articles used an experimental design (n=4) and 4 studies used an experimental design, 1 study used a Literature Review design, 1 study used a multilevel model and 1 study used an explanatory single case study design. This type of research design will provide fairly accurate data and will greatly assist researchers in answering research questions. Most of the multilevel model methods in research use test instruments for data collection [23]. As in the study the measurement was carried out on the pretest, post-test of 46,820 students using the student characteristics decision-making effectiveness scale [23]. Then research [20] conducted a study to measure the characteristics of students using statistical analysis and found a significant difference in the relationship between students' and teachers' critical thinking. Another quantitative study with experimental design was also carried out by measuring the effect of the level of involvement on students on projects that have been carried out collaboratively on students. [18,20,22,24]. While the quantitative descriptive research conducted by Mammar Belagra [18] was conducted by distributing questionnaires to respondents and then processing the data and scores using statistical analysis and scores. When viewed from the research location, research on the integration of 4Cs Skills into the Project Based Learning (PjBL) learning model is mostly carried out in China [23] and Spain [20], each with 22%. Another 5 studies were conducted in the Netherlands (2 studies), Algeria, Germany, and Northern Ireland.

C. Research Objectives and Findings

The following table presents the authors of the articles, objectives, and research findings.

TABLE III. RESEARCH OBJECTIVES AND FINDINGS

Article Code	Author	Purpose	Findings
SG 01	Devika Kataria, Gustavo Sanchez dan Siddharta Govindasamy	Evaluating the benefits and challenges of various automation technologies and develop complete solutions to simple automation problems	The level of student involvement in all of these activities was high and it was found that although the project was carried out collaboratively, individual student learning could be assessed and feedback provided if needed.
SG 02	Mammar Belagra, Belkacem Draoui	This research studies the effect of project-based learning, information and communication technology on students' learning motivation.	The integration of ICT in a project-based learning approach will likely increase student motivation in the 2nd year of the electrical major.
SD 02	Penyeu Guo, Nadira Saab, Lysanne S. Post, Wilfried Admiraal	Students are given the chance to participate in real problem solving and knowledge construction in an authentic professional context.	Creating a product is important because it will help students to integrate and reconstruct their knowledge and improve their skills and interests in disciplines and abilities.
SD 03	Sergio Esteban, Manuel Ruiz Arahall	Providing students with the tools needed to monitor and manage courses and the ability to meet deadlines.	By using all the tools that teachers have. Together with the right organizational tools to ensure student learning processes, PjBL Education methods can be extended to groups of students.
SD 04	Jan-ole Brandt A, Matthias Barth A, Eileen Merritt B, Annie Hale C	Connecting a learning outcome with the learning process or how students learn to be able to uncover the concrete mechanisms of specific teaching and learning formats.	The investigated courses are characterized by special conditions that do not always apply, not only are the courses required for all Basic Education majors, but the financial resources that have been collected.
TF 05	Luiz Estrada Oliver, Lizmarie Rodrigurz dan Ambar Pagan	Describing an application of PjBL in the PETE program to develop 4 C's for 21st century education	Structural PjBL makes it possible to deeply engage and experience the real problems they may face on their PETE journey.
TF 06	Xin Ma, Yin Zhang, dan Xingkai Luo	Examining two important issues of critical thinking (the relationship between student and teacher critical thinking and the relationship between critical thinking and scientific achievement).	After controlling for the characteristics of students, teachers, and schools. Although Chinese eighth graders showed statistically significant critical thinking, and there was no statistically significant relationship.

D. Discussion

The PjBL (Project Based Learning) method is based on John Dewey's concept of "Learning By Doing", which is the process of achieving learning outcomes through the execution of specific actions consistent with the objectives [25]. Democratic classrooms mean that students are divided into small groups to complete interesting projects of their own choosing. Meanwhile, several studies discussed in this study provide a significant picture of the effect of implementing PjBL (Project Based Learning) in improving the 4 Cs (Communication, Collaboration, Critical Thinking and Problem Solving, and Creativity and Innovation) and preparing themselves to face the world of work and face the challenges of the 21st Century so that they are better prepared in making career decisions [14].

V. CONCLUSION

4Cs Skills can be integrated into the process, so that learning can be a potential tool to form a generation that is able to face the challenges of the 21st century [26]. The PjBL model is one model that can bridge the achievement of 4Cs Skills in learning [9]. In PjBL, students go through a wider inquiry process to respond to complex questions, problems, or challenges [9]. The syntax of this model is as follows: Commence with the most critical question, organize your efforts by creating a project plan. Create a schedule, Maintain an eye on the students and the progress of the project. Analyze the outcome, and Evaluate the encounter [27]. To guide

teachers in planning, organizing, and evaluating projects that lead to the achievement of 4Cs Skills, each stage must consider three aspects, namely design, develop, and determine [16]. In the early stages, the teacher must design a project [28] that leads to the emergence of 4Cs Skills opportunities. After that, build students' skills for a project by providing an understanding of how each aspect of the 4Cs Skills characterizes and provides the steps to achieve it. In the end, the teacher determines the outcome of the project work by assessing how well the students have learned the 4Cs Skills with a balanced approach [12,29].

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