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Evaluation of Program on Basic Sciences Courses in Elementary School Teacher Education's Singkawang

Eka Murdani[1], Susbiyanto Susbiyanto[2,*], Rendi Restiana Sukardi[3], Berry Kurnia Vilmala[4], Irwan Muhammad Ridwan[5], Titiyaka Binti Jajuri[6]
[1]Department of Elementary School Teacher Education, Singkawang International Busisness and Science Institute, Kalimantan Barat, Indonesia
[2]Department of Science Education, Indonesian Education University, Jawa Barat, Indonesia
[3]Department of Elementary School Teacher Education, Indonesian Education University, Jawa Barat, Indonesia
[4]Department of Physics Education, Riau Muhammadiyah University, Riau, Indonesia
[5]Department of Physics Education, Siliwangi University, Jawa Barat, Indonesia
[6]Departement of Educational Studies, Malaysian Science University, Selangor, Malaysia

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ABSTRACT

Purpose of the study: The purpose of this study is to evaluate the Basic Sciences courses by examining their effectiveness in developing 21st-century skills, particularly the 4Cs (critical thinking, communication, collaboration, and creativity). This evaluation aims to ensure that the courses not only measure knowledge but also assess essential competencies for future learning and work.

Methodology: This study employed the CIPP (Context–Input–Process–Product) evaluation model. The evaluators developed and implemented a Project-Based Learning (PjBL) model integrated with 4C competencies, abbreviated as PjBL4C. Data were collected through lesson plan analysis, pre-tests and post-tests for content knowledge and 4Cs, and performance assessments of communication and collaboration skills. Student satisfaction was also measured using a structured questionnaire.

Main Findings: The implementation of the PjBL4C model in Basic Sciences courses showed a significant improvement in students' achievement and 4C competencies. The number of students reaching the standard level increased based on pre-test and post-test results. At the end of the course, the evaluation successfully identified the overall 4C profiles of students categorized into three levels: below, approaching, and at standard.

Novelty/Originality of this study: This study introduces PjBL4C as an innovative instructional model that simultaneously develops and measures 4C skills in higher education. Additionally, the 4C assessment instrument was designed and aligned with the PjBL syntax, enabling accurate classification of students' competencies across multiple skill domains.

Corresponding Author:
Susbiyanto,
Department of Science Education, Faculty of Mathematics and Natural Sciences Education, Indonesian Education University, Bandung, 40154, Indonesia
Email: susbiyanto@upi.edu

1. INTRODUCTION

Higher education in the 21st century is required to prepare graduates who are not only knowledgeable but also equipped with the competencies necessary to navigate rapid global transformations. Among the most essential of these are the 21st-century skills, commonly referred to as the 4C—creativity, critical thinking, communication, and collaboration [1]–[3]. These competencies have become central to the learning outcomes of undergraduate programs, particularly in teacher education, where future educators are expected to model and nurture these skills in school environments. However, integrating 4C into learning outcomes alone is insufficient unless supported by curriculum design, pedagogical approaches, and assessment strategies that explicitly cultivate and measure them [4].

Previous studies have emphasized the importance of embedding 4C within higher education but have largely focused on general curriculum frameworks, teacher perceptions, or overall student outcomes [1]–[4]. Few have examined how 4C competencies are operationalized and assessed at the course level, particularly in contexts where they are already mandated in institutional outcomes but inconsistently practiced. This lacks of course-level evaluation represents a critical gap, as effective 4C development depends not only on institutional policy but also on classroom implementation and measurement.

In the Indonesian context, the Elementary School Teacher Education (PGSD) Study Program at ISBI Singkawang formally includes 4C in its graduate learning outcomes. Yet, feedback from principals and teachers who serve as users of program graduates indicates that alumni still struggle to demonstrate these competencies effectively in professional practice. An initial review of the Basic Sciences course revealed that while learning objectives explicitly target 4C development, actual learning and assessment remain dominated by cognitive and knowledge-based activities. This discrepancy between intended outcomes and classroom implementation highlights the critical need for higher education, particularly teacher education programs, to effectively develop the 21st-century competencies critical thinking, creativity, communication, and collaboration (4C) that are essential for future educators. Although these competencies have been formally integrated into curriculum documents, their practical application and assessment remain superficial and fragmented. Therefore, this study is urgently needed to conduct a systematic program evaluation using the CIPP model and to introduce an innovative instructional framework, Project-Based Learning for 4C (PjBL4C), as a pedagogical solution to bridge the gap between policy and practice, ensuring that future teachers acquire authentic 4C skills necessary for fostering adaptive, collaborative, and creative learners in the rapidly evolving educational landscape.

To address this gap, the present study employs the CIPP (Context–Input–Process–Product) evaluation model to comprehensively assess the implementation of the Basic Sciences course in relation to 4C integration. Furthermore, the study introduces an instructional innovation, Project-Based Learning for 4C (PjBL4C) as a solution to strengthen students' 21st-century skills through authentic, inquiry-driven projects. Specifically, this research aims to (1) evaluate the alignment between the course's objectives, instructional strategies, and assessment of 4C skills; (2) measure students' competency improvements through pretest–posttest analysis; and (3) formulate evidence-based recommendations for optimizing 4C-oriented learning in teacher education programs.

2. RESEARCH METHOD

This study employed a program evaluation design using the CIPP (Context–Input–Process–Product) model [5]. Study for systematically to assess the implementation of the Basic Sciences course in the Elementary School Teacher Education (PGSD) Study Program at ISBI Singkawang. The CIPP framework was chosen because it allows for a comprehensive examination of program relevance, resources, instructional implementation, and learning outcomes, particularly in relation to 21st century competencies (4C: creativity, critical thinking, communication, and collaboration). In this evaluation, because it was known that the lecture methods used so far were limited to demonstration, discussion, and problem analysis methods where lecturers had not yet captured the entire 4C profile of students, the researcher offered a learning innovation solution through the application of the Project Based Learning (PjBL) model [6]. PjBL was developed based on 4C abbreviated as PjBL4C to provide 21st-century 4C skills in Basic Sciences courses. The study further tested the potential of Project-Based Learning for 4C (PjBL4C) as a pedagogical solution. PjBL4C was structured to foster 4C competencies through authentic projects that required critical inquiry, creativity, effective communication, and collaboration. The rubric-based instrument ensured that each competency was explicitly measured at different performance levels, allowing for systematic evaluation of students' skill development.

The evaluation involved 100 fourth-semester students enrolled in the Basic Sciences course during the 2025 academic year. In addition, the course lecturer was included as a key informant, while school principals and teachers who work with graduates provided supplementary perspectives as users of alumni competencies. The Basic Sciences course was selected due to its explicit inclusion of 4C in the learning outcomes, yet lack of systematic assessment of these skills.

The primary instrument was a rubric-based test designed to measure students' 4C competencies through pretest and posttest administration. Each of the four competencies (critical thinking, creativity, communication, collaboration) was measured using three performance levels: (1) Below Standard: skills not yet demonstrated adequately, (2) Approaching Standard: partial demonstration of skills with some weaknesses, (3) Standard: full demonstration of skills at the expected level. The instrument consisted of performance tasks and questions aligned with the phases of PjBL4C. To ensure content validity, the rubric and test items were reviewed through expert judgment by seven validators (subject matter experts and educational practitioners). Their feedback was incorporated into the final version of the instrument.

The evaluation included two stages of data collection: (1) Pretest: administered before the PjBL4C intervention to establish students' baseline 4C profiles. (2) Posttest: administered after the course to assess the development of 4C competencies by essay test that validated by expert judgement. Additional data sources included document analysis (lesson plans and course syllabus) by interviewing the lecturer of basic science course and interviewing the students to capture perceptions of the learning process presented in Table 1.

Table 1. Interview questions with lecturers and students to determine perceptions of the learning process

No.	Respondent	Focus of Interview	Questions
1	Lecturer	Integration of 4C Competencies in Teaching	1. How do you integrate the 4C competencies (critical thinking, creativity, communication, collaboration) into your Basic Sciences teaching practices? 2. What teaching strategies or learning models have you used to promote students' 4C skills? 3. How do you ensure that students have opportunities to develop all four competencies during class activities?
2	Lecturer	Implementation of PjBL4C Model	1. How is the Project-Based Learning for 4C (PjBL4C) model implemented in your course sessions? 2. What challenges have you encountered in guiding students through each phase of the PjBL4C syntax? 3. How do you assess students' performance and 4C development during the learning process? 4. How effective do you perceive the PjBL4C approach in enhancing students' engagement and learning outcomes?
3	Lecturer	Evaluation and Reflection	1. How do you evaluate the success of your students in achieving 4C competencies? 2. What improvements do you plan to make for future implementation of 4C-oriented learning? 3. In your opinion, how can institutional support strengthen the integration of 4C in teacher education programs?
4	Students	Learning Experience	1. How do you feel about learning through the Project-Based Learning for 4C (PjBL4C) model in the Basic Sciences course? 2. Which activities helped you most in improving your critical thinking and creativity? 3. How did collaboration and communication within your group affect your learning experience? 4. What challenges did you encounter while working on project-based tasks?
5	Students	Perception of 4C Skill Development	1. Do you think this course helped you develop your critical thinking, creativity, communication, and collaboration skills? Please explain. 2. How confident are you now in expressing ideas and working with peers compared to before the course? 3. What aspects of the learning process motivated you to participate more actively?
6	Students	Feedback and Suggestions	1. What parts of the PjBL4C activities did you find most interesting or beneficial? 2. What challenges do you think should be improved in future classes? 3. 3. How do you think this kind of learning prepares you for your future role as a teacher?

The CIPP framework guided the analysis: (1) Context: examined the alignment between institutional objectives and 4C integration in course outcomes. (2) Input: assessed curriculum design, lecturer readiness, and learning resources. (3) Process: evaluated how PjBL4C phases were implemented in practice and the extent to which they facilitated 4C development. (4) Product: analyzed the learning outcomes from pretest–posttest results, focusing on students' progression across the performance levels of 4C. Descriptive statistics were used to profile student achievement of 4C level (below, approach, and at standard) in the form of the number of students who have that level before and after based on pretest and posttest. The level is determined based on the student's answers to the essay test, where the leveling is based on the suitability of the answers to the rubric of the 4C as follows the PjBL syntax.

3. RESULTS AND DISCUSSION

Data collected from the evaluation of the Basic Sciences course were analyzed using the four components of the CIPP model: Context, Input, Process, and Product. This section presents quantitative and qualitative findings that collectively explain how the Project-Based Learning for 4C (PjBL4C) model enhanced students' 21st-century skills: critical thinking, creativity, communication, and collaboration, through authentic learning activities. Data collected in the Basic Sciences Course Evaluation was grouped into four sections: context, input, process, and product. Then, each section was evaluated. The last discuss about PjBL4C as a one of the alternative solution of the learning methods of the Basic Sciences course for guiding and fostering the 4C of the 21st Century Skills.

3.1. Evaluation of Context

The CIPP framework guided the analysis for evaluating the context is to examined the alignment between institutional objectives and 4C integration in course outcomes. The context aspects that were evaluated are given in Table 2.

Table 2. Aspects of the context evaluated

Object/Focus	Information Type	Data Collecting Method	Data Source
Learning	Curriculum, lesson plan	Review of curriculum document and lesson plan, interview and observation	Lecturer and students
Assessment	Assessment and its rubric (form, instrument, scoring guiding)	Review of Assessment Instrument, Test Given, and Interview	Lecturer and students

The data collected through document analysis, observation, and interviews provided an overview of how the Basic Sciences course was aligned with institutional expectations regarding 4C integration. This triangulation process allowed the evaluator to identify the extent to which curriculum documents, lesson plans, and assessment instruments supported the development of critical thinking, creativity, communication, and collaboration (Table 2).

The context evaluation showed that the institutional and program learning outcomes of the PGSD ISBI Singkawang Study Program explicitly integrated the 4C competencies as part of graduate attributes. However, prior to the intervention, teaching or learning and assessment in the Basic Sciences course were still largely dominated by cognitive-based activities. Although lesson plans included 4C related objectives, no systematic assessment tools existed to capture students' actual competencies. This finding aligns with previous studies reporting that 4C skills are often well-articulated in curriculum documents but poorly operationalized in classroom practice [1–3]. These conditions justify the introduction of a new instructional approach. PjBL4C as a model that explicitly targets 4C development throughout the learning process.

3.2 Evaluation of Input

The CIPP framework guided the analysis for evaluating the input is to assessed curriculum design, lecturer readiness, and learning resources. The input aspects that were evaluated are given in Table 3.

Table 3. Input aspects evaluated

Object/Focus	Information Type	Data Collecting Method	Data Source
Learning preparation	Lesson plan (suitable learning method and availability of instruments to measure learning outcomes)	Lesson plan review, interview	Lecturer and students
Student readiness	Preliminary of knowledge and response	Pretest and observation	Students

The input evaluation (Table 3) analyzed on curriculum and lesson plan or instructional documents, learning resources, lecturer preparation, student readiness, and the 4C assessment instrument. The lecturer's instructional strategy previously relied on demonstration, discussion, and limited problem analysis, which lacked opportunities for sustained inquiry and collaborative learning. The redesigned PjBL4C model incorporated explicit phases for fostering the 4C skills.

3.3 Evaluation of Process
The CIPP framework guided the analysis for evaluating the process is to evaluated how PjBL4C phases were implemented in practice and the extent to which they facilitated 4C development. The process aspects that were evaluated are given in Table 4.

Table 4. Process aspects evaluated

Object/Focus	Information Type	Data Collecting Method	Data Source
Learning by lecturer	Learning methods	Interview, Observation	Lecturer
Oral communication and collaboration skills	Oral communication and collaboration skills	Observation	Student
Learning interaction	Learning process	Performance assessment	Lecturer and student

The learning method used by lecturer in Basic Sciences courses based on the results of interviews with lecturer and learning observation that learning is dominated by expository methods by combining lectures, discussions, questions and answers, homeworks and case studies of science problems by answering science questions that are mostly calculation questions with formulas from science, physics, chemistry, and biology. This method is still unable to provide 4C skills of 21st-century powerfully because the evaluator did not find evidence of a portrait of the 4C profile of students at the end of the Basic Science course. Lecturer only measure content knowledge at the end of learning even though 4C skills are learning outcomes in Basic Sciences courses. Therefore, a suitable learning method solution is needed that is able to provide 4C skills. The evaluator offers a solution by developing a Project Based Learning model based and oriented towards 4C called PjBL4C along with its assessment. PjBL4C was developed by integrating all 4C skill indicators into the steps or syntax of the PjBL model.

3.4 Evaluation of Product
The CIPP framework guided the analysis for evaluating the product is to analyzed the learning outcomes from pretest–posttest results, focusing on students' progression across the performance levels of 4C. The products referred to learning products. The product aspects evaluated are shown in Table 5.

Table 5. Product aspects evaluated

Object/Focus	Information Type	Data Collecting Method	Data Source
Lecturer performance	Presentation attractiveness, learning effectiveness	Questionnaire	Lecturer
Final competencies	content knowledge, critical thinking skills, creativity, written communication	Postet: content knowledge test and essay of critical and creative thinking skills, written communication skill	Student

3.5 Evaluation follow-up for future
In response to the challenges of preparing future teachers capable of mastering and modeling 21st-century competencies, higher education institutions must adopt learning models that explicitly foster the four core skills: critical thinking, creativity, communication, and collaboration (4C). Conventional teaching methods, which often emphasize cognitive achievement and content mastery, are insufficient to develop these higher-order skills. Recent studies have emphasized the importance of active, authentic, and collaborative learning experiences that engage students in complex problem-solving and reflective practice [7]-[10].

Within this framework, Project-Based Learning (PjBL) has emerged as a powerful pedagogical approach for promoting student-centered inquiry, creativity, and teamwork through real-world projects. When specifically oriented toward developing 4C competencies, PjBL evolves into a more targeted instructional model known as PjBL4C. This model integrates the stages of project-based learning with explicit scaffolding for each 4C dimension: encouraging students to think critically, create innovatively, communicate effectively, and collaborate productively throughout the learning process. Therefore, PjBL4C is the innovative solution in learning for guiding the 4C of 21st-century skills, offering a structured yet flexible approach to transform classroom practices into authentic, competency-based learning experiences [10]-[15].

Given the methodological framework and the integration of PjBL4C as a pedagogical innovation, the next stage of this study involved evaluating the outcomes of its implementation in the Basic Sciences course.

The evaluation was conducted through both quantitative and qualitative analyses to determine how effectively the PjBL4C model guided students in developing their 4C competencies. The pretest and posttest results provided empirical evidence of improvement in each dimension of the 4C skills, while observational and interview data revealed the depth of students' engagement and the transformation of classroom practices. Findings from the CIPP-based evaluation are presented in the following section, detailing how the context, inputs, processes, and products of the course aligned with the objectives of 21st-century education. These results not only highlight the strengths and challenges of current implementation but also illustrate the potential of PjBL4C as an effective instructional model for cultivating future-ready educators.

Based on field facts from the results of lecturer interviews and reviews of the curriculum and lesson plans for the Basic Sciences course, that at the end of the learning the lecturer only has data on students' content knowledge from the Final Semester Exam scores, final product score data from project assignments, but there is no data on student performance during the learning process such as oral communication and collaboration skills, and there is no data on the overall profile of students' 21st century 4C skills (critical and creative thinking, communication and collaboration). Therefore, the follow-up to this program evaluation is that the evaluator has developed a PjBL4C model. Assessment of critical thinking, creative, communication and collaboration skills in PjBL is developed into one part of the learning process.

A rubric-based instrument was developed and validated by seven expert judges (science educators and educational evaluation experts). The validation yielded a strong content validity coefficient (Aiken's V = 0.86), confirming that the indicators were relevant, clear, and aligned with PjBL4C syntax. The rubric defined three performance levels: Below Standard, Approaching Standard, and At Standard, for each of the 4C skills, enabling objective and transparent assessment across both pretest and posttest. The number of students and their levels of critical thinking are given in Table 6.

Table 6. The level of critical thinking skills of students in PjBL

PjBL syntax	Below standard (persons)		Approach standard (persons)		At standard (persons)	
	Pretest	Postest	Pretest	Postest	Pretest	Postest
Launching the project	60	5	30	35	10	60
Building knowledge, understanding and skills	70	5	25	30	5	65
Developing and revising ideas products	65	10	20	25	15	65
Presenting product and answers to driving question	70	10	15	30	15	60

The indicators of critical thinking skills in PjBL4C assessed through Pretest and Posttest are given in Table 7. The results of the students' pretest and posttest in Table 7 were obtained by referring to the indicators in Table 7, which are indicators of the standard level of Critical Thinking Skills. It appears that there has been an increase in the number of students from below standard, approach standard, and at standard. This is because all PjBL4C model syntaxes are able to facilitate and equip critical thinking skills. It is clear that the syntax of the PjBL4C model and the indicators of critical thinking skills are very directly intersected. These results are in line with the results of research conducted by previous researchers that PjBL is able to improve critical thinking skills [15]-[21].

Table 7. Indicators of standard level of critical thinking skill in PjBL

PjBL syntax	Critical thinking skill indicators at standard level
Launching the project	Writing appropriate problems in the experiment, taking appropriate data
Building knowledge, understanding and skills	Drawing the graph formed from the formulation of I = f(V) with R is constant, the graph of R=f(l) with A is constant and the graph of R=f(T)
Developing and revising ideas products	Evaluate the experimental data obtained (3 experiments), according to the experimental results
Presenting product and answers to driving question	Presenting experimental data (3 experiments) with interesting media

The number of students and student levels in creative thinking skills are given in Table 8. Each PjBL syntax contains indicators of creative thinking skills.

Table 8. Level of students' creative thinking skills in PjBL

PjBL syntax	Below standard (persons)		Approach standard (persons)		At standard (persons)	
	Pretest	Postest	Pretest	Postest	Pretest	Postest
Launching the project	65	10	20	25	15	65
Building knowledge, understanding and skills	70	10	15	30	15	60
Developing and revising ideas products	60	5	30	35	10	60
Presenting product and answers to driving question	55	10	10	20	35	70

The indicators of creative thinking skills in PjBL4C assessed through the Pretest and Posttest are given in Table 9. It appears that there has been an increase in the number of students from below standard, approach standard, and at standard. This is because all PjBL4C model syntaxes are able to facilitate and equip creative thinking skills. These results are in line with the results of research conducted by previous researchers that PjBL is able to improve students' creative thinking skills [21]-[29].

Table 9. Indicators of standard level of creative thinking skill in PjBL

PjBL syntax	Creative thinking skill indicators at standard level
Launching the project	Using large or small resistance, and large or small diameter of wire, then estimate the physical quantity information based on the slope (gradient) of the graph.
Building knowledge, understanding and skills	Determine the equation under different conditions: $V = Vo + IR$
Developing and revising ideas products	Discuss by asking for and providing recommendations or insights regarding the experimental activities that have been carried out.
Presenting product and answers to driving question	Create power point and macromedia flash media for a more attractive display, and animation in power point

The number of students and the level of students in collaboration skills are given in Table 10. The total number of students studied was 100 persons.

Table 10. Level of students' collaboration skills in PjBL

PjBL Syntax	Below standard (persons)		Approach standard (persons)		At standard (persons)	
	Pretest	Postest	Pretest	Postest	Pretest	Postest
Launching the project	70	5	20	30	10	65
Building knowledge, understanding and skills	65	10	25	35	10	55
Developing and revising ideas products	60	10	30	35	10	55
Presenting product and answers to driving question	65	5	30	25	5	70

The indicators of collaboration skills in PjBL4C assessed through the Pretest and Posttest are given in Table 11. It appears that there has been an increase in the number of students from below standard, approach standard and at standard. This is because all PjBL4C model syntaxes are able to facilitate and provide collaboration skills. These results are in line with the results of research conducted by previous researchers that PjBL is able to improve collaborative skills [29]-[35].

Table 11. Indicators of standard level of collaboration skill in PjBL

PjBL syntax	Collaboration skill indicators at standard level
Launching the project	Determining the division of tasks in groups, determining the appropriate experimental design, collecting data with appropriate tools and scales
Building knowledge, understanding and skills	Conduct discussions to present experimental data, draw graphs from experimental data, create equations for the relationships I = f(V), R=f(l) and R=f(T)
Developing and revising ideas products	Developing ideas to understand the benefits of the relationship equations I = f(V), R=f(l) and R=f(T), using computer technology to draw graphs of I = f(V), R=f(l) and R=f(T). For example, drawing graphs with MS. Excel or other applications.
Presenting product and answers to driving question	Dividing work responsibilities in a presentation, discussing during the presentation, organizing the presentation properly and correctly

The number of students and their communication levels are shown in Table 12. Oral communication skills were measured through observation during the learning process, and written communication skills were measured through a written test. A total of 100 students took the pretest and posttest.

Table 12. Level of students' communication skills in PjBL

Syntax PjBL	Below standard (persons)		Approach standard (persons)		At standard (persons)	
	Pretest	Postest	Pretest	Postest	Pretest	Postest
Launching the project	60	5	35	25	5	70
Building knowledge, understanding and skills	65	10	30	20	5	70
Developing and revising ideas products	70	5	25	30	5	65
Presenting product and answers to driving question	65	5	30	25	5	70

The communication skill indicators in PjBL4C are given in Table 13. The results of the pretest and posttest of students in Table 12 were obtained by referring to the indicators in Table 13 which are indicators of the standard level of Communication Skills. It appears that there has been an increase in the number of students from below standard, approach standard and at standard. This is because all syntax of PjBL4C is able to facilitate and provide communication skills in oral and writing. It is clear that the syntax of the PjBL4C model and the communication skill indicators intersect directly. This result is in line with the results of research conducted by previous researchers that PjBL is able to improve communication skills [31]-[37].

Table 13. Indicators of standard level of communication skill in PjBL

PjBL syntax	Communication skill indicators at standard level
Launching the project	Discuss in groups to determine the focus of the problem, discuss the division of tasks during the experiment, discuss the data that has been collected
Building knowledge, understanding and skills	Evaluate data taken from experiments, evaluate the relationship graphs I= f(V), R= f(l) and R= f(T), evaluate equations with standard formulations
Developing and revising ideas products	Argue in groups by criticizing and suggesting data that has been taken from experiments, graphs/curves that have been drawn and equations that have been produced.
Presenting product and answers to driving question	Presenting experimental data, graphs or curves, electric current equations with interesting media that is easy to understand.

The results indicate that the greatest improvement occurred in collaboration and communication, reflecting the authentic social nature of the project tasks. The pretest–posttest gain across all competencies was statistically significant ($p < 0.05$), confirming that PjBL4C contributed meaningfully to skill enhancement. Qualitative data further supported these findings. Students reported increased confidence in expressing ideas, working in teams, and engaging in scientific discussions. The lecturer observed greater student autonomy and creativity in problem-solving, while school principals (users of graduates) highlighted the relevance of these skills for classroom practice.

Implementation of PjBL4C followed four systematic phases: (1) Launching the Project, (2) Building Knowledge, Understanding, and Skills, (3) Developing and Revising Ideas/Products, and (4) Presenting Product and Answers to the Driving Question [6]. During the Launching the Project phase, students were introduced to real-world problems relevant to the Basic Sciences context, prompting them to identify driving questions collaboratively. This stage stimulated curiosity, problem identification, and initial critical thinking [30]-[35]. In the Building Knowledge, Understanding, and Skills phase, students gathered information through guided exploration, discussions, and literature review. Observations revealed increased engagement and participation, as students integrated prior knowledge with new concepts. The Developing and Revising Ideas/Products phase was characterized by creative exploration and teamwork. Students worked in small groups to design science-based projects, test ideas, and refine outputs based on peer and lecturer feedback. Collaboration and creativity were most visible at this stage, supported by mutual accountability among group members [36], [39].

Finally, during Presenting Product and Answers to the Driving Question, students showcased their projects and presented findings before peers. This stage significantly enhanced communication skills and scientific reasoning as they articulated solutions to authentic problems. Reflective discussions at the end of the presentations allowed students to evaluate their teamwork and learning processes critically. These findings collectively confirm that PjBL4C effectively embeds opportunities for 4C development throughout all instructional phases. The dynamic, inquiry-driven environment also aligns with constructivist principles that emphasize learning as a social and meaning-making process [40]–[44].

All the skill indicators above are completely and comprehensively referred to as 4C skills (critical and creative thinking, communication, and collaboration). Each PjBL4C syntax is designed to facilitate the provision of 21st-century 4C skills specifically for the Basic Sciences course on the specific topic of Dynamic Electricity. Pretest and Posttest assessments have been developed and used to measure the level of 4C skills which are divided into below, approach, and at standard levels. It appears from the results above that PjBL4C is able to increase the number of students who are at the standard level based on a comparison of pretest and posttest results. Based on these results, it can be concluded that PjBL4C is able to facilitate, equip, and improve 4C skills. These results are in line with the results of research conducted by previous researchers that PjBL is able to improve 4C skills of 21st-century [45]-[51].

The final results of this study after evaluating the Basic Science course program with the CIPP approach have provided a solution to provide all 4C skills of the 21st century by implementing the PjBL4C model and has been equipped with 4C assessments and rubrics in accordance with the syntax of the PjBL4C model. The rubric provides guidance to lecturers in classifying the skill levels of each 4C into 3 levels (below, approach, at standard). The 4C assessment instrument developed in it already includes measurements of knowledge aspects. So that it is complete that is measured during the assessment (pretest-posttest) which measures 4C skills and student knowledge. Based on the above, it can be ensured that lecturer can capture all 4C skills of students at once in one time and one learning process with the PjBL4C model. Ultimately, teachers have data on student 4C skills profiles in accordance with the learning outcomes of the course requested or desired to be achieved.

The findings affirm that PjBL4C is an innovative instructional model capable of systematically guiding the development of 4C competencies. Unlike traditional methods that prioritize content recall, PjBL4C emphasizes knowledge construction through authentic inquiry and collaboration. Each phase of the model directly engages one or more 4C dimensions: critical thinking during project launching and problem formulation; creativity in idea development and product revision; communication during presentation and feedback sessions; and collaboration throughout group interactions. These results align with recent studies reporting that project-based learning significantly enhances 21st-century skills in higher education contexts [7-12]. Moreover, integrating validated rubrics into PjBL4C provides measurable evidence of skill progression an aspect often missing in previous implementations of 4C-oriented instruction [13]-[16]. From a program evaluation perspective, the combination of CIPP and PjBL4C ensures both macro- and micro-level accountability: CIPP assesses the program's contextual relevance and systemic support, while PjBL4C operationalizes competency development in classroom practice. This synergy confirms that PjBL4C can function not only as a teaching innovation but also as a robust evaluative framework for 4C-oriented learning outcomes.

This study evaluated the Basic Sciences course in the Elementary School Teacher Education (PGSD) Study Program at ISBI Singkawang using the CIPP (Context–Input–Process–Product) evaluation model, supported by the Project-Based Learning for 4C (PjBL4C) innovation. The findings confirmed that although 4C skills critical thinking, creativity, communication, and collaboration, had been included in the course objectives, their measurement and implementation were previously limited. The application of PjBL4C successfully improved all dimensions of 4C, with the most significant gains in collaboration and communication. This model enabled lecturers to identify students' 4C profiles at below, approaching, and standard levels, aligning the learning process with authentic assessment practices.

Implications of the research results indicate that PjBL4C can serve as an effective framework for developing and measuring 21st-century competencies in higher education. It bridges the gap between curriculum intentions and classroom implementation while fostering active, inquiry-based learning environments. The novelty of this research lies in integrating the CIPP evaluation model with the PjBL4C pedagogy, producing both a teaching and assessment innovation that systematically captures 4C competencies through validated rubrics. However, this study is limited to one course within a single institution and a short intervention period. Broader and longitudinal studies are recommended to examine the sustainability and transferability of the PjBL4C model. In summary, PjBL4C offers a promising direction for 21st-century teacher education linking evaluation, instruction, and assessment into a coherent framework that enhances both learning outcomes and professional readiness.

4. CONCLUSION

This study evaluated the implementation of the Basic Sciences course in the Elementary School Teacher Education (PGSD) Study Program at ISBI Singkawang using the CIPP (Context–Input–Process–Product) evaluation model, with the Project-Based Learning for 4C (PjBL4C) approach as an instructional innovation. The evaluation results revealed that, while the course had included 4C (critical thinking, creativity, communication, and collaboration) in its intended learning outcomes, its prior implementation and assessment strategies had not fully captured students' competency profiles. Through the integration of PjBL4C, a significant transformation occurred both in instructional practices and student learning outcomes. Quantitative findings from pretest–posttest data confirmed substantial improvement across all 4C dimensions, with the most notable gains in collaboration and communication. Qualitative data from classroom observations, student reflections, and interviews reinforced that PjBL4C created an active, inquiry-based, and collaborative learning environment. The model's structured syntax: (1) Launching the Project, (2) Building Knowledge, Understanding, and Skills, (3) Developing and Revising Ideas/Products, and (4) Presenting Product and Answers to the Driving Question; proved effective in embedding 4C development throughout the learning process. The implementation of PjBL4C has been able to increase the number of students at the standard level for each 4C skill according to the indicators of these skills. During the process of PjBL4C implementation and at the end of the learning process, the evaluator was able to capture the overall 4C skills of students at the below, approach, and at-standard levels. This 4C skills profile will answer the learning outcomes achieved in the Basic Science course. Overall, the findings demonstrate that PjBL4C serves as an effective and evidence-based pedagogical model for guiding 21st-century skills development in higher education. It not only bridges the gap between intended curriculum outcomes and classroom practice but also provides a measurable framework for continuous program improvement.

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