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Unleashing the Potentials: Nurturing Students' 4Cs Skills through Project-Based Learning with ICT in EFL Classrooms

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Abstract

Project-based learning (PjBL) integrated with information and communication technology (ICT) has emerged as a promising learning model to nurture students' 4Cs skills (critical thinking, communication, collaboration, and creativity) in the EFL classroom. Therefore, this study aims to explore the perceived benefits and challenges of integrating PjBL with ICT in nurturing students' 4Cs skills in EFL classrooms. The research employed a qualitative single case study design involving semi-structured interviews with four EFL teachers and focus group discussions with twelve students. Thematic analysis was conducted on the collected data to identify emerging themes and patterns. The findings revealed several perceived benefits, including improved oral and written communication abilities, enhanced individual and group collaboration, clearly defined and implemented problems and solutions, and fostered creative idea generation, selection, and presentation. However, challenges such as time management issues, technical problems, physical and psychological burdens, and lack of sufficient teacher training and scaffolding were also identified. The study suggests that integrating PjBL with ICT can nurture the 4Cs skills essential for success in the 21st century. However, effective implementation necessitates resolving the highlighted issues, which include adequate teacher training, resource allocation, and support mechanisms. The implications of the research extend beyond the EFL classroom, showing the potential of this pedagogical model to cultivate crucial 21st-century skills across diverse educational contexts.

Keyword: EFL; ICT; Project-based learning; Students' 4Cs skills

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Introduction

The 4Cs—communication, collaboration, critical thinking, and creativity—have been identified as key 21st-century skills critical for preparing students for learning, innovation success, and addressing contemporary challenges (Erdoğan, 2019; Rati et al., 2023). Fisher and Fery (2007) suggested that critical thinking is crucial to identifying reliable sources and making informed decisions. Creativity involves spontaneous and imaginative thinking, leading to new inventions and creations (Machali et al., 2021; Sudjarwo et al., 2019). Effective communication enhances understanding, promotes collaboration, and facilitates idea exchange (Vlachopoulos & Makri, 2019). In addition, Child and Shaw (2018) emphasized that collaboration enhances student interactions, promoting social interdependence, communication, cooperation, resource sharing, idea exchange, and problem-solving. However, students may encounter challenges in group work that limit their development of collaborative skills. Therefore, integrating the 4Cs skills requires adjustments in classroom materials, teaching methods, and learning models (Saleh, 2019).

Project-Based Learning (PjBL) is a teaching model that follows a constructivist approach, focusing on engaging students in various inquiry-oriented activities, including their cooperative actions, to achieve learning goals (Cocco, 2006). It has been used as an instructional model to develop the 4Cs in EFL classrooms (Somphol et al., 2022), as well as all 21st-century skills (Krajcik & Czerniak, 2018; Miller & Krajcik, 2019; Virtue & Hinnant-Crawford, 2019; Tsybulsky & Rozanov, 2021). Many experts in education state that PjBL is a promising learning model that can develop students' 4Cs skills. In the EFL classroom, integrating PjBL into foreign language learning is necessary for EFL students to learn better, and it can develop their language skills (Syarifah & Emiliasari, 2019). PjBL has also become a suggested model for improving language-integrated and 4Cs skills. However, students and teachers have become accustomed to working alone, and working with peers is an unusual circumstance that can be stressful and unpleasant (Bashan & Holsblat, 2012). As a result, the use of ICT in the PjBL process can foster engagement and motivation in collaborative work.

In the EFL classroom, ICT is defined as a variety of technological tools and resources utilized for communication, information creation, dissemination, storage, and management (Tinio, 2003). ICT is instrumental in enhancing the quality of education by motivating and

engaging students and facilitating learning resources. Furthermore, it encompasses a diverse array of technologies, including software, mobile devices, the Internet, and computers (Chaidi et al., 2021). It is employed to enhance PjBL by facilitating communication and collaboration, as well as providing students with access to information and resources. Most importantly, it has the potential to foster a transition to a student-centered environment that is consistent with the project activities that PjBL suggests. The integration of PjBL and ICT shows the development of knowledge and skills through the incorporation of authentic learning situations and student-centered learning (Efendi, 2017). Therefore, the integration of PjBL with ICT in an ideal EFL classroom fosters students' self-direction, autonomy, and engagement (Mamakou & Grigoriadou, 2010). ICT cultivates a dynamic learning environment in which students engage in meaningful projects, utilizing digital tools and resources to improve their language skills and further develop their critical thinking, creativity, communication, and collaboration skills.

Comparing project-based learning with information and communication technology to other teaching methods can reveal valuable insights into its effectiveness and crucial advantages. As a student-centered learning model, PjBL enhances interdisciplinary connections and fosters practical skills in EFL classrooms. For instance, the implementation of PjBL in Indonesia and Malaysia has demonstrated significant improvements in students' collaboration, communication, and critical thinking skills (Martini et al., 2024). This method's integration with ICT further amplifies its potential by enhancing student engagement through real-world applications and creating more dynamic and interactive learning experiences. The use of ICT in PjBL also supports teaching and learning effectiveness by providing access to research resources and facilitating connections with mentors (Abdulkadir et al., 2019). While PjBL offers considerable benefits, such as increased student motivation and opportunities for real-world problem-solving (Yunus et al., 2021).

Previous studies have conducted a comprehensive analysis of the efficacy of project-based learning (PjBL) and Information and Communication Technology (ICT) operating separately. However, there remains a lack of research investigating the integration of PjBL with the 4Cs as 21st-century skills impact EFL classrooms. While some researchers like Gustiani et al. (2021), Sirisrimangkorn (2018), Yang et al. (2020), and Zhang (2015) have highlighted the positive outcomes of PjBL and ICT on English language skills and student motivation, the focus has

primarily been on language learning outcomes rather than the development of 4Cs skills. Erdoğan (2019) suggests that besides enhancing language skills, the EFL classroom should also foster the development of the 4Cs skills to align with students' evolving needs. In addition, no empirical research exists that comprehensively analyzes the impacts of each element of the 4Cs derived from PjBL with ICT.

On the other hand, over the past three years, there has been notable progress in researching PjBL and ICT, mainly focusing on individual 21st-century skills using action research and experimental methods from Al-Shaye (2021), Arabloo et al. (2002), Sari & Prasetyo (2021), and so on. Nevertheless, there is limited scientific evidence that explores the broader potential resulting from their combined implementation from both teachers' and students' perspectives. Understanding the diverse perceptions of PjBL with ICT among teachers and students is crucial before re-implementing this approach in classrooms. Despite extensive research on PjBL and ICT individually, there is a lack of empirical studies examining the specific impact of their integration on the development of 4Cs skills in EFL classrooms. This research aims to fill this gap by exploring both the benefits and challenges associated with this integration.

This research thus addresses this gap by exploring the integration of PjBL with ICT to improve students' language skills and foster the development of 4Cs skills. To grasp our discussion and insights, here are the research questions: (1) What are the perceived potential benefits of the implementation of PjBL integrated with ICT that nurtures the 4Cs Skills in EFL classrooms? (2) What are the perceived challenges of PjBL integrated with ICT that nurtures the 4Cs Skills in EFL classrooms?

Afterward, this research will also contribute to the development of a PjBL-based ICT intervention that can be used to nurture the 4Cs skills in EFL classrooms.

Literature Review

The 4Cs, including critical thinking, creativity, communication, and collaboration, are essential skills to succeed in the 21st-century era. The origin of the 4Cs skills came from the consensus of the Partnership for 21st-Century Skills (P21) that "Learning and Innovation Skills" is divided into four skill categories: "Creativity and Innovation," "Critical Thinking and Problem Solving," "Communication," and "Collaboration." Students should master those skills to assist

with the complexity of the learning process (Benek & Akcay, 2022) and achieve success (Somphol et al., 2022).

Communication skills are crucial for success in the 21st century. Larmer et al. (2015) define communication as the ability to convey information verbally and in writing, as well as understand written and oral information (Budiarti et al., 2020). This skill goes beyond articulating thoughts and listening effectively; it includes judging the effectiveness of communication and assessing its impact (P21, 2007). Erdoğan (2019) emphasized that communication ability involves effectively expressing oneself within context, addressing interlocutors, and considering time and location. It involves a collaborative effort to negotiate meaning in various scenarios (Saleh, 2019).

Collaboration enhances collective intelligence through technology-mediated interactions (Brown et al., 2015). It involves working with others to negotiate, recommend, and assist. Child and Shaw (2018) state that collaboration promotes social interdependence, communication, resource sharing, idea exchange, and problem-solving skills, emphasizing student interaction quality. In education, collaboration involves students working in groups to achieve project objectives, fostering critical thinking and knowledge application (Barron et al., 2008; Evans, 2020). In EFL classrooms, collaborative skills encompass group decision-making, feedback exchange, role sharing, idea generation, and issue characterization (Septiyanti & Fajriah, 2021).

Mastering creativity is essential for effective learning in the 21st century (Rati et al., 2023). Creativity, which is a component of the 4Cs, entails the generation of ideas, the ability to think openly, and the ability to respond to new ideas in groups. It encompasses the expression of undeveloped ideas, the development of products from environmental materials, and the provision of beneficial contributions to groups (Lubart & Thornhill-Miller, 2019). Teachers can foster creativity by promoting active participation, investigating topics with primary data, and innovatively presenting discoveries (Nakano & Wechsler, 2018). Kivunja (2015) recommends techniques such as the use of creative thinking tools such as mind mapping, the cultivation of curiosity, and the resolution of real-world challenges. Visual arts, the exploration of novel concepts, and the adaptation of diverse viewpoints are also components of creativity (Septiyanti & Fajriah, 2021).

Critical thinking is the capacity to think about a specific subject matter extensively (Ennis, 2018). According to Kivunja (2015), it involves the application of high-level cognitive skills, such as analyzing, evaluating, and creating, to resolve issues. This meta-cognitive process is associated with human cognitive capabilities (Ariadne de Villa, 2017). The Revised Bloom Taxonomy, developed by Anderson and Krathwohl (2001), defines six cognitive domains: remembering, understanding, applying, analyzing, evaluating, and creating. Analyzing and creating are crucial for developing critical thinking. Additional skills include interpretation, inference, explanation, and self-regulation (Baez, 2004). Critical thinking empowers students to analyze complex processes, employ reasoning effectively, and make decisions (Erdoğan, 2019).

The study conducted by Erdoğan (2019) underscored the critical significance of incorporating 21st-century skills, specifically the 4Cs (Communication, Collaboration, Creativity, and Critical Thinking), into English as a Foreign Language (EFL) classes. It suggested that these skills were crucial for success in current education and employment, which was consistent with the findings of significant educational organizations. The study suggested that EFL classes offered an optimal environment for the development of these skills alongside traditional language skills, thereby enhancing the relevance and engagement of language learning. The study suggested a transition from conventional grammar-focused instruction to a more collaborative, learner-centered approach. It also emphasized the importance of technology in improving communication and collaboration, and it provided practical recommendations for implementation, such as PjBL and debates. Ultimately, the teacher's role should be redefined from that of an instructor to that of a facilitator, thereby fostering student-centered learning experiences.

Project-Based Learning in EFL Classrooms

Project-based learning (PjBL) is a teaching model that emphasizes the assignment of project-based tasks to assist students in the inquiry process, thereby promoting the development of knowledge, skills, and attitudes as assessment criteria (Thomas, 2000). Bell (2010) described PjBL as an innovative approach that teaches critical strategies for success in the 21st century, where students manage their learning through exploration and collaboration, researching and developing projects that reflect their understanding. Krajcik and Shin (2014) identified six

hallmarks of PjBL: posing stimulating questions, aligning with learning objectives, engaging in educational activities, fostering student collaboration, utilizing scaffolded technology, and producing tangible products. The collaborative process of integrating knowledge applies to real-world problems and receiving teacher guidance during project completion (Guo et al., 2020).

Project-based learning has gained popularity in EFL classrooms, offering students opportunities for independent and collaborative learning (Ngadiso et al., 2021). Studies in Indonesia have shown that PjBL implementation improves class situations and is well-received by both students and teachers. PjBL promotes high levels of student participation and innovative teaching practices (Barak & Yuan, 2021). In large EFL secondary school classes, PjBL can be maximized by using realistic tasks, structured processes, and collaborative group work (Makniyah, 2020). Despite its benefits, EFL teachers face ideological, pedagogical, and operational challenges when implementing PjBL (Mouni, 2022). However, teachers suggest solutions to overcome these challenges for successful implementation (Mouni, 2022). Overall, PjBL shows promise in enhancing EFL teaching and learning, but careful consideration of its implementation is necessary to address potential obstacles and maximize its effectiveness in secondary school settings.

An effective learning cycle is initiated by PjBL principles, which involve the use of challenging problems or essential questions, the promotion of critical thinking and inquiry, and the empowerment of students through voice and choice for problem-solving in real-world contexts (Larmer et al., 2015). In the EFL classroom, the successful implementation of project-based learning necessitates the following key steps: defining project subjects, conducting research, formulating questions, collaborating in groups to create project plans, analyzing data, and preparing presentations with effective organization and feedback-based evaluation (Korkmaz & Kaptan, 2002). These activities correspond to the stages of planning, implementation, and reporting, which include activities such as topic selection, plan design, project completion, and result assessment (Dole et al., 2017).

ICT Use in EFL Classrooms

Information and Communication Technology is employed in education through the use of tools such as software, mobile devices, the Internet, and computers (Chaidi et al., 2021). ICT

enhances learning by promoting active engagement, problem-solving, collaboration, and communication (Tinio, 2003). It boosts motivation, engagement, and academic achievement (Khan & Alwi, 2018) and helps adapt to modern teaching methods (Akpabio & Ogiriki, 2017). Alkamel et al. (2018) categorize ICT tools into web-based (e.g., YouTube, email, Skype, Zoom) and non-web-based (e.g., radio, television, laptops, language labs) technologies, with internet-supported tools including e-learning platforms, AI, and multimedia resources. Integrating ICT transforms education by providing abundant resources, fostering continuous learning, and promoting collaboration and personalized learning (Afshari et al., 2009; Mukan & Kravets, 2022). It supports student-centered learning and engaging experiences (Cavas et al., 2009). However, challenges like time-consuming content creation, the need for expertise, training, data privacy concerns, and resource limitations highlight the need for careful implementation and support (Wang, 2017; Salehi & Salehi, 2012; Rabah, 2015).

The integration of ICT in EFL classrooms offers various advantages, including improved language acquisition, increased learner autonomy, and enhanced student motivation (Azmi, 2017; Soussi, 2016). Interactive work, faster access to teaching materials, and support for the learning-teaching process are facilitated by ICT (Sari et al., 2017). Nevertheless, successful implementation necessitates meticulous planning and well-defined objectives (Azmi, 2017). The adoption of ICT is significantly influenced by the characteristics of teachers, including their academic credentials and computer literacy (Lawrence & Tar, 2018). Time management, technical support, and teachers' self-confidence are among the obstacles to ICT integration (Sari et al., 2018). Furthermore, administrative, technical, and human factors can impede the complete integration of ICT in EFL classrooms (Soussi, 2016). Despite these challenges, the utilization of ICT in EFL instruction has been demonstrated to have a beneficial effect on both students and teachers, thereby enhancing classroom interaction and expediting the learning process (Pardede, 2020).

Project-Based Learning with ICT Develop the 4Cs Skills

A dynamic educational model has been established by the integration of project-based learning with information and communication technology, which has resulted in a variety of learning environments for students. This section explores the existing research on how the

integration of PjBL and ICT contributes to developing the 4Cs: creativity, critical thinking, communication, and collaboration. The robust correlation between PjBL and the development of these indispensable 21st-century competencies has been highly proven (Astawa et al., 2017; Canez, 2018).

Project-based learning with ICT integration has been shown to develop students' 4Cs skills effectively. Multiple studies have demonstrated significant improvements in these skills across various educational levels. At the secondary level, PjBL activities enhanced students' 4Cs skills beyond the 70% criteria (Somphol et al., 2022). A blended PjBL program proved effective in developing 4Cs skills for secondary students through students' worksheets (Siregar et al., 2023). In elementary schools, PjBL significantly improved students' critical thinking and creativity, with higher post-test scores in the experimental group compared to the control group (Amroni et al., 2024). Additionally, PjBL using ICT has been found to develop Thai learners' key competencies, including communication, thinking, problem-solving, life skills, and technological application capabilities (Soparat et al., 2014). These studies collectively highlight the potential of PjBL with ICT in fostering essential 21st-century skills across different educational contexts.

For example, Canez (2018) conducted a mixed-methods case study in a primary school, which demonstrated that PjBL fosters critical thinking, creative expression, effective communication, and collaboration among students. Similarly, Talat and Chaudhry (2014) discovered that PjBL improves students' competitiveness, creativity, and other 21st-century skills, as evidenced by a survey of teachers in Lahore, Pakistan. Astawa et al. (2017) also observed that PjBL had a positive impact on the teaching process and English skills, particularly in the development of enthusiasm, confidence, creativity, self-directed learning, and collaborative skills among seventh-grade students. Nevertheless, there are still areas that require further investigation, such as the clarification of the specific role of technology in PjBL programs.

Method

The research employed a qualitative single case study design since it involved the exploration of a phenomenon as a single or small case in a specific context (Yin, 2018). The single case study allowed for a detailed and in-depth exploration of a specific educational context

to gain a deeper understanding of the complexities involved (Mahadi & Husin, 2021). The present case being scrutinized involved project-based learning integrated with ICT in EFL classrooms, which had been proven to enhance English and the 4Cs skills. This phenomenon thus will be further investigated to explore teachers' and students' attitudes and perceptions related to the improved indicators of the 4Cs in PjBL with ICT. Moreover, the researcher selected several cases in different schools related to the learning model that are expected to get diverse perspectives to answer research questions. A cross-case study was conducted to compare the outcomes and developments in one school case to the others following the multi-case format. Stake (2006) suggested that this study used matrices and tables to conduct cross-case comparisons. Iterative intra- and cross-case comparisons led the researchers to a more general conclusion, which was facilitated by such a comparative presentation.

A purposive sampling technique was used to select a sample that would provide detailed information about the case under consideration. Purposive sampling is a non-probability sampling technique commonly used in qualitative research that selects participants based on specific characteristics or criteria relevant to the research objectives (Creswell & Poth, 2018). The primary goal is to identify and select information-rich cases that provide detailed insights and understanding of the phenomenon under investigation (Patton, 2015). The sample was selected based on the following criteria such as EFL teachers with experience teaching the lesson using project-based learning, ICT tools in the learning model process, willingness to share their perspectives on reflective teaching and classroom environments, and students who had participated in and completed such projects within the learning model. The researcher selected 4 EFL teachers of senior high schools (2 males and 2 females) in Central Java and Yogyakarta, Indonesia, and 12 students represented by 3 students in each school. The English teachers have achieved their English language education degree. One has a master's degree, and two have bachelor's degrees. They are generally young, aged between 27 and 35. Twelve students, aged 15-16, are in the 11th grade of senior high school. They focused on learning English productive skills (writing and speaking skills) with their teacher. The detailed participants can be seen in table 1:

Table 1. Research Settings and Participants

Participants	Schools	Classroom Projects	Skill Improvement	ICT Use	Code	Instruments
1 EFL Teacher (Male)	Private high school	A video tutorial or procedure of traditional foods	Speaking	Capcut, Tiktok, Youtube	T1	Semi-structured interview
3 Students	Grade 11				P1, P2, P3	Focus group discussion
1 EFL Teacher (Female)	Public high school	A video narrative story	Speaking	Capcut, Tiktok	T2	Semi-structured interview
3 Students	Grade 11				P4, P5, P6	Focus group discussion
1 EFL Teacher (Male)	Private high school	An infographic of discussion text	Writing	Canva, Google Translate	T3	Semi-structured interview
3 Students	Grade 11				P7, P8, P9	Focus group discussion
1 EFL Teacher (Female)	Public high school	A sequential picture of a narrative story	Writing	Google Translate, Storybird Apps	T4	Semi-structured interview
3 Students	Grade 11				P10,P11, P12	Focus group discussion

Data collection involved semi-structured interviews with teachers and focus-group discussions with students, which were employed to ensure the validation of qualitative research. Triangulation was used to validate findings, ensuring credibility, completeness, and validity (Creswell & Poth, 2018). By combining different perspectives, the depth and richness of understanding were enhanced, countering potential biases for a more comprehensive analysis. Patton (2015) emphasizes the benefits of triangulation in increasing trustworthiness, capturing holistic insights, and enriching data interpretation. The interviews and discussions aim to gather in-depth insights into the attitudes, perceptions, and responses of participants regarding the development of the 4Cs (critical thinking, communication, collaboration, and creativity) through PjBL with ICT integration. The interview questions were based on criteria from Budiarti et al. (2021), who developed approaches to the 4Cs in global project learning. For questions related to the benefits of the 4Cs, the sub-themes were derived from the interview results. Challenges of PjBL, such as lack of teacher training, technological issues, and time constraints, were modified from both the interviews and the study by Al Shaye (2021). First, the interviews with teachers were run well in offline meetings, each lasting about an hour. The teachers were responsive and provided detailed answers regarding the benefits and challenges of PjBL. Second, following the interviews, discussions were held with groups of three students from each of the four schools on

different and consecutive days. Each discussion lasted about an hour and focused on the benefits and challenges of PjBL and ICT, as well as validating the teachers' responses.

The obtained data was examined using thematic analysis, which identified, classified, and structured recurring patterns and themes to create a thorough knowledge of the phenomenon. Thematic analysis is a technique for identifying, assessing, and interpreting patterns of meaning in qualitative data. It required a rigorous process of data familiarization, coding, theme development, and revision to capture the essence of the data and answer the study objectives. Several strategies were used to ensure trustworthiness, including member checking, in which teachers and students reviewed and validated the interpretations and findings, and triangulation of multiple data sources from interview transcripts and relevant data instructional documents to corroborate the evidence and increase the credibility of the results.

Findings

The findings of this research respond to the two issues regarding teachers' and students' perceptions toward the learning model of project-based learning with ICT and the influence on students' 4Cs. The first is the perceived benefits of 4Cs development within the learning model. The next finding shows the challenges of implementing PjBL and ICT in nurturing students' 4Cs skills. Finally, the findings will sum up the overall benefits and challenges, which will be discussed with relevant supporting theories or previous findings from other research articles.

Improving Communication Skills (Oral and Written Communication)

PjBL integrated with ICT significantly enhances students' oral and written communication skills. Teachers observed that students became more engaged in class, asking more questions, which improved their ability to process information. One teacher noted,

> *It can increase students' active participation in class, especially in communication. Students often ask questions. (T1)*

The approach also fostered the development of oral communication skills through group discussions and project presentations, allowing students to articulate their ideas clearly. As one student shared,

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> *When we gathered to discuss preparation for this writing project, everyone was active, directly conveying suggestions and ideas.* (P7).

Teachers also assigned roles in video projects to help students practice pronunciation, intonation, and gestures, as T2 observed: *"They practiced diligently before the final recording of the narrative story for the mini-drama video."*

Written communication skills were also nurtured through activities like scriptwriting and online discussions. Students actively participated in online consultations, enhancing their composition skills while incorporating more English language usage. Another teacher shared,

> *During the Zoom or WA project group meetings, some students were enthusiastic about asking questions and giving suggestions. (T4).*

Overall, PjBL with ICT significantly improves students' communication skills by fostering active participation, clear articulation of ideas, and enhanced written communication through structured activities and digital tools.

Increasing Collaboration Skills (Enhanced Individual and Group Collaboration)

The study found that PjBL with ICT effectively fosters both individual and group collaboration. The boarding school setting played a key role in enhancing collaboration by limiting students' access to personal devices and encouraging interdependence within group projects. The teacher emphasized,

> *Each individual must have a role and responsibility to complete this project. In my school, students understand each other's limitations and naturally divide tasks accordingly.* (T2).

Teachers also strategically grouped students to promote collaboration between those with different personality traits.

> *I worked closely with someone who had the same task in editing, meeting frequently to finalize the poster design on Canva.* (P7).
>
> *To make collaboration work, I assign clear roles and responsibilities to each student and encourage regular check-ins and peer evaluations.* (T3).

In addition, group collaboration was evident in students' active exchanges of opinions and experiences within their project groups. T3 observed, *"During the third meeting of the project, I noticed they were still actively discussing their preparation in their respective groups."*

In summary, PjBL with ICT promotes effective collaboration by fostering interdependence in group tasks, encouraging teamwork among students with diverse traits, and ensuring active participation through clear role assignments.

Fostering Critical Thinking Skills (Capability to Clearly Define and Implement Solutions to Problems)

The findings show that PjBL integrated with ICT enhances students' critical thinking and problem-solving skills. These skills were nurtured through three key phases: problem definition, solution proposal, and solution implementation. In the problem definition phase, students had to understand project requirements and challenges. One of the teachers noted,

Students understand and follow the project guidelines and challenges. (T3).

During the solution proposal phase, students engaged in research, analysis, and the development of potential solutions. The teacher highlighted,

They research, analyze information, and propose solutions before executing the plan. (T4).

The solution implementation phase required problem-solving skills for executing project tasks, such as video creation and editing. The teacher described,

Executing project plans, such as video creation and editing, requires problem-solving skills. (T2).

Students continuously refined their solutions until the final project was completed. T4 observed, *"They continuously resolve all processes until the final product is finished, executing their ideas step by step."*

Thus, PjBL with ICT effectively enhances critical thinking by requiring students to define problems, propose solutions, and implement them through iterative processes, fostering an analytical mindset.

Cultivating Creativity and Innovation Skills (Creative Idea Generation, Selection, and Presentation)

PjBL with ICT fosters creativity and innovation by allowing students to generate, select, and present creative ideas. Teachers noted that students were given the freedom to conceptualize their projects according to their group's creativity. One student stated,

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> *We chose the picture designs ourselves for the chronological pictures of the narrative story about the origin of Borobudur.* (P9).

The use of ICT tools like Canva, TikTok, and video editing software enabled students to explore innovative presentation formats, enhancing their creative expression. The teachers perceived,

> *The infographic products edited in Canva were colorful and eye-catching, and they presented them using the Canva elements movement feature.* (T2).
>
> *Their creativity was extraordinary, from scriptwriting to video editing, including selecting background sounds and animations.* (T3).

In conclusion, PjBL with ICT promotes creativity by giving students the freedom to conceptualize their projects, utilize multimedia tools, and present their ideas innovatively, resulting in visually appealing and imaginative project outcomes.

Finally, in response to the first research question about fostering creativity and innovation skills using PjBL and ICT, the findings clearly show that this model promotes students' creative expression and innovative thinking. Students were given the freedom to conceptualize their projects, as highlighted by P9 and P1, which allowed them to undergo different creative ideas and presentation formats. Multimedia tools such as Canva, TikTok, and video editing software gave them more opportunities to express their creativity, resulting in visually appealing and imaginative project outcomes. T2 and T3 found that incorporating ICT into students' project work significantly improved their ability to generate, select, and present creative ideas.

Challenges of Implementing Project-Based Learning with ICT to Improve 4C Skills

The findings to address the second research question show several challenges encountered when implementing PjBL with ICT to improve the 4C skills. Time management emerged as a major concern, with students and teachers struggling to allocate sufficient time for project completion. Technological issues, such as unreliable internet connections and software limitations, further hindered the learning process. Moreover, physical and psychological issues, including screen fatigue and stress, were identified as barriers. A lack of sufficient teacher training

and scaffolding was also highlighted, underscoring the need for better preparation and support for teachers in facilitating PjBL effectively.

Time Management

The first challenge encountered by teachers and students in implementing PjBL with ICT is managing time effectively. This approach is more time-consuming than traditional teaching methods due to the various phases of planning, implementing, and managing the integration of projects. Effective time management is crucial to balance the increased time demands with other lesson responsibilities. As one teacher noted,

> *Managing the time, definitely. Doing PjBL with ICT is a lot more time-consuming than traditional methods. I have to plan the projects, select the right tools, and make sure all the students are engaged and learning. It takes a long time and effort.* (T4).

Both students and teachers struggle to manage the significant time and effort required for PjBL alongside other academic responsibilities. This balance is essential to meet educational standards and learning outcomes. One teacher and a student highlighted these difficulties:

> *Oh, for sure. PjBL is excellent for developing 4C skills, but ensuring that these projects also meet syllabus and learning outcomes can be challenging. Balancing the freedom of project work with the structure of the objectives is not that easy. (T1).*
>
> *It's hard to balance project work with other homework or assignments. The project takes a lot of time and effort, and it's tough to manage alongside other assignments, exams, and extracurricular activities. It can really lead to stress and burnout. (P7).*

In conclusion, time management remains a substantial challenge when implementing PjBL with ICT. Both teachers and students must navigate these demands to achieve the desired educational outcomes, making effective planning and strategic management essential.

Technological Issues

Technological issues present another significant challenge for both teachers and students. The reliability of internet connections and varying levels of digital literacy among students are critical obstacles that can disrupt PjBL activities. Unstable internet connections, incompatible software, and hardware can cause delays and frustration, as noted by a student:

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Yeah, the Internet is unstable and consumes a lot of internet quota to record videos because the school does not provide WiFi, and when on progress outside of school, sometimes the laptop crashes and bugs because it has to edit and process the video because many of us still don't have a laptop to edit. It totally disrupts the project flow and causes delays. It's really frustrating and demotivating." (P5).

In addition, different levels of digital literacy among students can impact collaboration and project success. Students with varying ICT skills may struggle to work together effectively:

Honestly, one big challenge is the different levels of operation of the application for editing the video or picture in the group. Not everyone is comfortable or skilled with the tools, which makes collaboration tough and can mess up the whole project. (P2).

Limited storage capacity on students' gadgets also restricts their ability to process and edit videos, requiring them to rely on school resources. As one teacher explained,

Before they save and upload the video to Google Drive or YouTube, they cannot use phones to process and edit the video due to the limited storage of the gadgets. They use the school's computer to upload and edit the video. (T1).

While using school facilities helps, it introduces additional logistical challenges, impacting project efficiency and completion. Teachers must provide extra support and coordination to manage these technological limitations effectively.

Physical and Psychological Issues

The demanding nature of PjBL with ICT can lead to physical and psychological challenges, affecting both students and teachers. The stress, burnout, and physical illness associated with balancing PjBL tasks with other academic responsibilities can significantly impact well-being and performance. Teachers often feel overwhelmed by the extensive planning, guidance, and troubleshooting required:

Honestly, the amount of work involved in PjBL with ICT is overwhelming. I feel like I'm always on the clock, preparing materials, guiding students, troubleshooting tech issues, and grading their projects. It's exhausting. (T3).

And let's not forget the tech problems. When the Internet gets into trouble, or students can't get the software to work, it all falls on us to fix it. It adds to my stress. (T1).

Students, too, experience high levels of stress, particularly when trying to balance PjBL with other commitments. Technical issues further exacerbate their anxiety, as more time is spent resolving problems than engaging in meaningful project work:

> *I like working on projects, but sometimes it's too much. Balancing all the different tasks with other classes and my part-time job gets really stressful. (P8).*
>
> *The deadline is quite strict. Trying to keep up with everything and still do a good job on the projects makes me feel a little bit anxious all the time. (P12).*

These psychological and physical burdens pose a substantial barrier to the successful implementation of PjBL with ICT.

Lack of Sufficient Teacher Training and Scaffolding

Teacher training and scaffolding are critical concerns in implementing PjBL with ICT. However, inadequate training can lead to underutilization or ineffective application of ICT tools. As one teacher noted,

> *I must keep updated on the ICT operations for students to assist them if they face trouble. Hence, I need more training, especially in the emergence of artificial intelligence tools as the new media to increase their projects.* (T2).

The continuous evolution of technology necessitates ongoing professional development. Teachers must stay updated and proficient with new ICT tools, as highlighted,

> *The continuous evolution of technology also poses a challenge. Keeping up with the latest ICT tools like TikTok, Canva, and Instagram and incorporating them effectively into PjBL can be challenging.* (T4).

Scaffolding students through PjBL with ICT also presents challenges. Teachers must adapt their teaching strategies to meet diverse student needs and technical complexities. As T3 emphasized, *Scaffolding becomes crucial in these situations. We need to provide support and guidance to students at different levels of tech proficiency to ensure everyone can contribute effectively."* Managing these diverse needs while addressing technical demands underscores the importance of continuous support for both teachers and students.

Discussions

The integration of Project-Based Learning with Information and Communication Technology proves to be an effective pedagogical model for fostering 21st-century skills, notably the 4Cs such as communication, collaboration, critical thinking, and creativity. This discussion highlights the benefits and challenges associated with this approach, drawing comparisons with previous research and theoretical frameworks.

Benefits of Project-Based Learning with ICT for Developing 4Cs Skills

Communication Skills

PjBL with ICT significantly enhances communication skills across receptive, oral, and written domains, aligning with Communicative Language Teaching (CLT) principles (Savignon, 1991). This approach fosters an active learning environment emphasizing collaboration and digital communication, which helps students articulate their ideas effectively across various mediums. Oral communication skills are particularly refined through group discussions and project presentations, which are supported by CLT principles and empirical studies (Patton, 2012; Widanta, 2023). These activities promote active participation and peer feedback, which is essential for improving spoken communication. Written communication skills are also developed through scriptwriting and project planning, reflecting a process-oriented approach (Jiang & Lee, 2022). Studies by Alemi et al. (2022) and Munajah et al. (2023) confirm that digital storytelling and multimedia tools enhance writing skills, including organization and vocabulary use, highlighting the comprehensive impact of PjBL with ICT on communication.

Collaboration Skills

The integration of PjBL and ICT strengthens collaboration skills, which aligns with cooperative learning theories (Johnson & Johnson, 2009). The boarding school environment, which restricts personal gadget use, promotes effective group interaction, emphasizing positive interdependence. The structured group roles and responsibilities foster collaboration and mutual support (Reeves et al., 2018). Effective group dynamics are enhanced by strategic grouping of introverted and extroverted students, supporting heterogeneous grouping theories

(Le & Wubbels, 2018). Teachers' observations of active idea exchange and support within groups underline the effectiveness of this collaborative approach.

Critical Thinking and Problem-Solving Skills

PjBL, combined with ICT, effectively cultivates critical thinking and problem-solving skills. The approach engages students in a holistic problem-solving process involving problem definition, solution proposal, and implementation. The problem definition phase focuses on identifying project requirements and setting goals, which aligns with inquiry-based learning methods (Tasnim et al., 2023). Solution proposals involve research and assessment, fostering critical thinking (Worachak et al., 2023). The solution implementation phase promotes adaptability and perseverance (Gadad et al., 2021). Overall, PjBL with ICT provides authentic problem-solving experiences, preparing students for complex challenges.

Creativity and Innovation Skills

The combination of PjBL and ICT enhances creativity and innovation, supported by research showing that such integration stimulates creative expression. Students benefit from the autonomy to explore and present their projects creatively, aligning with Ambiyar and Syah (2023) and Mumford et al. (2019). ICT tools like Canva and video editing software enable experimentation with presentation formats, fostering creativity (Fitria, 2022; Ghernaout, 2018). This integration allows students to push the boundaries of traditional learning methods, particularly in EFL settings where language barriers are minimized through innovative digital tools.

In conclusion, integrating PjBL and ICT creates an effective learning environment that helps EFL students nurture the 4Cs skills. This model promotes a holistic learning experience by involving students in real-world projects that require both individual and collaborative effort. Each of the 4Cs reinforces the others. For example, when students work together on group projects, they naturally improve their communication skills, both orally and in writing, because they must clearly articulate their ideas to peers and instructors. This collaborative process also improves critical thinking as students analyze problems and devise innovative solutions, frequently relying on one another's feedback to enhance their strategies.

Furthermore, ICT tools not only facilitate communication and collaboration but also provide a platform for creative expression. They are encouraged to experiment with new ideas by using multimedia presentations, video projects, and digital storytelling, which push the boundaries of traditional classroom learning. This combined impact is especially effective in EFL settings, where language barriers may hinder communication and collaboration. By combining PjBL and ICT, these barriers are reduced, giving them a variety of opportunities to practice and improve their language skills while also developing critical 21st-century competencies.

Challenges of Project-Based Learning with ICT in Nurturing 4Cs Skills

Implementing Project-Based Learning with Information and Communication Technology to enhance students' critical thinking, communication, collaboration, and creativity presents significant challenges. These challenges can be categorized into four main aspects: time management, technological issues, physical and psychological factors, and teacher training and scaffolding, which are the findings of the second research question.

Time Management

Time management emerges as a significant challenge in PjBL with ICT. The approach requires extensive planning, execution, and administration compared to traditional methods (Lapina & Prakasha, 2022). Teachers struggle to balance project design, ICT integration, student guidance, and assessment (Santoso et al., 2021; Milian, 2023). Integrating time management skills into the learning process and using digital project management tools can mitigate these challenges (Santucci et al., 2020). Effective time management is crucial, as limited time can compromise critical thinking, communication, and creativity by leading to rushed projects and diminished opportunities for in-depth analysis.

Technological Challenges

Technological issues, such as unstable internet connections and varying levels of digital literacy, pose substantial obstacles in PjBL with ICT. Intermittent connectivity disrupts collaboration and resource access, leading to frustration and delays (Zilka et al., 2021). Disparities in digital literacy hinder effective engagement and collaboration (Surur et al., 2023). Solutions

include incorporating offline resources, providing digital literacy training, and developing contingency plans for technical issues (Motogna et al., 2020; Fami, et al., 2023; Patil & Karikatti et al., 2022). Technological challenges can divert focus from critical thinking to troubleshooting, affecting overall engagement and creativity.

Physical and Psychological Factors

Physical and psychological factors, including stress and burnout, impact both teachers and students. The rigorous demands of PjBL with ICT contribute to elevated stress levels and exhaustion (Cai et al., 2019; Taylor et al., 2024). Students also face stress from technical issues and time constraints, affecting motivation and academic performance. Addressing these challenges involves implementing stress management initiatives, promoting self-care, and offering reliable technical support (Demir & Onal, 2021; Taylor et al., 2024; Mergendoller & Thomas, 2017). Stress can reduce cognitive functions and motivation, impacting critical thinking, communication, and creativity.

Insufficient Teacher Training and Scaffolding

Inadequate teacher training and scaffolding hinder the effective use of ICT in PjBL. Many teachers lack confidence and competence in ICT integration, resulting in suboptimal use of technology (Kwon et al., 2019; Voogt et al., 2018). Continuous professional development and mentoring are necessary to address this gap (Koh et al., 2020; Kopcha et al., 2023). Effective teacher training should include technological, pedagogical, and content knowledge (Voogt et al., 2018). Insufficient training can lead to poorly structured projects and limited creative exploration, affecting students' ability to develop 4Cs skills.

In conclusion, Implementing PjBL with ICT to enhance critical thinking, communication, collaboration, and creativity faces several significant challenges. Time management issues arise as teachers struggle to balance their increased workload for designing and managing projects with their other responsibilities, impacting students' engagement and the depth of their work. Technological challenges, such as unreliable internet connections, software compatibility issues, and varying levels of digital literacy, can hinder collaboration, resource access, and creativity. Physical and psychological factors, including stress and burnout among

both teachers and students, further exacerbate these issues, negatively affecting motivation and well-being. Additionally, insufficient teacher training and scaffolding limit the effective use of ICT, leading to underutilization of technology and inadequate support for diverse student needs. Addressing these challenges requires better time management strategies, enhanced technical support, stress management initiatives, and comprehensive professional development for teachers to integrate ICT and support student learning in PjBL environments effectively.

Conclusion and Implication

This study explored the potential benefits and challenges of integrating project-based learning with information and communication technology in nurturing students' 4C skills in EFL classrooms. The findings highlighted several advantages, including enhanced verbal and written communication, improved collaboration, effective problem-solving strategies, and the generation and presentation of innovative ideas. However, challenges such as time management issues, technical constraints, physical and psychological burdens, and insufficient teacher training were also noted. This pedagogical model promotes active learning, problem-solving, cooperation, and creativity through real-life projects supported by technology, aligning with the evolving needs of students in EFL contexts.

The research has broader implications beyond EFL classrooms, suggesting that integrating PjBL with ICT could foster essential 21st-century skills in various educational settings. Educators and policymakers should consider adopting this approach better to prepare students for contemporary workforce and societal challenges. Successful implementation requires addressing the identified obstacles through effective teacher training, resource allocation, and support mechanisms. While the study provides valuable insights, its qualitative nature and limited sample size restrict the generalizability of the findings. Future research should include quantitative assessments of skill improvement and evaluate the long-term impact of PjBL with ICT on students' 4Cs skills and language proficiency. Educators and policymakers must ensure proper teacher training, allocate necessary resources, and establish robust support systems to optimize benefits and address challenges.

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