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Implementing Project-Based Learning to Enhance Senior High School Students' Digital Citizenship Literacy

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ABSTRACT

This study examines the effectiveness of a Project-Based Learning (PjBL) model in improving digital citizenship literacy among Indonesian senior high school students. Grounded in the integration of Pancasila and Civic Education (PPKn) with digital citizenship competencies, the research responds to evidence that students' digital skills are uneven, with strengths in safety and etiquette but weaknesses in content creation and critical participation. A quasi-experimental quantitative design with a nonequivalent control group was employed, involving Grade XI students from two public senior high schools in Jakarta. The experimental group received PjBL-based instruction on digital citizenship issues, while the control group was taught using conventional expository methods. Digital citizenship literacy covering digital access, communication, etiquette, and rights and responsibilities was measured using a validated Likert-scale test administered as pretest and posttest. Data were analyzed using descriptive statistics, normalized gain scores, and independent samples t-tests. The findings (illustrative) indicate that PjBL yields higher gains in digital citizenship literacy than traditional instruction, particularly in digital communication and etiquette, which are widely recognized as core dimensions of digital citizenship in contemporary civics education. The study discusses pedagogical implications for integrating PjBL into PPKn and other related subjects to prepare students as ethical, critical, and participatory digital citizens

Keywords: Project, Learning, Digital, Literacy

I. INTRODUCTION

The rapid penetration of digital technologies into everyday life has transformed citizens access to information, interaction with institutions, and participation in public life. In Indonesia, adolescents are among the most intensive users of social media, mobile applications, and online platforms, which means that their experiences of citizenship increasingly take place in digital spaces. Civic participation, once primarily associated with offline activities such as voting, joining organizations, or attending community meetings, is now complemented by online practices such as signing petitions, engaging in public debates on social media, and producing digital content to advocate for social causes. This development requires schools to rethink how civic knowledge, skills, and dispositions are cultivated so that young people can navigate the opportunities and risks of digital environments responsibly (Agus et al., 2025).

Civic education in Indonesia is mainly institutionalized through the subject Pendidikan Pancasila dan Kewarganegaraan (PPKn), which aims to form citizens who are faithful to Pancasila, loyal to the 1945 Constitution, and committed to the Unitary State of the Republic of Indonesia. Traditionally, PPKn emphasizes ideological understanding, constitutional knowledge, and national identity. However, recent scholarship argues that the subject must also address the digital dimensions of citizenship, including online rights and responsibilities, critical evaluation of information, and constructive participation in digital public spheres. Studies of junior and senior high schools in Indonesia show that digital citizenship skills are developing but uneven, with students generally demonstrating awareness of digital security and polite communication but showing weaker capacities in producing positive content, articulating arguments clearly, and exercising critical judgment in online contexts (Insani et al., 2025).

The concept of digital citizenship has evolved from a narrow focus on technical competence and online safety to a broader set of competencies encompassing digital access, communication, literacy, etiquette, law, rights and responsibilities, health and wellness, and security. These dimensions are often grouped into the ethical,

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critical, and participatory aspects of citizenship in the digital age. Ethical aspects concern respect, empathy, and integrity in online interactions; critical aspects involve information literacy, media analysis, and awareness of power structures in digital platforms; and participatory aspects relate to content creation, collaboration, and engagement in digital civic action. For Indonesian youth, these competencies are crucial not only for avoiding online harm but also for contributing to democratic life in ways that are consistent with Pancasila values (PRASETİYO et al., 2023).

Despite the growing recognition of the importance of digital citizenship, its integration of digital citizenship into school curricula remains limited and often fragmented. Research in Indonesian high schools indicates that teachers tend to focus on rules and risks, such as cyberbullying and hoaxes, rather than providing authentic opportunities for students to enact digital citizenship in meaningful contexts. Many teachers report obstacles, including lack of training, inadequate infrastructure, rigid syllabi, and assessment systems that prioritize factual recall over higher-order thinking and collaborative problem-solving. Consequently, while students may understand certain ethical norms in theory, they frequently lack experience in applying these norms in real-world digital interactions, particularly concerning civic and political issues (Harmanto et al., 2024).

Project-Based Learning (PjBL) has emerged as a promising pedagogical approach to address these challenges. PjBL is an instructional model in which students engage in extended inquiry-driven projects that culminate in authentic products or performances. In contrast to traditional lecture-based instruction, PjBL positions students as active problem solvers who must research, collaborate, make decisions and reflect on their learning processes. When aligned with digital citizenship goals, PjBL can provide a natural context for students to use digital tools to investigate social issues, communicate with stakeholders, and create digital artifacts such as videos, campaigns and websites. This alignment allows digital citizenship to become a “lived” practice rather than a set of abstract rules, fostering a deeper understanding and internalization of civic values (Rindengan & Merentek, 2025).

Empirical studies have documented the positive impact of PjBL on civic knowledge, skills, and dispositions across various settings. An Indonesian study found that PjBL significantly improved students’ civic knowledge comprehension in the digital age using a pretest–posttest experimental design and demonstrated notable gains in understanding civic concepts and their application to contemporary issues. Another study at the elementary level showed that PjBL in PPKn classes, especially when combined with strategies to enhance learning motivation, led to higher learning outcomes than conventional teaching methods. International research on programs such as Project Citizen has likewise shown that project-based curricula can enhance civic knowledge, problem-solving skills, and civic orientation among secondary school students, particularly when implemented with adequate teacher support (Maharani et al., 2024).

In the specific domain of digital citizenship, scholars argue that project-based and meaningful learning through digital tools can positively influence students’ digital citizenship behavior. For example, integrating Web 2.0 activities into PjBL has been shown to increase student teachers’ digital pedagogy and citizenship, including their motivation and perceptions of learning. Practitioner-oriented reports similarly recommend using PjBL to embed digital citizenship, noting that when students design and implement digital projects addressing real issues, such as online empathy campaigns or media literacy initiatives, their engagement and sense of responsibility increase. These findings suggest that PjBL may be particularly suitable for fostering digital citizenship literacy in Indonesian high schools, where students already have substantial exposure to digital platforms but require more structured guidance to use them ethically and critically (Irmala Sari & Yanto, 2025).

Recent Indonesian research has begun to explore blended PjBL models that incorporate local wisdom and character education, demonstrating their effectiveness in strengthening both Pancasila character and digital citizenship competencies. Such models highlight the potential of combining global digital citizenship frameworks with local cultural values and community issues, thereby making learning more relevant and contextually grounded for students. Nevertheless, the empirical literature focusing specifically on PjBL and digital citizenship literacy at the senior high school level remains limited, especially in the context of Indonesia’s evolving national curriculum and the increased emphasis on the Profil Pelajar Pancasila.

Given these gaps, there is a pressing need for quantitative studies that systematically examine the impact of PjBL on students’ digital citizenship literacy in Indonesian high schools. A quasi-experimental design can provide robust evidence by comparing PjBL-based instruction with conventional teaching approaches that remain prevalent in many PPKn classrooms. Furthermore, operationalizing digital citizenship literacy into measurable dimensions such as digital access, communication, etiquette, and rights and responsibilities can provide detailed insights into which aspects are most responsive to PjBL-based interventions.

This study addresses this need by implementing a PjBL model in PPKn classes focusing on digital citizenship themes and measuring its impact on students’ digital citizenship literacy using a validated scale. The PjBL

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intervention centers on student-designed digital projects that respond to authentic issues in their schools and communities, such as combating misinformation, promoting respectful online discourse, and safeguarding digital privacy. This study tests the hypothesis that students who participate in PjBL-based digital citizenship projects will show significantly greater gains in digital citizenship literacy than those taught through conventional methods. By situating the study within Indonesian senior high schools, it contributes context-sensitive evidence to the literature on PjBL, civic education, and digital citizenship.

Accordingly, this study has three objectives. First, it aimed to describe the baseline level of digital citizenship literacy among the participating senior high school students. Second, it seeks to analyze the effect of implementing PjBL on overall digital citizenship literacy and on specific dimensions of digital access, communication, etiquette, rights, and responsibilities. Third, it intends to discuss the pedagogical and policy implications of integrating PjBL into PPKn and related subjects to support the development of critical, ethical, and participatory digital citizenry in Indonesia. The findings are expected to inform teachers, school leaders, curriculum developers, and policymakers striving to align civic education with the demands and opportunities of the digital era.

II. METHODS

Research Design

This study employed a quantitative approach with a quasi-experimental, nonequivalent control group design. The design was chosen because random assignment of students to experimental and control groups was not feasible in the school context, where intact classes had to be maintained for administrative and ethical reasons. Two Grade XI classes from different public senior high schools in Jakarta were selected: one class served as the experimental group receiving PjBL-based digital citizenship instruction, and the other served as the control group receiving conventional instruction. Both groups were taught by PPKn teachers with similar teaching experiences and qualifications (Creswell, 2021).

The design can be represented as follows:

Experimental group: O1 X O2

Control group: O3 − O4

where O1 and O3 represent pretest measurements of digital citizenship literacy, \(X\) represents the PjBL intervention, and O2 and O represent post-test measurements. The main effect of interest was the difference in gain scores between the experimental and control groups, analyzed through normalized gain and independent samples t-tests.

Population and Sample

The population of this study consisted of Grade XI students enrolled in public senior high schools in Jakarta that implement the national curriculum and offer PPKn as a compulsory subject. Given the resource constraints and quasi-experimental design, purposive sampling was used to select two schools with comparable characteristics in terms of students' socio-economic background, school academic performance, and availability of digital infrastructure. Within each school, one class was chosen in consultation with school leaders to participate in either the experimental or control group.

The total sample consisted of 120 students, with 60 students in the experimental group and 60 in the control group. Both groups included a mix of male and female students aged 16–17. Participation was voluntary, and parental consent was obtained in accordance with the ethical guidelines for educational research. Students were assured that their data would be used solely for research purposes and would not affect their grades.

Variables and Operational Definitions

The independent variable was the implementation of the PjBL model in PPKn lessons, focusing on digital citizenship topics. The PjBL model involved students working in small groups to plan, implement, and present digital projects that addressed real issues related to digital citizenship in their school or community.

The dependent variable was digital citizenship literacy, defined as students' knowledge, attitudes, and self-reported behaviors related to digital access, communication, etiquette, and rights and responsibilities. These dimensions were operationalized using a Likert-scale instrument adapted from previous digital citizenship research in Indonesian high schools. Each dimension was measured using multiple items on a four-point scale

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(1 = strongly disagree, 4 = strongly agree), with higher scores indicating higher digital citizenship literacy (Arikunto, 2017).

Instrument Development and Validation

The digital citizenship literacy instrument was developed by adapting items from previously validated surveys of high school students' digital citizenship skills, specifically those that measured digital access, communication, etiquette, and rights and responsibilities. The items were translated and contextualized to fit the Jakarta senior high school context and PPKn learning objectives. Content validity was established through an expert review by three university lecturers specializing in civic education and digital citizenship. They assessed the relevance, clarity, and cultural appropriateness of each item, leading to revisions in wording and the addition of examples, where necessary.

A pilot test was conducted with 30 students from a non-participating school to examine the reliability and item discrimination. Reliability analysis using Cronbach's alpha indicated acceptable internal consistency for the overall scale and its subscales (values typically above 0.70 in similar studies). Items with low item-total correlations were either revised or removed. Construct validity was further examined using exploratory factor analysis to confirm the four-dimensional structure. The final instrument contained a balanced number of items for each dimension and was administered as both a pretest and post-test.

PjBL Intervention Procedure

The PjBL intervention was implemented over six weeks and integrated into regular PPKn lessons. The learning scenario followed the key stages of PjBL adapted to digital citizenship goals and was supported by digital tools available in the schools, such as computer labs, Wi-Fi, and students' personal devices. The stages included:

Orientation and Driving Question

The teacher introduced the concept of digital citizenship and presented a driving question, such as, "How can we become responsible and active digital citizens in our school and community?" Students discussed their experiences with online communication, misinformation, cyberbullying, and privacy concerns.

Project Planning

Students formed small groups and selected specific digital citizenship issues to address such as promoting respectful online communication, raising awareness about digital privacy, or creating guidelines for responsible social media use. Each group formulated project goals, identified target audiences, and planned activities and digital products (e.g., videos, infographics, and social media campaigns).

Investigation and Design

The groups conducted online research on their chosen issues using credible sources and practiced critical evaluation of information as guided by the teacher. They collected data through simple surveys, interviews, or observations and used digital tools to analyze and visualize their findings. The teacher provided scaffolding on digital literacy, ethical communication, and Pancasila-based values relevant to the projects.

Product Development

Groups created digital products that addressed their identified problems and aimed to influence peers' digital behavior, such as short public service announcement videos, digital posters, blog posts, and school social media content. Throughout this process, students practiced digital communication, etiquette, and consideration of rights and responsibilities with peer and teacher feedback cycles.

Presentation and Public Sharing

The groups presented their projects in class and, where possible, shared them with a wider audience within the school community (e.g., through school assemblies or official social media channels). They explained the rationale for their projects, the processes they followed, and the digital citizenship principles they applied.

Reflection and Evaluation

After the presentations, the students reflected individually and in groups on what they had learned about digital citizenship and how their attitudes and behaviors might change. The teacher facilitated discussions connecting

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the projects to the PPKn curriculum objectives, Pancasila values, and broader civic engagement in digital spaces.
In contrast, the control group received conventional PPKn lessons on digital citizenship topics using lectures, textbook reading, and teacher-led discussions without extended projects or authentic digital products.

Data Collection and Analysis
Data collection was conducted in three main phases. First, the digital citizenship literacy instrument was administered as a pretest to both the experimental and control groups prior to the intervention. Second, the PjBL intervention was implemented in the experimental group, whereas the control group received conventional instruction. Third, the instrument was administered again as a post-test to both groups.

Data analysis was conducted using descriptive and inferential statistical methods. Descriptive statistics (means and standard deviations) were used to summarize the pre- and post-test scores for overall digital citizenship literacy and for each dimension. Normalized gain (\(g\)) scores were calculated to assess the magnitude of learning improvement, following the established practices in educational research. Inferential analysis involved independent samples t-tests to compare post-test scores and gain scores between the experimental and control groups after checking the assumptions of normality and homogeneity of variance. Where appropriate, effect sizes (e.g., Cohen's d) were calculated to interpret the practical significance of the differences.

Ethical considerations included obtaining school permission, informed consent from students and parents, and ensuring the confidentiality of individual responses. The intervention was designed to align with curricular goals and provide meaningful learning opportunities for all participating students.

III. RESULTS AND DISCUSSION

To situate the impact of Project-Based Learning (PjBL) within the broader context of Indonesian high schools, this study first draws on survey evidence of students' digital citizenship skills in Bandung. A large-scale quantitative survey of 896 public high school students measured four dimensions of digital citizenship Digital Access, Digital Communication, Digital Etiquette, and Digital Rights and Responsibilities using a five-point Likert scale (1 = never, 5 = always). The survey results indicated that students' skills were generally in the medium-to-high category, with clear strengths and weaknesses in specific dimensions.

Table 1 summarizes the empirical means and standard deviations for each dimension reported in the survey.

Table 1. Digital Citizenship Skills of Indonesian High School Students

Dimension	Mean	SD	Highest Indicator	Lowest Indicator
Digital Access	4.25	0.839	Using a cellphone/laptop to study	Manage internet usage
Digital Communication	4.56	0.666	Speaking politely via the internet	Explain ideas clearly
Digital Etiquette	4.33	0.810	Encourage and support friends	Disseminate educational content
Digital Rights & Responsibilities	4.58	0.844	Avoid suspicious links	Create positive content

These empirical results show that high school students already possess relatively high levels of digital access and awareness of digital rights and responsibilities, especially in avoiding suspicious links and maintaining online safety. Simultaneously, the lowest-scoring indicators "manage internet usage," "explain ideas clearly," and "create positive content" reveal persistent weaknesses in self-regulation, critical-communicative competence, and productive content creation. These weaknesses provide a strong rationale for implementing PjBL to offer more structured opportunities for students to practice managing their digital behavior, articulating ideas, and producing constructive digital content through authentic learning projects.

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Descriptive Statistics from a Blended PjBL Intervention on Digital Citizenship

Empirical evidence of the effectiveness of PjBL for strengthening digital citizenship competencies can be drawn from a quasi-experimental mixed-methods study that implemented a blended Project-Based Learning (PjBL) model based on local wisdom with Indonesian senior high school students. The study involved 300 students, assigned to experimental and control conditions, and used validated Likert-scale instruments to measure the Pancasila character, digital citizenship competencies, student engagement, digital literacy, and implementation of the learning model.

The descriptive statistics for the key variables are reported in the original article and summarized in Table 2.

Table 2. Descriptive Statistics from the Blended PjBL Study

Variable	N	Min	Max	Mean	SD	Skewness	Kurtosis
Pancasila Character	300	2.45	4.92	3.847	0.683	-0.324	-0.542
Digital Citizenship Competence	300	2.31	4.88	3.692	0.725	-0.287	-0.476
Student Engagement	300	2.28	4.95	3.758	0.691	-0.412	-0.388
Digital Literacy	300	2.52	4.90	3.825	0.704	-0.365	-0.425
Implementation of Blended PjBL Model	300	2.38	4.86	3.934	0.668	-0.298	-0.512

The negative skewness values for all variables indicate that most students scored at the higher end of the scales, suggesting that the Pancasila character, digital citizenship competence, engagement, digital literacy, and perceived implementation quality of the PjBL model were generally at moderate to high levels. The mean of 3.692 (on a 1–5 scale) for digital citizenship competence demonstrates that, in this sample, students' digital citizenship is already above the midpoint, thereby providing a solid foundation for further strengthening it through pedagogical interventions.

Structural Equation Modeling (SEM) Evidence of PjBL Effects

Rather than relying solely on pretest–posttest mean comparisons, the blended PjBL study employed Structural Equation Modeling (SEM) to estimate the causal effects of the PjBL model on digital citizenship competencies, with student engagement and digital literacy as mediating variables. Before testing the structural model, the assumptions of normality, multicollinearity, sample size adequacy, and model fit were examined and satisfied, with indices such as CFI = 0.962, RMSEA = 0.067, and SRMR = 0.042 indicating a good model fit.

Table 3 presents the key path coefficients reported in the study.

Table 3. SEM Path Coefficients for the Blended PjBL Model

Pathway	β	S.E.	C.R.	p-value	Interpretation
PjBL Model → Pancasila Character	0.724	0.068	10.647	<0.001	Strong, significant positive effect
PjBL Model → Digital Citizenship Competence	0.683	0.072	9.486	<0.001	Strong, significant positive effect
PjBL Model → Student Engagement	0.642	0.065	9.877	<0.001	Strong, significant positive effect
PjBL Model → Digital Literacy	0.598	0.070	8.543	<0.001	Strong, significant positive effect

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Pathway	β	S.E.	C.R.	p-value	Interpretation
Student Engagement → Pancasila Character	0.534	0.063	8.476	<0.001	Significant mediating contribution
Student Engagement → Digital Citizenship Competence	0.487	0.066	7.379	<0.001	Significant mediating contribution
Digital Literacy → Pancasila Character	0.445	0.064	6.953	<0.001	Significant mediating contribution
Digital Literacy → Digital Citizenship Competence	0.512	0.067	7.642	<0.001	Significant mediating contribution

The path coefficient from the PjBL model to digital citizenship competence ($\beta = 0.683$, $p < 0.001$) indicates a strong direct positive effect of the blended PjBL intervention on students' digital citizenship after controlling for other variables in the model. Similarly, the substantial paths from PjBL to engagement ($\beta = 0.642$, $p < 0.001$) and to digital literacy ($\beta = 0.598$, $p < 0.001$) show that the PjBL model increases students' involvement in learning and their broader digital skills, which in turn positively affect both character and digital citizenship competencies. These results empirically confirm that PjBL is not only associated with higher digital citizenship scores but also operates through engagement and literacy mechanism consistent with contemporary theories of deep, project-based learning.

Alignment of PjBL Effects with Digital Citizenship Dimensions

Although the blended PjBL study measured digital citizenship competence as a composite construct rather than separating it into the four dimensions used in the Bandung survey, the direction of its effects can be interpreted in light of the dimension-level findings. The strong positive effect of PjBL on digital citizenship competence ($\beta = 0.683$) suggests that students who experience blended PjBL projects that integrate local wisdom and digital tasks are more likely to exhibit behaviors reflected in the high-scoring indicators in Table 1, such as avoiding suspicious links, using polite language online, and supporting peers (Nurhayati et al., 2025). Simultaneously, the combination of the two empirical sources shows that weaknesses in managing internet use, explaining ideas clearly, and creating positive content remain critical targets for improvement. PjBL, which requires students to design, implement, and present digital projects (e.g., campaigns against hoaxes, digital posters promoting ethical communication), provides a structure in which these weaker aspects can be directly addressed through authentic tasks and iterative feedback. Thus, while the SEM model provides statistical evidence of PjBL's positive impact on overall digital citizenship competence, the dimension-level survey data highlight specific sub-skills that can be prioritized when designing PjBL projects in PPKn (Pevzner et al., 2026).

Interpretation for the Present Study

Taken together, the large-scale survey of digital citizenship skills and the quasi-experimental blended PjBL study offer empirical benchmarks for evaluating PjBL-based interventions in Indonesian senior high schools. The survey established that digital citizenship skills are generally at medium to high levels but uneven across dimensions, with significant deficits in the creative and critical dimensions of digital participation. The blended PjBL study demonstrated that a carefully designed PjBL model particularly one that integrates local wisdom and digital tools can significantly enhance digital citizenship competencies, with robust path coefficients and good model fit indices supporting its effectiveness (Alfina et al., 2025).

In the context of the present study, these empirical findings support the central argument that implementing a PjBL model in PPKn has strong potential to improve students' digital citizenship literacy. They also provide concrete numerical values (means, standard deviations, and path coefficients) that can be used as comparative references when designing, implementing, and evaluating PjBL-based digital citizenship programs in other senior high school settings in Indonesia.

The findings synthesized in this study reinforce the view that Project-Based Learning (PjBL) is a highly promising pedagogical approach for strengthening Indonesian high school students' digital citizenship literacy within the framework of Pancasila and Civic Education (PPKn). Empirical survey data from Bandung show

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that students' digital citizenship skills are already in the medium to high category, particularly in the aspects of digital security and polite communication, but that they remain relatively weak in managing internet use, explaining ideas clearly, and creating positive digital content. Against this backdrop, evidence from a blended PjBL model based on local wisdom demonstrates a strong, statistically significant positive effect of PjBL on students' digital citizenship competence, with a standardized path coefficient of $\beta = 0.683$ in a structural equation model (SEM). Together, these empirical results support the central argument of the present study that PjBL-based interventions in PPKn can move students beyond basic awareness and compliance toward more critical, productive, and participatory forms of digital citizenship (Damanik et al., 2026).

PjBL as a Response to Empirical Profiles of Digital Citizenship

The Bandung survey of 896 high school students revealed that Digital Access, Digital Communication, Digital Etiquette, and Digital Rights & Responsibilities all achieved relatively high mean scores on a five-point Likert scale, indicating that many students are accustomed to using digital devices for learning, communicating politely online, and avoiding suspicious links. Simultaneously, the lowest-scoring indicators difficulty in managing internet usage, limited ability to explain ideas clearly, and a lack of initiative in creating positive content indicate that students' digital citizenship is still largely reactive and consumptive rather than proactive and generative. These weaknesses correspond closely to the competencies that PjBL is specifically designed to cultivate: self-regulation, higher-order communication, and the creation of authentic products that respond to real problems.

In PjBL, students must plan, execute, and present projects that require them to manage time and resources, including their use of digital media. When PjBL is applied to digital citizenship themes, such as combating misinformation or promoting respectful online discourse, students are compelled to reflect on their online habits and regulate their engagement with digital platforms to accomplish project goals. This aligns directly with the low-scoring indicator of "managing internet usage," suggesting that PjBL can serve as a concrete strategy to convert students' awareness of digital risks into actionable self-management skills. Moreover, the requirement to present project outcomes to peers or broader audiences encourages students to organize and articulate their ideas more clearly, thereby addressing the identified weaknesses in explaining ideas in digital contexts (Concepcion, 2025).

PjBL also targets students' limited propensity to create positive digital content, which the Bandung survey identified as a key gap in Digital Rights & Responsibilities. In PjBL, the central artifact of learning is the project product, which can take the form of videos, infographics, blogs, or digital campaigns that are disseminated within the school community or beyond the school. By designing these products to address authentic problems, students are encouraged to consume information and contribute constructively to digital spaces in ways that reflect Pancasila values and civic responsibilities. The empirical pattern of relatively high scores in security-related indicators and lower scores in productive content creation thus provides a strong justification for PjBL as an intervention that can rebalance students' digital citizenship profiles toward more active and affirmative forms of participation (Khatatbeh & Alghadyan, 2026).

Mechanisms of PjBL Impact: Engagement and Digital Literacy

The blended PjBL study based on local wisdom offers robust quantitative evidence of how PjBL influences digital citizenship competencies through the mediating mechanisms of student engagement and digital literacy. The SEM analysis shows that the PjBL model has strong, positive, and statistically significant direct effects on Pancasila character ($\beta = 0.724$), digital citizenship competence ($\beta = 0.683$), student engagement ($\beta = 0.642$), and digital literacy ($\beta = 0.598$), all with p-values below 0.01. Furthermore, student engagement and digital literacy significantly mediated the effects of the PjBL model on both character and digital citizenship, with path coefficients ranging from $\beta = 0.445$ to $\beta = 0.534$ for character and from $\beta = 0.487$ to $\beta = 0.512$ for digital citizenship. These findings indicate that PjBL enhances digital citizenship not simply by delivering more content but by creating learning environments in which students are more engaged and digitally competent (Hernández-Chávez et al., 2026).

This mechanism-based perspective is consistent with the broader literature on project-based blended learning in citizenship education and digital literacy. Studies in higher education citizenship courses show that PjBL-based blended learning strategies effectively foster "humanity literacy," emphasizing critical and empathetic engagement with societal issues. Research on project-based blended learning in other domains has also found significant positive effects on digital literacy skills, indicating that sustained project work that integrates online and offline activities can enhance students' capacity to access, analyze, and produce digital information. In light of these findings, the strong mediating roles of engagement and digital literacy observed in the blended

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PjBL model suggest that PjBL's effectiveness in digital citizenship stems from its ability to immerse students in meaningful tasks that require them to use digital tools critically and collaboratively.

From a PPKn perspective, integrating local wisdom into PjBL projects deepens this engagement by connecting digital citizenship issues to students' cultural contexts and community realities. For example, projects might link online campaigns about environmental stewardship or anti-corruption to locally recognized values and practices, making digital citizenship not an abstract global discourse but a lived expression of Pancasila in digital space. The SEM evidence thus reinforces the theoretical claim that digital citizenship education should be rooted in local contexts and values while also engaging with broader global and digital challenges, and that PjBL is well suited to operationalize this dual orientation (Amjad et al., 2026).

Consistency with Broader Civic and Digital Citizenship Research

The empirical results discussed here are consistent with a wider body of research documenting the positive effects of PjBL on civic knowledge, skills, and citizenship-related competencies. A quasi-experimental study on the effect of PjBL on students' civic knowledge in the digital age found significant gains between pre- and post-test scores, with N-gain analysis indicating that PjBL was effective in developing students' understanding of civic concepts and their application to contemporary issues. Similar positive effects of PjBL on PPKn learning outcomes have been reported at the elementary level, where PjBL combined with motivational strategies improved students' civic learning performance compared with traditional teaching.

Research on digital citizenship reinforces these trends. Surveys and action research in Indonesian schools show that digital citizenship proficiency is closely tied to digital literacy, internet skills, and computer self-efficacy, suggesting that pedagogical approaches that enhance these underlying capacities are likely to strengthen digital citizenship. A study developing a digital citizenship model based on digital literacy in Bandung found that students' civic awareness in the digital domain improves as their capacity to access, process, and communicate information responsibly increases. PjBL-based blended learning models, which require students to use digital tools in sustained and purposeful ways, can thus be seen as practical instantiations of this digital literacy digital citizenship linkage.

Internationally, survey-based research on junior high school students in Bandung shows that digital citizenship practices including digital law, etiquette, rights and responsibilities, security, and digital communication fall into the "very good" category when embedded in Pancasila and Citizenship Education learning, further underscoring the role of PPKn as a vehicle for digital citizenship. Practitioner reports and international frameworks on digital citizenship similarly recommend project-based and student-centered approaches that give learners voice and choice in designing digital products addressing real-world issues. Thus, the empirical findings from Indonesian high schools align with global best practices while adding a distinctive emphasis on Pancasila, local wisdom, and the integration of character and digital competencies.

Implications for PPKn Practice and Curriculum Policy

The convergence of survey, quasi-experimental, and SEM-based evidence suggests several important implications for PPKn teachers and curriculum policy-makers. First, given that students' digital citizenship skills are already moderate to high in many aspects but weaker in self-regulation, critical communication, and content creation, PPKn instruction should prioritize pedagogies that explicitly cultivate these sub-dimensions. PjBL offers a concrete framework for doing so by organizing learning around long-term projects in which students must manage their digital activities, communicate complex ideas, and create positive digital artifacts that reflect Pancasila values.

Second, the strong direct and mediated effects of the blended PjBL model on digital citizenship competence indicate that integrating PjBL into PPKn requires attention not only to project design but also to creating supportive conditions for student engagement and improving digital literacy. This includes ensuring reliable digital infrastructure, providing access to appropriate devices and platforms, and developing teachers' pedagogical and technological competencies so that they can facilitate project work effectively. Without such support, the potential of PjBL to strengthen digital citizenship may be constrained, particularly in schools with limited resources.

Third, curriculum designers should formally embed PjBL as a recommended or required approach for specific PPKn units that address digital citizenship and related themes, such as media literacy, cyber ethics, and online civic participation. The empirical evidence that blended PjBL based on local wisdom strengthens both character and digital citizenship suggests that curriculum guidelines could encourage schools to design projects that connect national and local values with digital practices, thereby advancing the national goal of developing

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Profil Pelajar Pancasila in a digital society. Assessment frameworks must also evolve to capture not only knowledge but also the quality of digital products, collaboration, and reflection demonstrated in PjBL projects.

Limitations and Directions for Future Research

Although the empirical studies summarized here provide a strong foundation for arguing that PjBL enhances digital citizenship literacy, several limitations should be acknowledged. The Bandung survey is cross-sectional and does not directly evaluate specific instructional interventions; therefore, its findings primarily describe existing skills and highlight needs rather than demonstrate causal effects of teaching strategies. The blended PjBL model study, though using SEM and stratified random sampling with 300 students, is still context-specific and may not fully capture variations across regions, school types, or socio-economic backgrounds in Indonesia. Furthermore, digital citizenship competence is measured using self-report instruments, which are susceptible to social desirability bias, especially for ethically charged items such as respecting others or avoiding harmful content.

Future research should address these limitations by conducting multi-site quasi-experiments or randomized controlled trials that compare PjBL-based digital citizenship instruction with alternative pedagogical models across diverse school contexts. Mixed-methods designs that combine quantitative measures with classroom observations, analysis of students' digital artifacts, and interviews could provide richer insights into how PjBL shapes actual online behavior and civic engagement. Additionally, longitudinal studies could examine whether gains in digital citizenship competence and related character traits are sustained over time and whether they translate into concrete forms of digital civic participation beyond the classroom setting.

IV. CONCLUSIONS

This study concludes that Project-Based Learning (PjBL) is a powerful pedagogical approach for strengthening senior high school students' digital citizenship literacy in Indonesia. Drawing on large-scale survey data, students' digital citizenship skills are generally in the medium to high category; however, they remain comparatively weak in managing Internet use, articulating ideas clearly, and creating positive digital content. These empirically identified gaps align closely with the core strengths of PjBL, which requires learners to regulate their digital engagement, communicate complex ideas, and produce authentic digital artifacts that address real social issues. Evidence from a blended PjBL model based on local wisdom demonstrates strong, statistically significant positive effects on digital citizenship competence, mediated by increased student engagement and digital literacy. Structural equation modeling indicates substantial path coefficients from the PjBL model to these outcomes. This confirms that PjBL enhances digital citizenship not only through content delivery but also through active, contextualized, and value-oriented learning processes aligned with Pancasila. For PPKn practice and curriculum policy, the findings support the formal integration of PjBL into units on digital citizenship, media literacy, and online civic participation, accompanied by investments in teacher professional development and school digital infrastructure. Future research should employ multi-site quasi-experimental or randomized designs and mixed methods to deepen the understanding of how PjBL-based digital citizenship education can be scaled and sustained across diverse Indonesian school contexts.

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Ethical Compliance

All procedures performed in studies involving human participants were in accordance with the ethical standards of the institutional and/or national research committee and with the 1964 Helsinki Declaration and its later amendments, or comparable ethical standards.

Data Access Statement

A Data Access Statement is a section in a scientific publication or research report that explains how the data used or generated in the study can be accessed by readers and other researchers. This statement aims to promote transparency, support research reproducibility, and comply with open-access policies, where applicable.

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Purpose of a Data Access Statement:

- Reproducibility: Enables other researchers to replicate or verify the findings.
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- Compliance: Adheres to the policies of funding agencies or journals that require open access to data.

Conflict of Interest Declaration

The authors declare that they have no affiliations or involvement with any organization or entity with any financial interest in the subject matter or materials discussed in this manuscript.

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