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A mobile–computer-based learning model to enhance students' critical thinking in Pancasila education at senior high schools in Bali

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Abstract

This study examines changes in senior high school students' critical thinking following the implementation of a mobile computer-based learning approach in Pancasila Education in Bali. Addressing the continued predominance of teacher-centered instruction, the study explores how an integrated Learning Management System (LMS), accessible via both mobile and desktop devices, supports learning activities that emphasize analysis, evaluation, and reflection within value-based contexts. A quasi-experimental pre-test–post-test design was employed involving 200 students from four public senior high schools in Bali. The intervention was implemented over four weeks as part of regular Pancasila Education lessons, during which students engaged in LMS-supported activities, including case-based discussions, formative digital assessments, and reflective assignments. Students' critical thinking skills were measured using a validated scenario-based test aligned with Pancasila Education content. Data were analyzed using paired-sample t-tests and effect size calculations, while LMS log data were examined descriptively to contextualize student engagement. The results show consistent improvements in students' critical thinking scores across all participating schools, with an average gain of approximately 13.5 points and large effect sizes (Cohen's $d > 1.6$). Engagement data indicate stable participation across learning activities, suggesting adequate implementation conditions. Given the absence of a control group, the findings are interpreted as evidence of learning improvement under comparable instructional conditions rather than as causal effects.

Keywords: Critical thinking, Learning management system, Mobile–computer-based learning, Pancasila education, Senior high school students.

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Contents

Contribution of this paper to the literature

This study contributes to the literature by explicitly operationalizing critical thinking as a measurable cognitive outcome in Pancasila Education and empirically examining an integrated mobile–computer-based LMS model in senior high schools. It provides context-specific evidence from Bali demonstrating how structured digital learning activities can support higher-order civic reasoning under authentic classroom conditions.

1. Introduction

The use of information and communication technology (ICT) in secondary education has increasingly been recognized as an important means of supporting higher-order cognitive skills, particularly critical thinking (Sousa, Marôco, Gonçalves, & Machado, 2022). Within the context of Pancasila Education, which seeks to foster students' civic competence, moral reasoning, and democratic attitudes, learning processes are expected to extend beyond the transmission of content toward activities that promote analysis, evaluation, and reflection on real social issues (Rengganis et al., 2023; Sulkipani, Komalasari, Sapriya, Fitriasari, & Blegur, 2025). In practice, however, instructional approaches in senior high schools continue to rely heavily on teacher-centered and text-based methods. Such approaches limit students' opportunities to engage actively and critically with Pancasila values. This situation underscores the need for instructional models that are capable of facilitating active learning and critical inquiry within civic education (Husni, 2021; Japar, Hermanto, Muyaroah, Susila, & Alfani, 2023).

Recent research indicates that mobile computer-based learning environments, particularly those supported by learning management systems (LMS), have the potential to enhance students' critical thinking, self-regulated learning, and collaboration skills. Mobile learning offers flexibility and autonomy, while computer-based platforms provide structured learning activities, formative assessments, and feedback mechanisms that support higher-order cognitive processes (Casmana & Rahmawati, 2020; King, Taylor, & Webb, 2021). In the field of social and civic education, digital discussion forums, case-based learning tasks, and reflective portfolios have been shown to support students' ability to critically analyze and evaluate socio-civic issues (Bömmel, 2026; Patras, Japar, Rahmawati, & Hidayat, 2025). Despite these findings, empirical studies that specifically design and validate mobile–computer-based learning models aimed at strengthening students' critical thinking in Pancasila Education at the senior high school level remain limited. This gap is particularly evident in culturally rich contexts such as Bali (Agus, Rizal, Muhajir, & Jamalong, 2025; Nguyen et al., 2025). Accordingly, the present study seeks to address this gap by developing and examining a mobile–computer-based learning model intended to enhance students' critical thinking in Pancasila Education at senior high schools in Bali (Hadikusuma, Syafri, Musyaffa, & Putra, 2024; Sulkipani et al., 2025).

Although digital learning technologies are increasingly available in senior high schools, Pancasila Education continues to be delivered predominantly through conventional, teacher-centered instructional practices that do not sufficiently promote students' critical thinking skills (Lutfi, Pramono, & Masrukhi, 2024). In many cases, the use of digital tools is confined to distributing learning materials rather than being purposefully designed to engage students in analysis, evaluation, and reflection on civic and moral issues grounded in Pancasila values (Bagherimajd & Khajedad, 2025; Wenger, Hubacher, Aydin, & Waldis, 2026). To respond to this challenge, the present study proposes a mobile–computer-based learning model that integrates structured LMS-supported activities, including case-based discussions, formative assessments, and reflective tasks, to foster an active and critical learning environment (Potocan, Nedelko, & Rosi, 2025; Sousa et al., 2022; Val & Quintas, 2025). By combining the flexibility of mobile access with the pedagogical structure of computer-based learning, the model is designed to systematically support the development of students' critical thinking in Pancasila Education at senior high schools in Bali.

Recent work in educational technology underscores that students' critical thinking is most effectively developed when digital learning environments are deliberately designed to foster higher-order cognitive processes, rather than functioning solely as channels for content delivery. Studies on mobile learning emphasize its advantages in terms of flexibility, accessibility, and sustained engagement, allowing students to interact with learning materials beyond the limits of the classroom (Lobos, Cobo-Rendón, Bruna Jofré, & Santana, 2024; Oyetade, Harmse, & Zuva, 2024). At the same time, computer-based learning environments supported by Learning Management Systems (LMS), such as Moodle, have been shown to enable structured learning sequences, formative assessment practices, and reflective feedback, which are essential for developing analytical, evaluative, and reasoning skills (Fischer, Lundin, & Lindberg, 2023; Senanayake et al., 2023). The literature consistently indicates that integrating mobile and computer-based modalities helps balance learner flexibility with pedagogical structure, thereby creating conditions that support the sustained development of critical thinking (Fischer et al., 2023; McCarthy, Maor, McConney, & Cavanaugh, 2023).

Within civic and values-based subjects such as Pancasila Education, researchers argue that critical thinking is most effectively cultivated through instructional approaches that emphasize case-based learning, collaborative discussion, and reflective tasks grounded in real social and moral issues (Japar et al., 2023; Komalasari, Fitriasari, & Noor Anggraini, 2021). Empirical evidence shows that LMS-supported discussion forums, guided inquiry activities, and digital portfolios encourage students to articulate arguments, examine diverse perspectives, and engage in systematic reflection on civic values (McCarthy et al., 2023; Sousa et al., 2022). Building on these findings, the

literature supports the implementation of integrated mobile–computer-based learning models that align digital learning features with specific critical thinking indicators, offering a theoretically sound and empirically supported approach to strengthening students' critical thinking in Pancasila Education (Casmana, Cahyana, & Paristiowati, 2020; Casmana & Rahmawati, 2020).

Empirical studies on digital learning consistently demonstrate that both mobile learning and computer-based LMS environments can contribute to the development of students' critical thinking when instructional activities are centered on inquiry, discussion, and reflection (Bömmel, 2026; Sulkipani et al., 2025). Research in civic and social science education further highlights that critical thinking is most effectively developed through argument-driven discussions, analysis of socio-political cases, and reflective evaluation of values and decisions. LMS-supported discussion forums, formative quizzes, and portfolio-based reflection have been identified as effective tools for organizing and supporting these learning processes (Trisiana, Priyanto, & Sutoyo, 2024). However, much of the existing research examines these tools in isolation or applies them within general subject areas, without explicitly situating critical thinking development within the epistemological and normative foundations of Pancasila Education (Oktaviani, Aulia, Murdiono, & Suharno, 2024; Rengganis et al., 2023).

Furthermore, research on Pancasila Education in Indonesian senior high schools has largely emphasized affective and character-based outcomes, including nationalism, civic disposition, and moral attitudes (Agus et al., 2025; Nguyen et al., 2025). Although these aspects are fundamental to the subject, they are frequently not supported by systematic instructional designs that define critical thinking as an explicit and measurable cognitive outcome. Only a limited number of studies clearly explain how particular digital learning features are aligned with specific critical thinking indicators such as analysis, evaluation, and inference within Pancasila learning activities, and even fewer provide empirical evidence derived from integrated mobile–computer-based learning environments (Kuncorowati, Handayani, & Subekti, 2025). This situation points to a clear research gap: the lack of an empirically examined, integrated mobile–computer-based learning model that deliberately embeds critical thinking into Pancasila Education and evaluates its effectiveness among senior high school students, especially within localized contexts such as Bali, where cultural values and civic education hold a central role (Agus et al., 2025; Gonzalez-Mohino, Rodriguez-Domenech, Callejas-Albiñana, & Castillo-Canalejo, 2023).

Accordingly, this study seeks to design and examine a mobile–computer-based learning model aimed at supporting the development of senior high school students' critical thinking skills in Pancasila Education. The primary contribution of this research lies in its explicit instructional alignment between digital learning activities and specific critical thinking processes within a civic and values-based educational context, rather than in claims of broad pedagogical innovation (Hadikusuma et al., 2024). By integrating mobile access with a structured LMS environment, the proposed model operationalizes critical thinking through case analysis, guided discussion, and reflective assessment grounded in Pancasila-related issues (Husni, 2021; Oktaviani et al., 2024). The study is limited to Pancasila Education classes in public senior high schools in Bali and examines changes in students' critical thinking skills following the implementation of the model under comparable instructional conditions, without extending causal claims beyond the specific context investigated.

2. Literature Review

2.1. Mobile–Computer-Based Learning in Civic and Values Education

Mobile–computer-based learning has been widely recognized as a relevant approach in civic and values education, where learning objectives emphasize reasoning, judgment, and ethical reflection beyond content mastery (Lloyd, Hyett, & Kenny, 2024). Mobile learning supports flexibility and continuous access to learning across contexts, while computer-based learning through Learning Management Systems (LMS) provides structured instructional sequences, assessment management, and documented learning processes (Fischer et al., 2023; Senanayake et al., 2023). The integration of these modalities is therefore considered effective in balancing accessibility with pedagogical structure, particularly for civic and values education that requires sustained analytical engagement (Lobos et al., 2024; Yaman, Sousa, Neves, & Luz, 2024).

Empirical studies show that LMS-supported environments can facilitate students' critical engagement with civic content when learning activities emphasize discussion, inquiry, and assessment. Digital discussion forums, scenario-based tasks, and formative assessments encourage students to articulate arguments, evaluate multiple perspectives, and reflect on value-laden social issues (Oksana, Kateryna, Iryna, Olena, & Neonila, 2022; Trisiana et al., 2024). Moodle-based implementations, in particular, have been associated with collaborative learning, transparent assessment, and iterative feedback, which are closely linked to higher-order thinking development in civic education (García, Gil-Mediavilla, Álvarez, & Casares, 2020; Sousa et al., 2022).

However, the literature also indicates that technology integration in civic and values education often remains focused on content delivery or administrative efficiency rather than on the intentional development of cognitive processes such as analysis, evaluation, and reasoning (Wenger et al., 2026). Many studies prioritize technology adoption or learner engagement without clearly demonstrating how digital features are aligned with civic learning outcomes (Bömmel, 2026; Kuncorowati et al., 2025). This limitation highlights the need for instructional models that explicitly integrate mobile and computer-based learning features with the cognitive demands of civic and values education, particularly within normative subjects such as Pancasila Education.

2.2. Developing Students' Critical Thinking in Pancasila Education

Pancasila Education is normatively positioned as a core subject for developing students' civic reasoning, moral judgment, and democratic dispositions in Indonesia (Hadikusuma et al., 2024; Patras et al., 2025). Recent curriculum reforms have shifted their orientation from value transmission toward critical engagement with constitutional principles, social justice issues, and pluralistic realities (Casmana et al., 2020; Husni, 2021). As a result, critical thinking encompassing analysis, evaluation, inference, and reflective judgment has been formally recognized as an essential cognitive outcome of Pancasila Education, particularly at the senior high school level, where students encounter increasingly complex socio-political and ethical issues (Trisiana et al., 2024).

Empirical research indicates that students' critical thinking in Pancasila Education is most effectively supported through inquiry-oriented and dialogic pedagogies, including case-based learning, moral dilemma discussions, problem-based learning, and structured debate (Hwang, Huang, & Chen, 2025; Komalasari et al., 2021). These approaches enable students to analyze competing values, evaluate arguments, and justify decisions grounded in Pancasila principles. However, the literature also highlights that such practices are often implemented inconsistently, rely heavily on individual teachers' initiatives, and lack systematic instructional scaffolding (Kuncorowati et al., 2025; Patras et al., 2025).

More critically, existing studies reveal a structural gap in the development of critical thinking within Pancasila Education (Agus et al., 2025; Hadikusuma et al., 2024). Assessment practices tend to prioritize factual recall and normative agreement, instructional innovations are rarely sustained across learning phases, and digital technologies are frequently used for content delivery rather than for cultivating higher-order thinking. These limitations point to the need for an integrated learning model that deliberately embeds critical thinking indicators within the instructional design of Pancasila Education and leverages digital platforms to support continuous engagement, reflection, and evidence-based assessment of students' civic reasoning (Casmana & Rahmawati, 2020; Oktaviani et al., 2024).

2.3. Contextual Implementation of LMS-Supported Learning in Senior High Schools in Bali

The implementation of LMS-supported learning in senior high schools in Bali takes place within a complex interplay of curricular demands, sociocultural values, and uneven pedagogical practices (Grover et al., 2022; Suratmi & Sopandi, 2022). Although Bali is often regarded as having a relatively adequate educational infrastructure, the use of LMS in classroom instruction, particularly in Pancasila Education, has largely remained functional rather than transformative (Martinez & Montoya, 2023). In most cases, LMS platforms are used primarily for distributing materials and collecting assignments, while their potential to support critical inquiry, ethical reasoning, and civic deliberation remains underutilized. This pattern reflects a broader tendency for digital technologies to be adopted administratively without strong alignment to higher-order learning objectives (Fahruddin & Saefudin, 2025; Rajab, Almarabeh, Mohammad, & Majdalawi, 2024).

From a pedagogical perspective, Pancasila Education poses specific challenges for LMS-based implementation because it is inherently value-laden and requires students to critically interpret social realities, moral dilemmas, and civic responsibilities (Chen, Zhang, Bi, Qiu, & Lyu, 2024; Zhang & Ma, 2024). However, classroom practices in Balinese senior high schools continue to prioritize content transmission and memorization over dialogic and analytical engagement, even when digital tools are available (Ambusaidi & Al-Abri, 2023; Chanaa & El Faddouli, 2024). Consequently, the presence of LMS alone does not ensure the development of students' critical thinking unless it is supported by intentional instructional design and active teacher facilitation (Johnston, Wells, Shanks, Boey, & Parsons, 2024).

Accordingly, the relevance of LMS-supported learning in Bali should be assessed not in terms of technological availability but in relation to how it is pedagogically enacted within existing school cultures (Efiloğlu Kurt, 2023; Marín, Sampedro, Muñoz González, & Vega, 2022). An effective LMS model for Pancasila Education must integrate critical thinking activities such as case analysis, guided discussion, and reflective tasks into the digital learning flow, positioning the LMS as a scaffold for critical engagement rather than a mere delivery system (Rahmani, Groot, & Rahmani, 2024; Sader et al., 2022). This perspective underscores the need for a context-sensitive and pedagogically explicit learning model capable of addressing the gap between normative civic instruction and the development of students' critical thinking skills in Balinese senior high schools (Agus et al., 2025; Trisiana et al., 2024; Wenger et al., 2026).

3. Research Method

3.1. Research Design

This study employed a quasi-experimental research design to examine changes in students' critical thinking following the implementation of a mobile computer-based learning approach in Pancasila Education. Specifically, a pre-test–post-test non-equivalent group design was used, as random assignment of students was not feasible within the existing school structures. This design is commonly applied in educational technology research to evaluate instructional interventions conducted in authentic classroom settings while preserving ecological validity (Castro-Vargas, Cabana-Caceres, & Andrade-Arenas, 2020). Rather than developing or validating a new instructional product, the study focused on examining the learning effects of an existing mobile–computer-based instructional structure when systematically implemented in senior high school classrooms. This instructional structure served as the treatment condition and was analyzed concerning changes in students' critical thinking outcomes.

3.2. Participants and Research Context

The participants consisted of 200 senior high school students enrolled in Pancasila Education courses from four public schools in Bali, Indonesia: SMA Negeri 1 Denpasar, SMA Negeri 2 Denpasar, SMA Negeri 3 Singaraja, and SMA Negeri 1 Kuta. Each school contributed 50 students, selected through intact class sampling to maintain instructional continuity. All participating schools had adequate access to mobile devices and computer laboratories, allowing the combined use of smartphones and desktop computers during instruction. The learning intervention was carried out over a four-week period within regular Pancasila Education lessons. Throughout the intervention, students engaged in learning activities via a responsive Learning Management System (LMS) accessible on both mobile and desktop devices. The instructional context reflected typical classroom conditions in Balinese senior high schools, ensuring that the findings represent realistic technology-supported learning practices rather than controlled laboratory conditions.

3.3. Instructional Intervention and Learning Implementation

The instructional intervention involved a mobile–computer-based learning approach that integrated face-to-face classroom instruction with LMS-supported learning activities. Through the LMS, students accessed learning

materials, participated in structured discussion forums, completed formative quizzes, and submitted reflective assignments. Mobile devices were primarily used to support flexible access, discussion participation, and short formative tasks, while computer-based access facilitated extended reading activities, structured assignments, and reflective writing. All learning activities were aligned with the objectives of Pancasila Education, emphasizing civic reasoning, value-based decision-making, and contextual analysis of social issues. The instructional components represented the implementation of established LMS-supported pedagogical practices rather than the development of a new learning product. In this context, the LMS functioned as a medium for mediating learning interactions and providing a consistent technological environment throughout the intervention.

3.4. Instruments and Data Collection

Students' critical thinking skills were assessed using a critical thinking test adapted to the context of Pancasila Education and administered as both a pre-test and a post-test. The instrument measured key dimensions of critical thinking, including analysis, evaluation, inference, explanation, and interpretation, using scenario-based multiple-choice items situated in civic and moral contexts. Content validity was established through expert review involving specialists in Pancasila Education and educational technology, while pilot testing indicated acceptable internal consistency, with a Cronbach's alpha coefficient exceeding 0.80. To support the interpretation of learning processes, LMS usage data, such as login frequency and participation in discussion activities, were collected descriptively. These data were used to contextualize student engagement during the intervention and were not treated as primary outcome variables.

3.5. Data Analysis Techniques

At the outset of the intervention, all participants completed the critical thinking pre-test under standardized classroom conditions. The mobile computer-based learning activities were then implemented over four consecutive weeks as part of regular instruction. At the conclusion of the instructional period, students completed the post-test using the same instrument. All data collection procedures took place during scheduled school hours and were supervised by the classroom teacher and the research team to ensure procedural consistency.

Data analysis focused on examining changes in students' critical thinking performance following the intervention. Paired-sample t-tests were applied to analyze within-group differences between pre-test and post-test scores, while independent-sample t-tests were used to examine potential differences in learning gains across participating schools. Effect sizes were calculated using Cohen's d to determine the magnitude of observed effects. Prior to conducting inferential analyses, assumptions of normality and homogeneity of variance were tested and met. All statistical analyses were performed at a significance level of $\alpha = 0.05$.

4. Results

4.1. Effects of Mobile–Computer-Based Learning on Students' Critical Thinking in Pancasila Education

The primary analysis examined whether implementing a mobile–computer-based learning approach was associated with measurable changes in students' critical thinking skills in Pancasila Education (Oktaviani et al., 2024; Prakoso, Rokhman, & Handoyo, 2024). Using a quasi-experimental pre-test–post-test design, students' critical thinking performance was assessed before and after a four-week instructional intervention across senior high schools in Bali. The intervention integrated LMS-supported activities accessed via mobile and desktop devices, emphasizing case-based discussions, structured reflection, and formative digital assessments aligned with Pancasila Education competencies.

To examine changes in students' critical thinking scores, paired-sample t-tests were conducted to analyze within-group differences between pre-test and post-test results. This analytical approach was consistent with the study design, which focused on identifying learning gains following the instructional intervention rather than establishing causal effects through random assignment. The results indicate consistent increases in post-test scores compared to pre-test scores, suggesting that students demonstrated higher levels of critical thinking after participating in the mobile computer-based learning activities.

Table 1. Pre-Test and Post-Test Results of Students' Critical Thinking by School.

School	N	Pre-Test Mean (SD)	Post-Test Mean (SD)	Mean Gain	Cohen's d
SMA Negeri 1 Denpasar	50	64.1 (7.4)	77.9 (6.6)	+13.8	1.83
SMA Negeri 2 Denpasar	50	62.7 (7.8)	75.8 (6.9)	+13.1	1.69
SMA Negeri 3 Singaraja	50	63.9 (7.5)	77.1 (6.7)	+13.2	1.74
SMA Negeri 1 Kuta	50	63.0 (7.6)	76.8 (6.9)	+13.8	1.85
Overall	200	63.4 (7.6)	76.9 (6.8)	+13.5	1.78

Table 1 presents the pre-test and post-test results of students' critical thinking scores across four participating senior high schools. Pre-test mean scores ranged from 62.7 to 64.1, indicating relatively comparable baseline levels of critical thinking across schools. Following the intervention, post-test mean scores increased consistently, with mean gains ranging from 13.1 to 13.8 points. The magnitude of these improvements was large across all schools, as reflected by Cohen's d values exceeding 1.6 in every case. Overall, the pattern of results suggests that the observed learning gains were not limited to a single institutional context but occurred consistently across different senior high schools in Bali. Given the quasi-experimental pre–post design without a control group, these findings are interpreted as evidence of substantial learning improvement under comparable instructional conditions rather than as definitive causal effects attributable solely to the intervention.

4.2. Student Engagement in Mobile–Computer-Based Learning Activities

Student engagement data were examined to provide contextual support for the observed improvements in students' critical thinking skills during the four-week implementation of the mobile–computer-based learning model. These data were drawn from LMS system logs that recorded students' interactions with key platform

features, including frequency of access, participation in online discussions, completion of quizzes, and submission of reflective assignments. The purpose of this analysis was to describe learning participation and implementation consistency across schools, rather than to explain causal mechanisms.

Across the four participating senior high schools, patterns of engagement were generally comparable, indicating that the instructional model was implemented under similar learning conditions. Students accessed the LMS regularly using both mobile devices and desktop computers, engaged in asynchronous discussions related to Pancasila values and civic issues, and completed formative assessments embedded within the learning modules. This pattern reflects an instructional environment characterized by continuous and structured interaction with digital learning activities.

Table 2. Student Engagement with LMS Features by School.

School	Avg. Logins (per student)	Forum Posts (Mean)	Quiz Attempts (Mean)	Assignment Completion (%)
SMA Negeri 1 Denpasar	17.8	6.4	4.2	96
SMA Negeri 2 Denpasar	16.9	5.9	4.0	94
SMA Negeri 3 Singaraja	17.2	6.1	4.1	95
SMA Negeri 1 Kuta	18.1	6.6	4.3	97
Overall	17.5	6.3	4.2	95.5

As presented in Table 2, average login frequencies ranged from 16.9 to 18.1 per student, suggesting sustained access throughout the intervention period. Levels of participation in discussion forums and quiz attempts were also relatively consistent across schools, indicating similar exposure to discussion-oriented and assessment-based learning tasks. Assignment completion rates were uniformly high, ranging from 94% to 97%, which points to strong implementation fidelity across all sites. Taken together, these engagement patterns indicate that the improvements in students' critical thinking reported in Subsection A occurred within stable and sufficiently active learning conditions. The consistency of student participation across schools supports the internal alignment between the instructional design, learning processes, and observed outcomes, while remaining within the interpretive limits of the quasi-experimental design.

To further clarify the instructional context underlying these findings, Figure 1 presents selected screenshots of the LMS interface used during the intervention. The figure illustrates the main dashboard, structured learning modules, and the asynchronous discussion environment through which students accessed materials, participated in discussions, and completed formative tasks. This visual representation provides contextual support for the engagement patterns reported in Table 2 by showing how learning activities were organized within the platform. The figure is included to enhance transparency regarding the implementation setting rather than to introduce additional outcome data.

5. Discussion

The results of this study show that the implementation of a mobile computer-based learning environment in Pancasila Education was accompanied by consistent improvements in students' critical thinking across all participating senior high schools in Bali (Casmana & Rahmawati, 2020; Patras et al., 2025). These improvements suggest that technology-supported learning environments can meaningfully support higher-order cognitive processes such as analysis, evaluation, and reflection when they are organized through a unified LMS and aligned with the objectives of civic education (Sulkipani et al., 2025; Trisiana et al., 2024). Rather than pointing to the effectiveness of a specific instructional product, the findings highlight the role of instructional organization, structured digital interaction, and sustained student engagement as key conditions that enable effective technology-enhanced learning (Lampropoulos & Kinshuk, 2024; Senanayake et al., 2023).

To further contextualize the learning process, Figure 1 illustrates the LMS interface used during the intervention, including the main dashboard and the asynchronous discussion environment. The interface was designed to present clear learning sequences, integrate assessment tasks, and provide structured discussion prompts related to Pancasila values and civic issues. Such design features are consistent with previous studies indicating that well-organized LMS environments can help reduce extraneous cognitive load and support deeper engagement with learning content. Complementary engagement data indicate that students interacted regularly with both learning materials and peers, suggesting that the intervention was implemented with adequate fidelity across schools. Nevertheless, given the quasi-experimental pre–post design without a control group, the findings should be interpreted as evidence of learning improvement under comparable instructional conditions rather than as confirmation of causal effectiveness. Further research employing controlled or longitudinal designs is therefore recommended to strengthen empirical validation.

Consistent with these observations, the overall pattern of results aligns with prior research reporting positive associations between technology-supported learning environments and higher-order cognitive outcomes, particularly when instructional activities are well structured and assessment is embedded within the learning process (Nussbaum et al., 2021; Sousa et al., 2022). Unlike studies that focus exclusively on either the flexibility of mobile learning or the functionality of desktop-based LMS platforms, the present study examined student learning within an integrated access environment. The observed pre–post score increases, accompanied by large effect sizes across schools, indicate that the combined use of mobile and computer access may create favorable conditions for engaging students in analytical and reflective civic learning activities (Chanaa & El Faddouli, 2024; García et al., 2020). At the same time, the absence of a control group necessitates a cautious interpretation of these results, which are best understood as indicative of learning improvement within the implemented instructional context rather than as definitive evidence of causal impact.

Compared with previous studies in civic and values education, this study differs in its explicit positioning of critical thinking as a primary learning outcome rather than as a secondary or indirect effect. Much of the literature on Pancasila and civic education continues to emphasize affective outcomes such as civic disposition, moral reasoning, and national identity, with limited operationalization of critical thinking as a measurable cognitive

process (Hadikusuma et al., 2024; Komalasari et al., 2021). In contrast, the present study aligned LMS-supported learning activities, case discussions, formative quizzes, and reflective assignments with clearly defined cognitive indicators assessed through standardized pre-test and post-test measures (Laine, Korhonen, & Hakkarainen, 2023; Lampropoulos & Kinshuk, 2024). The consistency of learning gains across schools suggests that the instructional structure played an important role in shaping learning experiences, although the quasi-experimental design requires cautious interpretation of effect magnitude due to potential confounding factors (García et al., 2020; Sousa et al., 2022).

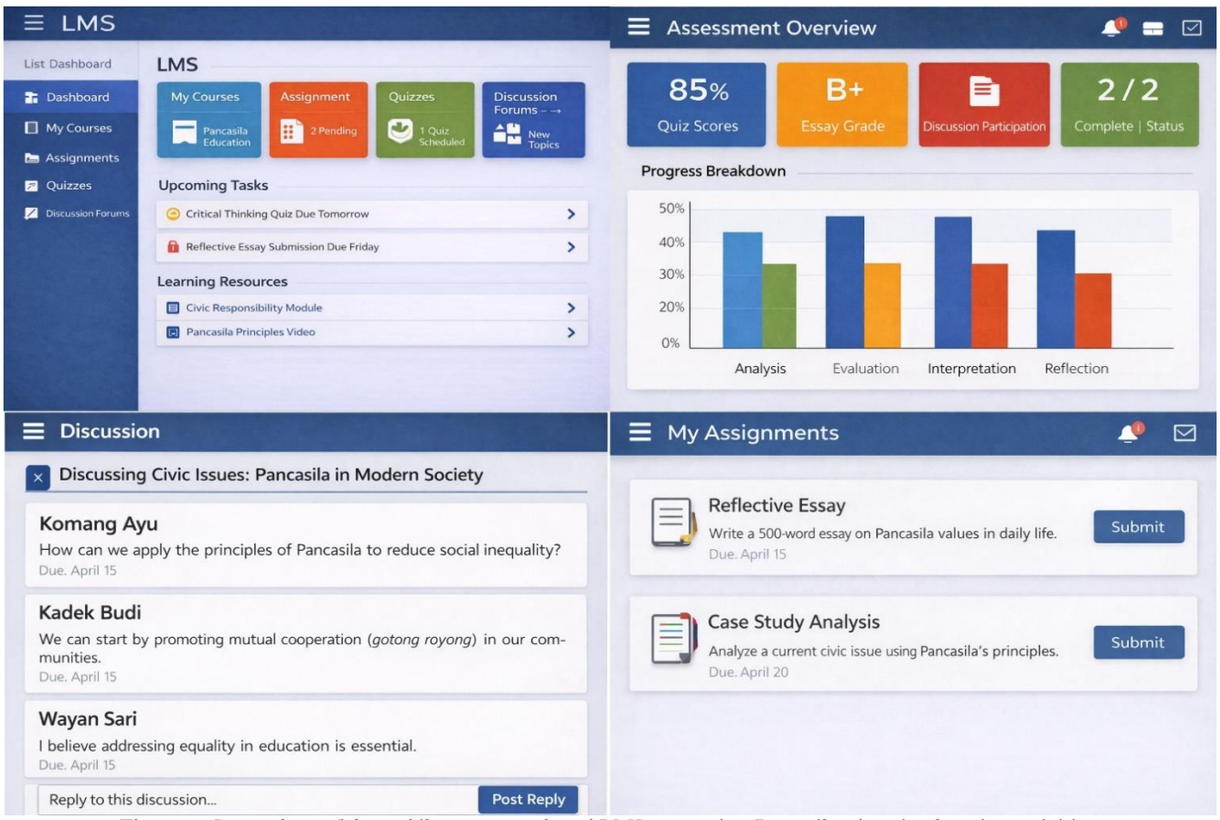

Figure 1. Screenshots of the mobile–computer-based LMS supporting Pancasila education learning activities.

A further contribution of this study lies in the use of engagement data to contextualize learning outcomes. LMS log data indicated relatively consistent patterns of student participation across schools, including system access, discussion involvement, quiz attempts, and assignment completion (Ayasrah, Hanandeh, Ghazal, & AlEid, 2024; Ferine, Murliasari, Saefudin, & Fahruddin, 2024). These patterns suggest that improvements in critical thinking occurred within a learning environment characterized by sustained and structured engagement, rather than uneven or incidental use of digital tools (Agus et al., 2025; Wang, Chen, Tian, Wang, & Ying, 2024). Importantly, engagement indicators were used to demonstrate implementation fidelity rather than to imply direct causal relationships, reinforcing the methodological caution of the study and highlighting the need for future controlled or longitudinal research (Hadikusuma et al., 2024; Li, Yu, Wei, & Chan, 2024).

Overall, the findings address the research objective by showing that the implementation of a mobile–computer-based learning approach in Pancasila Education was associated with measurable improvements in students' critical thinking across participating senior high schools in Bali (Gonzalez-Mohino et al., 2023; Jaramillo & Chiappe, 2024). The consistent pre–post gains indicate that structured digital learning activities can support analytical, evaluative, and reflective thinking in civic education contexts, although further research is needed to examine the applicability of these results in settings with different levels of digital readiness and institutional support (Komalasari et al., 2021; Widawski & Oleśniewicz, 2023).

From a scientific standpoint, this study extends technology-enhanced learning research into values and civic education, a field that has traditionally emphasized affective and normative outcomes rather than cognitive ones. Although prior studies on mobile learning and LMS use have reported gains in engagement or general performance, relatively few have examined critical thinking as a primary outcome within Pancasila or civic education contexts (Agus et al., 2025; Hadikusuma et al., 2024; Hwang et al., 2025). Consistent with evidence that well-structured LMS environments can support higher-order cognition, the present findings differ from studies showing limited effects when technology is used mainly for content delivery, suggesting that instructional design rather than technology alone acts as a key moderating factor (Hwang et al., 2025). Nonetheless, the absence of a control group limits direct comparison with experimental studies and warrants cautious interpretation (Fahruddin et al., 2025; García et al., 2020).

Practically, the results indicate that mobile–computer-based learning can be a feasible approach for strengthening critical thinking in Pancasila Education when supported by a clear pedagogical structure and consistent student engagement (Hadikusuma et al., 2024; Husni, 2021; Serevina & Hamidah, 2022). High participation and assignment completion across schools suggest applicability within regular senior high school settings, provided that basic infrastructure and teacher facilitation are available (Agus et al., 2025; Wenger et al., 2026). Rather than proposing a prescriptive product, this study offers evidence-informed guidance on integrating case-based discussions, formative digital assessments, and reflective tasks within an LMS to support cognitive goals in civic education (Nussbaum et al., 2021). Future research should test this approach across more diverse contexts and employ controlled designs to clarify conditions for effectiveness.

6. Conclusion

This study concludes that the implementation of a mobile–computer-based learning approach in Pancasila Education was associated with consistent improvements in students' critical thinking across senior high schools in Bali. Using a quasi-experimental pre-test–post-test design, the findings showed uniform learning gains with large effect sizes, indicating that an integrated LMS-supported instructional environment can support higher-order cognitive processes in civic and values education. Engagement data showed stable participation and high completion rates, suggesting that learning gains occurred under adequate implementation fidelity. Although causal inference is limited by the absence of a control group, the findings provide empirical support for the use of mobile–computer-based learning as a viable instructional approach for fostering critical thinking in Pancasila Education within comparable secondary school contexts.

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