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The Influence of E-Maginative Media on Critical Thinking Skills and Personal Learning Journey among Tenth-Grade Students at SMAN 1 Kademangan

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Abstract. The urgency of this study stems from the misalignment between Indonesia's educational programs—particularly the P5 profile, which aspires to shape critical, independent, and collaborative learners—and classroom realities in which students' critical thinking skills (CTS) and personal learning journey (PLJ) in Pancasila Education remain relatively low. This study aims to analyse the influence of e-maginative media on CTS and PLJ among tenth-grade students. A quantitative quasi-experimental non-equivalent control group design was employed, involving an experimental class using e-maginative media—an interactive virtual book integrating text, images, case-analysis videos, and automatic evaluation—and a control class using printed textbooks. CTS were measured through tests, while PLJ was assessed via questionnaires; data were analysed using N-gain scores and simple linear regression. The results show that both groups improved between pretest and posttest, but the experimental class achieved substantially higher gains in CTS and PLJ. Regression analysis indicated that e-maginative media contributed 24.3% of the variance in CTS and 25.0% of the variance in PLJ, with statistically significant positive effects. These findings lead to the conclusion that interactive, multimodal digital media can effectively enhance higher-order thinking and self-directed learning in Pancasila Education. The novelty of this research lies in the specific application of e-maginative media to the *Bhinneka Tunggal Ika* topic, simultaneously targeting CTS and PLJ within a unified digital learning framework at the senior secondary level. The study contributes theoretically by reinforcing evidence on the effectiveness of interactive digital media for developing CTS and learning autonomy, practically by offering an innovative instructional alternative for teachers, and strategically by supporting the implementation of P5-oriented policies that promote character formation and digital literacy.

Keywords: *E-maginative Media; Critical Thinking Skills; Personal Learning Journey; Pancasila Education; Interactive Digital Learning*

INTRODUCTION

Research in twenty-first-century education has received increasing attention as rapid advances in information and communication technology fundamentally transform social, economic, and cultural life, including how young people learn and construct knowledge (Sebayang, 2019; Goh, 2020; Nuthall, 2005). In this context, critical thinking skills (CTS) are widely recognised as a core transversal competence that underpins students' ability to navigate complexity, evaluate information, and make reasoned decisions across disciplines and life domains (Liu & Puteh, 2025; Schalock, 2025; Yang et al., 2025). Empirical studies across school and higher education settings consistently show that CTS are central to academic success, professional readiness, and civic participation in an era characterised by information overload and accelerating technological change (Arifin et al., 2025; Bates et al., 2025; Kim et al., 2025; Maulana et al., 2025). At the same time, the notion of a personal learning journey (PLJ) has

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emerged to capture students' increasingly individualised, reflective, and self-directed trajectories of learning in both formal and informal environments (Greenfield, 2025; Loach, 2024; Palmer, 2017). Within the Indonesian context, these global demands intersect with national policy directions such as the Profil Pelajar Pancasila and the P5 program, which emphasise the cultivation of critical, independent, and character-driven learners who are able to respond adaptively to the challenges of the twenty-first century (Sebayang, 2019; OECD, 2023).

The concept of PLJ resonates strongly with international scholarship that frames learning as a continuous, situated, and personally meaningful journey in which individuals construct identity and agency through educational experience (Martin, 2025; Morewood, 2025; Rao et al., 2023). Studies on academic and professional development describe how learners' personal trajectories involve cycles of reflection, adaptation, and self-regulation, supported by learning environments that afford autonomy and inclusive participation (Herrera et al., 2015; Hill, 1999; Leach & Batalden, 2007; McIlwaine et al., 2007). Research on personal learning journeys in diverse contexts—from higher education to community and intercultural learning—highlights the importance of scaffolding learners' capacity to monitor their progress, negotiate challenges, and connect prior experiences with new knowledge (Cann, 2012; DeGennaro, 2016; Dwen, 2025; Prior, 2019). In digital and blended settings, the notion of a learning journey is further linked to the design of technology-enhanced experiences that support personalised pathways and ongoing reflection, positioning PLJ as a key dimension of twenty-first-century competence alongside CTS (Cortellazzo et al., 2022; Morewood, 2025; Shuler et al., 2016).

Despite this conceptual convergence, evidence from Indonesian schools indicates that CTS and PLJ remain at relatively low levels, especially at the upper secondary stage. Classroom-based investigations report that many students struggle to answer higher-order thinking skills (HOTS) items, display superficial understanding of subject matter, and show limited capacity to analyse, evaluate, and justify arguments (Amelia, 2025; Fadillah, 2024; Nurhayati, 2022). Large-scale assessments corroborate these findings: the PISA 2022 results show that Indonesian students' science literacy scores lag significantly behind the international average, suggesting persistent weaknesses in reasoning, problem-solving, and evidence-based judgement (OECD, 2023). Studies conducted in various SMA settings further reveal considerable variation in students' self-directed learning and autonomy, with a substantial proportion remaining in the low-to-moderate category in terms of planning, monitoring, and reflecting on their learning (Gusnita, 2021; Hasanah, 2022; Khoiriah, 2022). In specific schools, including SMA Negeri 1 Praya Barat and other comparable institutions, early observations indicate that CTS among Grade X students are still weak and require targeted intervention (Maulana et al., 2025; Saputri, 2025).

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A parallel concern arises in the domain of personal learning journeys. Empirical work shows that many students remain dependent on teacher direction, are reluctant to explore learning resources beyond the textbook, and rarely engage in systematic self-reflection about their strengths, needs, and progress (Darojat, 2022; Hasanah, 2022; Herrera et al., 2015). Although some learners demonstrate emergent autonomy, research suggests that the majority have not yet developed the metacognitive habits required for sustained self-regulated learning, particularly in cognitively demanding subjects (Greenfield, 2025; Loach, 2024; Palmer, 2017). In Indonesian classrooms, these challenges are exacerbated by structural and cultural factors, including exam-oriented practices, limited time for inquiry-based activities, and uneven access to rich learning media (Amelia, 2025; Fadillah, 2024; Nurhayati, 2022). Consequently, the core research problem addressed in this study is the misalignment between policy aspirations for CTS and PLJ and the realities of classroom practice, especially in Pancasila Education.

To address this challenge, various pedagogical approaches have been proposed in the literature. Active learning strategies and inquiry-based models have been found to promote deeper engagement and higher-order thinking when implemented systematically in science and mathematics education (Al-Raggad, 2026; Arifin et al., 2025; Lestari et al., 2025; Ramlawati et al., 2025; Sukmak & Klinbumrung, 2025). Project-based learning and citizen science projects have similarly been shown to strengthen students' ability to reason, collaborate, and apply concepts in authentic contexts (Atmojo et al., 2025; Lestari et al., 2025; Saenab et al., 2025). In language and literacy education, flipped classroom models, research projects, and structured debate have been used to enhance argumentative writing, evidence-based reasoning, and classroom discourse (Aamani & Mkimbili, 2025; Aarar & Pérez-Valverde, 2025; Humaid & Hamzeh, 2025; Ismail et al., 2025; Qi et al., 2025). Meta-analytic and survey studies further confirm that a range of learner-centred strategies can improve CTS across different subjects and levels, although effect sizes and sustainability vary depending on design quality and contextual alignment (Alsuwailan & Al-Shurai, 2025; Bates et al., 2025; Maulana et al., 2025; Schalock, 2025).

More recently, digital and multimedia-based solutions have gained prominence as promising avenues for fostering CTS and supporting more personalised learning trajectories. Research on video-based and interactive media demonstrates that well-designed digital resources can stimulate analysis, interpretation, and evaluation, particularly when they embed problem-based scenarios, scaffolding questions, and immediate feedback (Hidayah, 2023; Istiqomah, 2023; Mardiana et al., 2025; Sofiar et al., 2025). The development of e-modules and virtual environments grounded in problem-based learning, inquiry, or Socratic dialogue has been shown

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to enhance CTS and scientific literacy, especially in STEM subjects (Kimiati, 2019; Lestari et al., 2025; Pitorini, 2025; Ramlawati et al., 2025). Emerging work on augmented reality, AI-generated content, and AI-supported dashboards further suggests that technology can enrich learning tasks, visualise complex relationships, and create adaptive pathways that challenge students' reasoning while providing timely support (Anwar et al., 2025; Kachouie et al., 2025; Ninghardjanti et al., 2025; Sánchez-López et al., 2025; Zhang & Liu, 2025). At the same time, studies highlight that without careful design, digital tools may increase cognitive load or encourage superficial engagement, indicating the need for integrated, theory-based media that explicitly target CTS and self-regulated learning (Chen et al., 2025; Mutchima et al., 2025; Zhao et al., 2025).

Specific to PLJ and learner autonomy, several studies in the Indonesian and broader international context show that interactive digital materials can support self-paced exploration, reflection, and strategic planning. The development of interactive teaching materials using platforms such as 3D Pageflip Professional and online worksheets has been found to strengthen students' independence in planning, monitoring, and evaluating their learning, particularly in mathematics and science topics (Darojat, 2022; Hasanah, 2022; Khoiriah, 2022). Cooperative and inquiry-based models, including Think Pair Square and guided discovery, have been shown to encourage responsibility for learning and peer support mechanisms that underpin PLJ (Fadillah, 2024; Gusnita, 2021; Saenab et al., 2025). Internationally, research on personal learning journeys underscores the role of technology-enhanced environments in scaffolding self-directed discovery, reflective practice, and identity formation across diverse educational settings (Cann, 2012; DeGennaro, 2016; Greenfield, 2025; Loach, 2024). However, most of these initiatives have been developed in STEM or language education, with relatively limited attention to normative and citizenship-oriented subjects such as Pancasila Education.

Overall, the literature indicates substantial progress in designing interventions to improve CTS and, to a lesser extent, PLJ, yet several gaps remain salient. First, many studies focus on either CTS or self-regulated learning as isolated outcomes, rather than examining how digital media can simultaneously foster both dimensions within a coherent pedagogical framework (Al-Raggad, 2026; Liu & Puteh, 2025; McKendry, 2025; Yang et al., 2025). Second, research on CTS often concentrates on science, mathematics, or EFL contexts, with few studies investigating how critical inquiry can be cultivated through media-rich environments in subjects that emphasise values, citizenship, and national identity (Arifin et al., 2025; Atmojo et al., 2025; Bhakti et al., 2025; Putri et al., 2025; Roper, 2025). Third, while there is growing interest in PLJ and personal development, much of this work is situated in higher education or professional training, with limited exploration of PLJ among upper secondary students in relation to their civic and moral

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education (Greenfield, 2025; Herrera et al., 2015; Leach & Batalden, 2007; McIlwaine et al., 2007). Finally, several studies emphasise the potential of web-based learning, AI integration, and immersive technologies to transform learning experiences, but their application to integrated CTS–PLJ outcomes in Pancasila Education remains largely unexplored (Kaddouri et al., 2025; Ninghardjanti et al., 2025; Xiong & Luo, 2025; Ariza-Rúa et al., 2025; Ogunsola & Adigun, 2025; Salameh & Alkhateeb, 2025).

This study responds to these gaps by introducing and empirically testing an e-maginative medium—an interactive virtual book developed using a flipbook platform—within the specific context of Pancasila and Citizenship Education (PPKn) on the topic of *Bhinneka Tunggal Ika* for Grade X students at SMAN 1 Kademangan. The innovation lies in integrating multimodal resources (text, images, and case-based videos) with embedded automatic evaluation features to stimulate critical reflection and support students' personal learning journeys in a single digital environment (Hidayah, 2023; Kimiati, 2019; Mardiana et al., 2025). Drawing on evidence that e-learning and digital platforms can increase student interest and participation in PPKn (Sari et al., 2025) and that interactive media can enhance both CTS and learner autonomy in other subjects (Darojat, 2022; Hasanah, 2022; Ramlawati et al., 2025), the research hypothesises that the use of e-maginative media will positively influence CTS and PLJ compared to conventional textbook-based instruction. The scope of the study is delimited to Grade X students in one public senior high school, focusing on measurable changes in CTS and PLJ before and after the intervention.

Accordingly, the main objective of this study is to examine the influence of e-maginative media on CTS and PLJ in Pancasila Education. Specifically, the research seeks to: (1) describe the levels of students' CTS before and after the implementation of e-maginative media; (2) describe the levels of students' PLJ before and after the implementation of e-maginative media; (3) analyse whether the use of e-maginative media has a significant effect on CTS among Grade X students at SMAN 1 Kademangan; and (4) analyse whether the use of e-maginative media has a significant effect on PLJ among the same students (Amelia, 2025; Hardani, 2020; Nurhayati, 2022; Saputri, 2025). By addressing these research questions through a quasi-experimental design, this study aims to contribute both to the theoretical development of digital media integration in citizenship education and to practical efforts to realise the goals of the Profil Pelajar Pancasila and the P5 program in Indonesian schools (OECD, 2023; Sebayang, 2019; Sari et al., 2025).

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RESEARCH METHODS

This study employed a quantitative quasi-experimental design of the non-equivalent control group type to examine the effect of e-maginative media on students' critical thinking skills (CTS) and personal learning journey (PLJ). The choice of a quasi-experimental approach was based on the practical constraints of random assignment in authentic school settings and the need to estimate causal relationships between the intervention and outcomes, a strategy widely adopted in contemporary educational research on critical thinking and technology-enhanced learning (Al-Raggad, 2026; Amelia, 2025; Arifin et al., 2025; Bates et al., 2025; Fadillah, 2024; Maulana et al., 2025; Ramlawati et al., 2025; Salameh & Alkhateeb, 2025; Saputri, 2025; Sukmak & Klinbumrung, 2025). The design involved two intact classes: one experimental class receiving instruction supported by e-maginative media and one control class taught using conventional printed textbooks. Both groups were administered pretests and posttests to capture changes in CTS and PLJ attributable to the intervention, following guidelines for rigorous quasi-experimental implementation in educational contexts (Hardani, 2020; Kim et al., 2025; McKendry, 2025; Schalock, 2025).

The research site was SMA Negeri 1 Kademangan, a public senior high school selected purposively in the even semester of the 2024/2025 academic year. The school was chosen because it had adequate digital infrastructure, including access to computers or mobile devices and stable internet connectivity, which are essential conditions for implementing interactive digital media in classroom practice (Goh, 2020; Kaddouri et al., 2025; Kachouie et al., 2025; Ninghardjanti et al., 2025; Sari et al., 2025). The participants comprised Grade X students, who, according to Piaget's theory of cognitive development, are generally in the formal operational stage and therefore capable of abstract, logical, and systematic reasoning required for CTS tasks (Al-Raggad, 2026; Maulana et al., 2025; Ogunsola & Adigun, 2025). Sampling was conducted using purposive sampling based on the average scores of the Ujian Satuan Tingkat Sekolah (USTS) in Pancasila and Citizenship Education (PPKn), with the aim of ensuring comparable initial academic ability between the experimental and control classes (Alsuwailan & Al-Shurai, 2025; Bhakti et al., 2025; Daengneam et al., 2025; Lestari et al., 2025; Sujatmika et al., 2025; Tandililing et al., 2025; Wijayanti et al., 2025).

The implementation of the study followed three main stages: preparation, implementation, and analysis. In the preparation stage, the researchers formulated the problem, developed the hypotheses, defined the independent and dependent variables, and designed the research procedures by adapting best practices from previous quasi-experimental and technology-based interventions in critical thinking research (Amelia, 2025; Fadillah, 2024; Hidayah, 2023;

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Istiqomah, 2023; Kimiati, 2019; Mardiana et al., 2025; Pitorini, 2025; Ramlawati et al., 2025; Sofiar et al., 2025; Zhang & Liu, 2025). The implementation stage involved delivering a series of PPKn lessons on the topic *Bhinneka Tunggal Ika* to both groups over several meetings. The experimental class learned through e-maginative media integrated into the teaching–learning process, whereas the control class received instruction using standard textbooks and teacher-centred methods, in line with descriptions of conventional practice in PPKn classrooms (Amelia, 2025; Nurhayati, 2022; Sari et al., 2025; Sebayang, 2019). The final stage comprised data compilation, scoring, and statistical analysis to determine the effects of the intervention on CTS and PLJ.

The primary materials in this study included the e-maginative medium and printed textbooks used in regular instruction. The e-maginative medium was an interactive virtual book developed using a flipbook platform (Heyzine Flipbook) that integrated textual explanations, illustrative images, and case-based analysis videos, accompanied by automatic evaluation features such as embedded quizzes and feedback. This design was informed by theoretical and empirical work on multimedia learning, interactive e-modules, and virtual environments for fostering CTS and self-regulated learning (Chen et al., 2025; Hidayah, 2023; Kimiati, 2019; Mardiana et al., 2025; Pitorini, 2025; Ramlawati et al., 2025; Saenab et al., 2025; Zhang & Liu, 2025; Zhao et al., 2025). The control class relied on conventional PPKn textbooks and teacher explanations without digital enrichment, reflecting typical practice in many Indonesian classrooms (Amelia, 2025; Fadillah, 2024; Nurhayati, 2022; Sari et al., 2025).

Two main instruments were developed to measure CTS and PLJ. The CTS test consisted of multiple-choice and constructed-response items aligned with critical thinking indicators such as interpretation, analysis, evaluation, and inference, drawing conceptually on the critical thinking literature in mathematics, science, language, and social sciences (Amani & Mkimbili, 2025; Arifin et al., 2025; Bhakti et al., 2025; Humaid & Hamzeh, 2025; Liu & Puteh, 2025; McKendry, 2025; Pavitola & Rieksta, 2025; Prayogi et al., 2025; Roper, 2025; Yang et al., 2025). The PLJ questionnaire was constructed to capture students' ability to plan, monitor, and reflect on their learning, informed by research on personal learning journeys, self-directed learning, and learner autonomy (Cann, 2012; Cortellazzo et al., 2022; Greenfield, 2025; Herrera et al., 2015; Loach, 2024; Martin, 2025; Morewood, 2025; Palmer, 2017; Rao et al., 2023; Shuler et al., 2016). In the Indonesian context, the operationalisation of PLJ was further adapted from studies on learning independence and cooperative models that promote student autonomy (Darojat, 2022; Gusnita, 2021; Hasanah, 2022; Khoiriah, 2022). Both instruments were written to suit the content and cognitive level of Grade X PPKn students, with item difficulty calibrated to encourage higher-

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order thinking without overwhelming learners (Bhakti et al., 2025; Sujatmika et al., 2025; Tandililing et al., 2025).

Data collection procedures were carefully structured to ensure consistency across the two groups. At the beginning of the intervention, both classes completed the CTS pretest and the PLJ questionnaire under standardised conditions, similar to procedures used in other quasi-experimental studies on critical thinking and digital learning (Al-Raggad, 2026; Maulana et al., 2025; Ogunsola & Adigun, 2025; Salameh & Alkhateeb, 2025; Sofiar et al., 2025; Xiong & Luo, 2025). The teaching intervention was then implemented over several sessions, during which the experimental class interacted with the e-maginative medium as an integral part of the learning process, while the control class followed conventional instruction. At the end of the intervention, both groups were administered the same CTS test and PLJ questionnaire as posttests. All test and questionnaire administrations were conducted in the classroom during regular lesson times, with invigilation by the researchers and classroom teachers to minimise disruptions and maintain procedural fidelity (Aarar & Pérez-Valverde, 2025; Amani & Mkimbili, 2025; Hidayah, 2023; Istiqomah, 2023; Ismail et al., 2025; Qi et al., 2025; Ran, 2025).

Quantitative data analysis proceeded in two main steps. First, descriptive statistics were computed to summarise mean scores, standard deviations, and distributions of CTS and PLJ for both groups at pretest and posttest. Second, normalised gain (N-gain) scores were calculated to determine the magnitude of improvement in CTS and PLJ from pretest to posttest, following established procedures in science and mathematics education research (Lestari et al., 2025; Mardiana et al., 2025; Ramlawati et al., 2025; Saenab et al., 2025; Sujatmika et al., 2025). To test the research hypotheses, simple linear regression analyses were conducted to examine the effect of the use of e-maginative media (independent variable) on CTS and PLJ (dependent variables) separately, a strategy commonly employed to quantify the contribution of instructional interventions in educational studies (Bates et al., 2025; Chen et al., 2025; Maulana et al., 2025; Ogunsola & Adigun, 2025; Salameh & Alkhateeb, 2025; Tandililing et al., 2025). All analyses were carried out using SPSS version 25, consistent with many empirical studies on critical thinking assessment and technology-supported learning (Alsuwailan & Al-Shurai, 2025; Bhakti et al., 2025; Ismail et al., 2025; Mardiana et al., 2025; Nusivera et al., 2025; Pitorini, 2025).

Instrument validity and reliability were ensured through several stages. Content validity was established by consulting experts in Pancasila and Citizenship Education and specialists in digital learning media, who evaluated the relevance, clarity, and alignment of each item with the intended constructs and curriculum standards, a practice widely recommended in educational measurement research (Arifin et al., 2025; Bhakti et al., 2025; Herrera et al., 2015; McIlwaine et

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al., 2007; Roper, 2025). Based on expert feedback, revisions were made to item wording, difficulty, and formatting before the instruments were administered in the main study. Reliability was examined using Cronbach's alpha, with coefficients of 0.70 or higher interpreted as indicating acceptable internal consistency (Alsuwailan & Al-Shurai, 2025; Bhakti et al., 2025; Mardiana et al., 2025; Maulana et al., 2025; Sujatmika et al., 2025; Tandililing et al., 2025; Wijayanti et al., 2025). Pilot testing in a class outside the sample was conducted to refine the instruments and to confirm that students understood the instructions and item formats. In addition, the comparability of the experimental and control groups at baseline was checked by comparing pretest scores on CTS and PLJ, ensuring that subsequent differences in posttest performance could reasonably be attributed to the instructional treatment rather than pre-existing disparities (Amelia, 2025; Fadillah, 2024; Maulana et al., 2025; Nurhayati, 2022; Saputri, 2025).

Ethical considerations were observed throughout the research process. Permission to conduct the study was obtained from the school administration and PPKn teachers, and students were informed about the purpose of the research and assured that their participation would not affect their official grades. Data were anonymised and reported in aggregate form to protect participants' privacy, consistent with ethical standards in educational research and studies of personal learning journeys in diverse settings (Greenfield, 2025; Herrera et al., 2015; Loach, 2024; Martin, 2025; Morewood, 2025; Palmer, 2017; Rao et al., 2023).

RESULT

Overview of Findings

The quantitative analysis examined changes in students' critical thinking skills (CTS) and personal learning journey (PLJ) before and after the implementation of e-maginative media, and assessed the extent to which the intervention predicted post-test outcomes. In line with prior quasi-experimental work on CTS in diverse educational contexts, the results revealed clear gains in the experimental group relative to the control group, with medium contributions of the intervention to variance in both CTS and PLJ (Al-Raggad, 2026; Amelia, 2025; Arifin et al., 2025; Bates et al., 2025; Bhakti et al., 2025; Fadillah, 2024; Lestari et al., 2025; Maulana et al., 2025; Mardiana et al., 2025; Ramlawati et al., 2025; Saenab et al., 2025; Salameh & Alkhateeb, 2025; Schalock, 2025; Sofiar et al., 2025; Sukmak & Klinbumrung, 2025; Tandililing et al., 2025; Wijayanti et al., 2025; Yang et al., 2025). Tables 1–4 present the detailed descriptive and inferential statistics, while Figures 1 and 2 (conceptual diagrams to be developed) summarise the distributional changes and the conceptual relationships between e-maginative media, CTS, and PLJ.

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Students' Critical Thinking Skills Before and After the Intervention

Students' CTS were assessed using pretest and posttest scores in both the control and experimental classes. The scores were then categorised into five levels: very critical (VC), critical (C), moderately critical (MC), less critical (LC), and non-critical (NC). The distribution of students across these categories before and after the intervention is presented in Table 1.

Table 1. Distribution of Students' CTS Levels Before and After the Intervention

CTS category	Control class (%)	Experimental class (%)
	Pretest	Posttest
VC	0.0	0.0
C	8.6	25.7
MC	60.0	62.9
LC	31.4	11.4
NC	0.0	0.0

Source: Research data, 2025.

Before the intervention, the majority of students in both groups were in the moderately critical category (60.0% in the control class and 57.1% in the experimental class), with a substantial proportion still in the less critical category (31.4% and 37.1%, respectively). After the intervention, the experimental class showed a marked shift toward higher-level CTS: the proportion of students in the critical category increased from 5.7% to 48.6%, and a new segment (2.9%) reached the very critical level. At the same time, the percentage of students categorised as less critical in the experimental group decreased dramatically from 37.1% to 2.9%. By contrast, the control class exhibited only modest improvement, with the critical category rising from 8.6% to 25.7% and the less critical category declining from 31.4% to 11.4%, while the majority of students remained in the moderately critical category.

These distributional patterns indicate that both instructional models contributed to some improvement in CTS, but the e-maginative media produced substantially larger gains and a clearer upward shift in the quality of students' critical thinking. This pattern is consistent with findings from prior interventions employing inquiry-based learning, project-based learning, and technology-enhanced environments to develop CTS across disciplines (Amani & Mkimbili, 2025; Arifin et al., 2025; Bhakti et al., 2025; Chen et al., 2025; Hidayah, 2023; Humaid & Hamzeh, 2025; Kachouie et al., 2025; Kartika et al., 2025; Lestari et al., 2025; Liu & Puteh, 2025; Mardiana et al., 2025; McKendry, 2025; Omeh et al., 2025; Pavitola & Rieksta, 2025; Pitorini, 2025; Prayogi et al., 2025; Qi et al., 2025; Ramlawati et al., 2025; Ran, 2025; Roper, 2025; Saenab et al., 2025; Sofiar et al., 2025; Sukmak & Klinbumrung, 2025; Tandililing et al., 2025; Wijayanti et al., 2025; Xiong & Luo, 2025; Zhang & Liu, 2025; Zhang et al., 2025; Zhao et al., 2025; Z.

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Alsuwailan & Al-Shurai, 2025). Figure 1 (to be prepared) can illustrate these shifts using a clustered bar chart showing the percentage of students in each CTS category for both groups at pretest and posttest, thereby providing a visual summary of the magnitude and direction of change.

Students' Personal Learning Journey Before and After the Intervention

Students' PLJ levels were measured via a questionnaire and categorised into five levels: highly independent (HI), independent (I), moderately independent (MI), less independent (LI), and non-independent (NI). The pretest and posttest distributions for both classes are summarised in Table 2.

Table 2. Distribution of Students' PLJ Levels Before and After the Intervention

PLJ category	Control class (%)	Experimental class (%)
	Pretest	Posttest
HI	0.0	0.0
I	51.4	77.1
MI	42.9	17.1
LI	0.0	0.0
NI	0.0	0.0

Source: Research data, 2025.

Prior to the intervention, most students in both classes were clustered in the independent and moderately independent categories. In the experimental class, 40.0% of students were already independent and 51.4% moderately independent, whereas the control class had 51.4% independent and 42.9% moderately independent. After the intervention, the experimental class exhibited a pronounced upward shift: the proportion of independent students increased from 40.0% to 88.6%, and a new highly independent segment (8.6%) emerged. At the same time, the moderately independent category in the experimental group dropped from 51.4% to 0.0%, indicating that nearly all students moved into higher PLJ levels. In the control class, the independent category rose more modestly from 51.4% to 77.1%, while the moderately independent category decreased from 42.9% to 17.1%, with no students reaching the highly independent level.

These results suggest that, although traditional instruction can support incremental gains in learning independence, the e-maginative media more effectively strengthened students' ability to plan, monitor, and reflect on their learning. This pattern aligns with previous research showing that interactive digital materials and inquiry-based tasks can enhance learners' self-regulation and autonomy (Cann, 2012; Cortellazzo et al., 2022; Darojat, 2022; DeGennaro, 2016; Greenfield, 2025; Gusnita, 2021; Hasanah, 2022; Herrera et al., 2015; Hill, 1999; Khoiriah, 2022; Loach,

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2024; Martin, 2025; McIlwaine et al., 2007; Morewood, 2025; Palmer, 2017; Prior, 2019; Rao et al., 2023; Shuler et al., 2016). Figure 2 (to be prepared) can present a similar bar-chart display for PLJ categories, emphasising the dramatic expansion of the independent and highly independent levels in the experimental class.

Effect of E-Maginative Media on Critical Thinking Skills

To quantify the effect of the e-maginative media on CTS, a simple linear regression analysis was conducted with the use of e-maginative media as the predictor and students' CTS scores as the outcome. The results are presented in Table 3.

Table 3. Simple Linear Regression Results for CTS

Parameter	Value
Constant (a)	0.052
Regression coefficient (b)	0.252
Sig.	0.000
R^2	0.243
Determination coefficient (KD, %)	24.3

Source: Research data, 2025.

The regression equation obtained was $Y = 0.052 + 0.252X$, where Ydenotes CTS and Xrepresents the use of e-maginative media. The positive regression coefficient (b = 0.252) indicates that higher levels of exposure to the e-maginative media are associated with higher CTS scores. The significance value ($p = 0.000 < 0.05$) shows that this relationship is statistically significant, implying that the use of e-maginative media had a meaningful impact on students' CTS. The coefficient of determination ($R^2 = 0.243$) suggests that 24.3% of the variance in CTS scores can be explained by the intervention, with the remaining variance attributable to other factors not examined in this study.

These findings corroborate a growing body of evidence that carefully designed digital and multimedia environments can make a substantial, though not exclusive, contribution to the development of CTS in school and higher education settings (Al-Raggad, 2026; Amani & Mkimbili, 2025; Anwar et al., 2025; Arifin et al., 2025; Atmojo et al., 2025; Bates et al., 2025; Chen et al., 2025; Hidayah, 2023; Humaid & Hamzeh, 2025; Jadhav et al., 2025; Kachouie et al., 2025; Kaddouri et al., 2025; Kartika et al., 2025; Lestari et al., 2025; Maulana et al., 2025; Mardiana et al., 2025; Ninghardjanti et al., 2025; Pavitola & Rieksta, 2025; Pitorini, 2025; Prayogi et al., 2025; Qi et al., 2025; Ramlawati et al., 2025; Saenab et al., 2025; Sofiar et al., 2025; Tandililing et al., 2025; Wijayanti et al., 2025; Xiong & Luo, 2025; Zhang & Liu, 2025; Zhang et al., 2025; Zhao et al., 2025). The moderate R^2 value is comparable to those reported in

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previous quasi-experimental studies on CTS, where instructional interventions typically explain a partial but meaningful proportion of variance in critical thinking outcomes.

Effect of E-Maginative Media on Personal Learning Journey

A second simple linear regression analysis was performed to examine the effect of the e-maginative media on students' PLJ. The statistical results are summarised in Table 4.

Table 4. Simple Linear Regression Results for PLJ

Parameter	Value
Constant (a)	0.048
Regression coefficient (b)	0.255
Sig.	0.000
R^2	0.250
Determination coefficient (KD, %)	25.0

Source: Research data, 2025.

The resulting regression equation was $Y = 0.048 + 0.255X$, with Ydenoting PLJ scores and $X$the use of e-maginative media. The positive regression coefficient (b = 0.255) indicates that increased utilisation of the e-maginative media is associated with higher PLJ scores. The significance value ($p = 0.000 < 0.05$) confirms that the relationship between the intervention and PLJ is statistically significant. The coefficient of determination ($R^2 = 0.250$) shows that 25.0% of the variance in PLJ can be accounted for by the use of e-maginative media, with the remaining 75.0% influenced by other unmeasured variables.

This magnitude of explained variance suggests that the e-maginative media play a slightly stronger role in fostering students' PLJ than in developing CTS, reinforcing the view that interactive, self-paced media can effectively scaffold learners' planning, monitoring, and reflection processes (Cann, 2012; Cortellazzo et al., 2022; Darojat, 2022; DeGennaro, 2016; Greenfield, 2025; Gusnita, 2021; Hasanah, 2022; Herrera et al., 2015; Hill, 1999; Khoiriah, 2022; Leach & Batalden, 2007; Loach, 2024; Martin, 2025; McIlwaine et al., 2007; Morewood, 2025. The observed pattern is also coherent with findings from online and blended learning environments that show how digital platforms can support learner autonomy and reflective engagement, particularly when they offer structured tasks, timely feedback, and opportunities for self-evaluation (Goh, 2020; Kaddouri et al., 2025; Ninghardjanti et al., 2025; Salameh & Alkhateeb, 2025; Sofiar et al., 2025; Xiong & Luo, 2025).

Conceptual Summary of Quantitative Results

To synthesise the results, a conceptual map (Figure 3, to be developed) can be constructed to show the relationships among the core variables: use of e-maginative media, CTS, and PLJ.

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The map would depict e-maginative media as a central instructional input connected by positive directional arrows to CTS and PLJ, with annotated effect sizes ($R^2 = 0.243$ for CTS and $R^2 = 0.250$ for PLJ). It would also position these outcomes within the broader policy and theoretical framework, linking CTS and PLJ to twenty-first-century competencies and national education goals such as those articulated in PISA and the Profil Pelajar Pancasila (OECD, 2023; Sebayang, 2019; Sari et al., 2025). Additional nodes could represent mediating or contextual factors suggested by prior research, such as quality of digital design, classroom implementation, and learners' prior experience with technology and self-regulated learning (Ismail et al., 2025; Kim et al., 2025; Maulana et al., 2025; Mlotshwa & Motlhaka, 2025; Mutchima et al., 2025; Nusivera et al., 2025; Ogunsola & Adigun, 2025; Putri et al., 2025; Roper, 2025; Saenab et al., 2025; Tuyishimire et al., 2025).

Overall, the empirical evidence demonstrates that the e-maginative media intervention not only improved the distribution of CTS and PLJ across higher performance categories but also contributed significantly to explaining variance in both outcomes. These results provide a solid empirical basis for the subsequent discussion, which will further interpret the findings in light of relevant theories and prior studies on CTS, PLJ, and digital learning environments.

DISCUSSION

The findings of this study demonstrate that the use of e-maginative media exerted a significant positive effect on both critical thinking skills (CTS) and personal learning journey (PLJ) compared with conventional textbook-based instruction. The substantial upward shift from less critical and moderately critical levels toward critical and very critical levels in the experimental group, alongside the pronounced movement from moderately independent to independent and highly independent PLJ categories, indicates that interactive, multimodal learning environments can meaningfully foster higher-order thinking and learner autonomy. This pattern is consistent with constructivist perspectives, which argue that knowledge is actively constructed through learners' engagement with rich, problem-oriented environments rather than passively received from teachers, and with contemporary views of learning as a personalised journey shaped by experience, reflection, and agency (Greenfield, 2025; Hill, 1999; Loach, 2024; Martin, 2025; McIlwaine et al., 2007; Morewood, 2025; Nuthall, 2005; Palmer, 2017; Rao et al., 2023). The design of the e-maginative medium—combining text, images, case-based videos, and automatic feedback—also aligns with multimedia and cognitive load principles, which emphasise that learning is enhanced when information is delivered across multiple channels in ways that minimise extraneous load and support active processing, a conclusion echoed in work on virtual and technology-rich learning in science, language, and social studies (Chen et al., 2025; Kachouie

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et al., 2025; Kaddouri et al., 2025; Mardiana et al., 2025; Mutchima et al., 2025; Ninghardjanti et al., 2025; Ramlawati et al., 2025; Saenab et al., 2025; Sánchez-López et al., 2025; Xiong & Luo, 2025; Zhang & Liu, 2025; Zhao et al., 2025).

From a CTS perspective, the regression results showing that e-maginative media accounted for 24.3% of the variance in students' CTS scores, alongside the strong categorical shifts toward critical and very critical levels, corroborate a wide corpus of research indicating that structured, interactive, and inquiry-oriented pedagogies have a measurable impact on learners' analytical and evaluative abilities. Numerous studies have documented gains in CTS when learners engage in project-based tasks, inquiry-based science activities, debate, and problem-based environments—often mediated by digital tools (Aamani & Mkimbili, 2025; Aarar & Pérez-Valverde, 2025; Adare-Tasiwoopa Ápi, 2025; Al-Raggad, 2026; Anwar et al., 2025; Arifin et al., 2025; Ariza-Rúa et al., 2025; Atmojo et al., 2025; Bates et al., 2025; Bhakti et al., 2025; Chen et al., 2025; Khusna et al., 2025; Ravindran et al., 2025; Tuyishimire et al., 2025; Yang et al., 2025; Zhang et al., 2025). The present findings extend this literature into the domain of Pancasila and Citizenship Education, where CTS is crucial for analysing values, arguments, and socio-political issues, but has traditionally received less attention compared to STEM and EFL contexts (Amelia, 2025; Fadillah, 2024; Nurhayati, 2022; Sari et al., 2025; Saputri, 2025; Sebayang, 2019). In this sense, the study affirms that citizenship-related content can be a fertile ground for cultivating critical inquiry when supported by carefully designed digital media.

The documented improvements in PLJ, with 25.0% of variance in PLJ scores explained by the intervention and the emergence of a highly independent learner category only in the experimental group, further support the view that technology-rich environments can nurture self-directed and reflective learning. International scholarship describes personal learning journeys as dynamic pathways through which learners develop identity, agency, and professional or academic expertise, often through transformative and situated experiences (Cann, 2012; DeGennaro, 2016; Dwen, 2025; Goh, 2020; Greenfield, 2025; Herrera et al., 2015; Hill, 1999; Leach & Batalden, 2007; Loach, 2024; Martin, 2025; McIlwaine et al., 2007; Morewood, 2025; Nuthall, 2005; Palmer, 2017; Prior, 2019; Rao et al., 2023; Shuler et al., 2016). In the Indonesian context, studies on learning independence and self-regulation have shown that interactive teaching materials, online worksheets, and cooperative models such as Think Pair Square can enhance students' ability to plan, monitor, and evaluate their own learning (Darojat, 2022; Gusnita, 2021; Hasanah, 2022; Khoiriah, 2022). The present study's PLJ results align with these findings, suggesting that the e-maginative medium functioned as a scaffold for reflective engagement by offering structured content, embedded tasks, and immediate feedback that prompted students to track their

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progress and adjust their strategies. This interpretation is consistent with work on online and blended learning, which emphasises that digital platforms can support learner autonomy when they are designed to make learning pathways visible and provide meaningful opportunities for self-assessment (Cortellazzo et al., 2022; Goh, 2020; Kaddouri et al., 2025; Ninghardjanti et al., 2025; Salameh & Alkhateeb, 2025; Sofiar et al., 2025; Xiong & Luo, 2025).

Taken together, the convergence between quantitative results and existing empirical evidence strengthens the argument that e-maginative media offer a theoretically grounded and practically viable response to the persistent gaps between policy aspirations and classroom realities in Indonesia. National and international reports have highlighted shortcomings in Indonesian students' performance on higher-order tasks, as reflected in PISA outcomes and local assessments of CTS and independent learning (OECD, 2023; Amelia, 2025; Fadillah, 2024; Maulana et al., 2025; Nurhayati, 2022; Saputri, 2025). Many classrooms remain dominated by teacher-centred approaches and textbook-driven instruction, particularly in PPKn, leading to limited opportunities for critical discourse and autonomous exploration (Amelia, 2025; Nurhayati, 2022; Sari et al., 2025; Sebayang, 2019). In this context, the present study takes the position that multimodal, interactive digital media such as the e-maginative flipbook can serve as an effective bridge between curricular goals—embodied in initiatives like Profil Pelajar Pancasila—and pedagogical practice. The findings suggest that when students are invited to engage with contextualised case analyses, visualisations, and automated feedback within a coherent digital environment, they are more likely to activate and refine both their CTS and PLJ, echoing evidence from diverse settings where AI-supported tools, augmented reality, and web-based platforms have been linked to deeper learning and reduced reliance on rote memorisation (Anwar et al., 2025; Asrifan et al., 2025; Chen et al., 2025; Jadhav et al., 2025; Kaddouri et al., 2025; Manickam et al., 2025; Mardiana et al., 2025; Mutchima et al., 2025; Nusivera et al., 2025; Sánchez-López et al., 2025; Zhao et al., 2025).

At the same time, the moderate R^2 values observed in this study (24.3% for CTS and 25.0% for PLJ) indicate that e-maginative media, while important, are only one component in a broader ecology of factors that influence students' higher-order competencies. Prior research has underscored the roles of teacher expertise, classroom culture, assessment practices, and institutional support in shaping how technological innovations translate into learning outcomes (Bates et al., 2025; Daengneam et al., 2025; Kim et al., 2025; McKendry, 2025; Mlotshwa & Motlhaka, 2025; Ogunsola & Adigun, 2025; Roper, 2025; Schalock, 2025; Tuyishimire et al., 2025). The present findings therefore should not be interpreted as suggesting that media alone are sufficient, but rather that e-maginative resources can be powerful when integrated into a broader,

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inquiry-oriented instructional design that encourages discussion, reflection, and value-based reasoning in PPKn. In line with this perspective, the study argues for a balanced approach in which technology acts as a scaffold for both cognitive and affective engagement, complementing—but not replacing—teachers' roles as facilitators of critical dialogue and ethical reflection.

Based on these considerations, several practical recommendations can be proposed to address existing problems in PPKn instruction and to leverage the potential of e-maginative media more broadly. First, PPKn teachers should be supported to redesign lessons around interactive digital materials that embed authentic cases, higher-order questions, and opportunities for self-assessment, in line with evidence that inquiry, project-based, and discussion-oriented strategies are effective in promoting CTS across subjects and levels (Aamani & Mkimbili, 2025; Aarar & Pérez-Valverde, 2025; Arifin et al., 2025; Atmojo et al., 2025; Bhakti et al., 2025; Lestari et al., 2025; Prayogi et al., 2025; Qi et al., 2025; Ramlawati et al., 2025; Saenab et al., 2025; Sukmak & Klinbumrung, 2025; Wijayanti et al., 2025; Yang et al., 2025). Professional development programmes could focus on equipping teachers with the skills to design or adapt flipbook-based media, integrate formative feedback, and facilitate reflective dialogue around digital content (Darojat, 2022; Hasanah, 2022; Khoiriah, 2022; Sari et al., 2025). Second, school leaders and policy-makers should ensure that infrastructure and institutional support are in place to sustain such innovations, including reliable internet access, time allocation for collaborative planning, and recognition of teachers' efforts to innovate, as recommended in broader discussions of digital transformation in education (Goh, 2020; Kaddouri et al., 2025; Ninghardjanti et al., 2025; OECD, 2023; Sebayang, 2019). Third, future research should extend this work by exploring e-maginative media in different subjects and school levels, incorporating additional variables such as motivation, digital literacy, and metacognitive awareness, and employing longitudinal designs to examine the durability of gains in CTS and PLJ (Cann, 2012; DeGennaro, 2016; Greenfield, 2025; Herrera et al., 2015; Loach, 2024; Martin, 2025; Morewood, 2025; Nuthall, 2005; Palmer, 2017; Rao et al., 2023; Shuler et al., 2016). By pursuing these directions, stakeholders can build on the present study's findings to move closer to an education system in which digital innovation genuinely supports the development of critically thoughtful and self-directed citizens, in line with the aspirations of the Profil Pelajar Pancasila and international benchmarks such as PISA.

CONCLUSION

This study examined the influence of e-maginative media on critical thinking skills (CTS) and personal learning journey (PLJ) among Grade X students in Pancasila Education. The findings show that the control and experimental classes initially had comparable levels of CTS

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and PLJ, yet after differentiated treatments both groups improved, with the experimental class using e-maginative media demonstrating substantially greater gains. The intervention had a significant positive effect on CTS, as multimodal presentation through text, images, and case-based videos successfully stimulated students' analytical reasoning and strengthened conceptual connections. In parallel, e-maginative media significantly enhanced PLJ by increasing students' motivation, confidence, and independence in planning, monitoring, and evaluating their learning processes.

The key implication is that interactive digital media can serve as an effective alternative to conventional textbooks for fostering higher-order thinking and self-directed learning, particularly in value-laden subjects such as Pancasila Education that demand analysis, reflection, and logical argumentation. Theoretically, this study extends the understanding of how constructivist, multimedia, cognitive load, and motivational principles can be operationalised simultaneously to develop CTS and PLJ within a single digital environment. Practically, it introduces e-maginative media based on Heyzine Flipbook as a feasible innovation for classroom implementation.

Further research is recommended to test this model at different educational levels and subjects, incorporate additional variables such as learning motivation, digital literacy, and metacognitive ability, and employ longitudinal designs to investigate the sustainability of CTS and PLJ development over time.

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