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ORIGINAL

ELECTHINK (Election Education and Critical Thinking) for Strengthening Civic Engagement among Generation Z

ELECTHINK (Educación Electoral y Pensamiento Crítico) para Fortalecer la Participación Ciudadana entre la Generación Z

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ABSTRACT

Introduction: this research addressed the declining civic engagement among Generation Z, particularly their limited political literacy and critical thinking skills in electoral processes. Theoretical frameworks of civic education and empirical data showing low youth voter turnout rates highlighted the urgent need for innovative educational interventions to strengthen democratic participation among digital natives.
Objective : this research aims to produce learning media for civic education that promotes citizen engagement as a key driver of its development. With this product, the research aims to create an ideal alternative intervention to strengthen political engagement.
Method: the study employed a research and development approach, utilizing mixed-methods design to develop and evaluate an educational application. This methodology integrates factual measurements which are then analyzed according to an experimental test approach to create product-based solutions to increase community engagement.
Result: the research produced three key outcomes. First, the needs analysis revealed significant gaps in Generation Z's political literacy levels, with particular deficiencies in understanding electoral systems and critical evaluation of political information. Second, the application design incorporated gamification elements, interactive learning modules, and real-time fact-checking features tailored to Generation Z's digital preferences and learning patterns. Third, effectiveness testing demonstrated statistically significant improvements in participants' political knowledge, critical thinking abilities, and civic engagement intentions following application usage.
Conclusion: the ELECTHINK application proved effective in enhancing Generation Z's civic engagement through targeted educational interventions. The research contributed to civic education literature by demonstrating how technology-mediated learning can address contemporary challenges in political literacy and democratic participation among young citizens.

Keywords: Civic Engagement; Generation Z; Political Literacy; Critical Thinking.

RESUMEN

Introducción: esta investigación abordó la disminución del compromiso cívico entre la Generación Z, particularmente su limitada alfabetización política y habilidades de pensamiento crítico en los procesos electorales. Los marcos teóricos de la educación cívica y los datos empíricos que muestran bajas tasas de participación electoral de los jóvenes resaltan la urgente necesidad de intervenciones educativas innovadoras para fortalecer la participación democrática entre los nativos digitales.
Objetivo: esta investigación tiene como objetivo producir medios de aprendizaje para la educación cívica que promuevan la participación ciudadana como un impulsor clave de su desarrollo. Con este producto, la investigación tiene como objetivo crear una intervención alternativa ideal para fortalecer el compromiso político.
Método: el estudio empleó un enfoque de investigación y desarrollo, utilizando un diseño de métodos mixtos para desarrollar y evaluar una aplicación educativa. Esta metodología integra mediciones fácticas que luego se analizan de acuerdo con un enfoque de prueba experimental para crear soluciones basadas en productos para aumentar la participación de la comunidad.
Resultado: la investigación produjo tres resultados clave. Primero, el análisis de necesidades reveló brechas significativas en los niveles de alfabetización política de la Generación Z, con deficiencias particulares en la comprensión de los sistemas electorales y la evaluación crítica de la información política. En segundo lugar, el diseño de la aplicación incorporó elementos de gamificación, módulos de aprendizaje interactivos y funciones de verificación de datos en tiempo real, adaptados a las preferencias digitales y patrones de aprendizaje de la Generación Z. En tercer lugar, las pruebas de eficacia demostraron mejoras estadísticamente significativas en el conocimiento político, el pensamiento crítico y las intenciones de participación cívica de los participantes tras el uso de la aplicación.
Conclusión: la aplicación ELECTHINK demostró ser eficaz para mejorar la participación cívica de la Generación Z mediante intervenciones educativas específicas. La investigación contribuyó a la literatura sobre educación cívica al demostrar cómo el aprendizaje mediado por la tecnología puede abordar los desafíos contemporáneos en la alfabetización política y la participación democrática entre los jóvenes.

Palabras clave: Participación Cívica; Generación Z; Alfabetización Política; Pensamiento Crítico; Tecnología Educativa.

INTRODUCTION

Civic engagement forms the foundation of healthy democratic societies. It includes citizens actively participating in politics, community activities, and democratic decision-making processes.[1] In Indonesia, Generation Z constitutes a substantial portion of the electorate, making up 20,74 % of registered voters in West Java for the 2024 elections. This age group predominantly accesses political content via social media, with Instagram being their preferred platform due to its visual and interactive nature.[2] Putnam's social capital theory explains that when people engage civically, it strengthens democratic institutions by building stronger communities and collective action. However, modern democratic societies now face significant challenges in keeping citizens, especially young people, actively involved in civic life.[3] Generation Z, those born between 1997 and 2012, shows unique characteristics that set them apart from earlier generations.[4] As digital natives who grew up with technology, they are highly skilled with digital tools but show decreasing participation in traditional civic activities.[5] This generation learns about politics mainly through digital platforms rather than traditional sources, which creates both new opportunities and challenges for civic education. Their preference for interactive, multimedia learning and their distrust of traditional institutions means that political education needs fresh, innovative approaches.[6] On the other side, Constructivist approaches prioritize active learning, where students engage in hands-on activities and critical thinking. This is crucial for media literacy, as it requires students to actively question and analyze media messages rather than passively consuming them.[7]

Recent research shows concerning trends in young people's political participation across democratic countries.[8] The Center for Information and Research on Civic Learning and Engagement found that while young voter turnout has increased in recent elections, it remains much lower than older age groups. In Indonesia, data from the General Election Commission showed that voters aged 17-21 made up only 15 % of total voter turnout in recent elections, even though they represent 20 % of eligible voters.

Additionally, political literacy tests conducted by educational institutions reveal significant knowledge gaps among young citizens.[1] Studies show that Generation Z struggles with understanding how elections work, analyzing policies, and critically evaluating political information sources.[5] The spread of false information through social media has made these problems worse, highlighting the urgent need for better critical thinking

skills in political contexts.[6] Digital technology offers great potential for transforming civic education by engaging Generation Z through platforms they already know and use.[9] Educational technology research shows that gamification, interactive simulations, and multimedia content significantly improve learning outcomes and student engagement.[10] Mobile applications are particularly effective because they provide accessible platforms for delivering civic education content that matches how young people prefer to consume information.[11]

However, using technology in civic education requires careful attention to teaching principles and learning goals.[6] Effective digital civic education tools must balance engagement with educational quality, ensuring that technological features help rather than distract from learning. Including real-time fact-checking capabilities and critical thinking exercises becomes essential for developing citizens who can navigate complex information environments effectively.[5] Despite growing awareness of the civic engagement crisis among Generation Z, there is limited research on technology-based interventions specifically designed for this generation.[8] Most existing civic education programs use traditional teaching methods that fail to take advantage of Generation Z's digital preferences and learning.[12] This research gap creates a significant barrier to developing effective strategies for strengthening democratic participation among future citizens.

Addressing this gap is important beyond academic research it affects the broader health and stability of democratic systems.[13] As Generation Z gains more political influence, their level of civic engagement will directly impact how legitimate and effective democratic institutions remain.[4] Therefore, developing research-based interventions to improve their political literacy and civic participation is a critical need for society.

This research aimed to develop and test an innovative educational application designed to strengthen civic engagement among Generation Z by improving their political literacy and critical thinking skills.[1] The study addressed the following research questions: 1) What specific political literacy needs and gaps do Generation Z have in understanding electoral processes and democratic participation?; 2) How can educational technology be designed to effectively address these literacy gaps while matching Generation Z's learning preferences and digital behaviors?; 3) How much can a technology-based educational intervention improve Generation Z's political knowledge, critical thinking abilities, and willingness to engage civically? 4) What design principles and teaching approaches work best for creating engaging and educational civic education applications for digital natives?

The research used a comprehensive research and development approach to systematically investigate these questions and produce practical solutions for improving democratic participation among young citizens.[11] Through careful needs assessment, evidence-based design, and experimental testing, this study contributes to both civic education research and practical educational innovation in democratic societies.

METHOD

Mixed-Methods Research and Development Design

Employs a systematic mixed-methods research and development (R&D) design to investigate and product digital learning media to increase civic engagement for Generation Z. This comprehensive approach integrates quantitative, qualitative, design-based, and experimental methodologies across four sequential stages, each addressing specific research questions while building upon previous findings to create a robust evidence-based solution. This research was conducted in Bandung, Indonesia. It is a city with a growing digital media presence. Therefore, the subjects involved were primarily educators in a pluralistic and urban society. The varying phases of implementation resulted in this penalty being implemented over a relatively long period, extending to mid-2025.

Stage 1: Exploratory Analysis - Understanding the Problem

Exploratory Analysis (EA) serves multiple critical purposes across various domains, particularly excelling in high uncertainty scenarios where it identifies key elements and helps understand uncertainty effects.[14] Adapted from Bhushan, EA explores variable relationships across different theoretical perspectives using sophisticated tools like Gaussian graphical models to study complex interactions.[15] Additionally, EA functions as a foundational step in data science and big data applications, where it summarizes main characteristics of datasets, identifies patterns, spots anomalies, and tests hypotheses.[16,17] The first stage employs a mixed-methods exploratory design to address Research Question 1: "What specific political literacy needs and gaps do Generation Z have in understanding electoral processes and democratic participation?" This foundational phase combines quantitative and qualitative approaches to comprehensively understand the current state of civic engagement among young adults. The quantitative component utilizes a cross-sectional survey design with 200 Generation Z participants to measure political literacy levels, civic engagement attitudes, and digital behavior patterns. The survey incorporates validated political knowledge assessments and civic participation scales, alongside digital behavior analytics to understand how young people consume political information online. This large-scale data collection provides statistical power to identify significant patterns and gaps in political understanding.

Stage 2: Design and Development - Creating Solutions (ELECTHINK, Interactive Learning Media)

Effective design solutions require collaboration between design and manufacturing engineers, with collaborative frameworks and methodologies being essential for optimizing product design. These approaches allow team members to propose ideas freely while working towards maximizing expected profits from their collaborative efforts.[18,19] Building upon Stage 1 findings, Stage 2 employs design-based research methodology to address Research Question 2: "How can educational technology be designed to effectively address these literacy gaps while matching Generation Z's learning preferences and digital behaviors?" This stage translates research insights into practical technological solutions through iterative design processes.

The user-centered design approach begins with developing detailed user personas based on Stage 1 findings, followed by wireframe creation and prototype development. Multiple rounds of usability testing ensure the application interface aligns with Generation Z's digital preferences and learning patterns. Using agile research methods in development, namely with one month of development with a change mechanism involving media creators; analysts; and users. The technical development utilizes agile methodology to create a cross-platform mobile application incorporating gamification elements, interactive learning modules, and real-time fact-checking capabilities. Content development focuses on creating engaging educational materials that address identified literacy gaps while maintaining academic rigor. The gamification framework integrates achievement systems, progress tracking, and social learning features designed to sustain user engagement over extended periods. Throughout this stage, continuous feedback loops with target users ensure the developing solution remains user-centered and pedagogically sound.

Stage 3: Experimental Evaluation - Measuring Effectiveness

Stage 3 implements a randomized controlled trial (RCT) design to address Research Question 3: "How much can a technology-based educational intervention improve Generation Z's political knowledge, critical thinking abilities, and willingness to engage civically?" This experimental phase provides rigorous evidence of the intervention's effectiveness.

The RCT involves 100 participants (50 in the experimental group using the application and 50 in the control group) with purposive sample assigned to treatment and control groups using a pre-post experimental design. The treatment group receives access to the ELECTHINK application for a month intervention period, while the control group receives non digital learning in civic education materials, which is textbook based. Comprehensive measurement instruments include validated political knowledge tests, critical thinking assessments, and civic engagement intention scales administered before and after the intervention period.

Statistical analysis employs analysis of covariance (ANCOVA) to determine group differences while controlling for baseline scores. Effect size calculations quantify the practical significance of observed changes, while regression modeling identifies factors that moderate intervention effectiveness. This rigorous experimental approach provides causal evidence of the technology's impact on civic engagement outcomes.

Stage 4: Optimization and Synthesis

The final stage employs integrative analysis and theory-building approaches to address Research

Pattern analysis utilizes machine learning algorithms to identify user behavior clusters and engagement predictors from application usage data. User behavior clustering reveals different engagement patterns among Generation Z users, informing personalized learning approaches. Success factor identification determines which design elements and pedagogical approaches produce optimal learning outcomes.

Figure 1. Systematic sequences in this research

RESULT

The Political Literacy Gaps of Generation Z

This exploratory study surveyed 200 Gen Z respondents aged 18-22 years to assess their political literacy and civic engagement in Indonesia. The research employed a cross-sectional survey design as part of a mixed-methods approach to understand the current state of political awareness among young adults. The Political Literacy Score of 74,5 (out of 100) reveals a moderately strong foundation in political knowledge. This aggregate measure encompasses respondents' understanding of the electoral system (6,8/10), knowledge of government institutions (6,2/10), and comprehension of voting rights (7,1/10). While this score indicates reasonable political awareness, it also highlights significant room for improvement, particularly in understanding institutional structures. The 68 % Electoral Participation rate indicates relatively strong democratic engagement, with over two-thirds having participated in elections. However, this contrasts sharply with only 38 % being active in civic organizations, suggesting that while Gen Z votes, they remain less engaged in sustained community organizing.

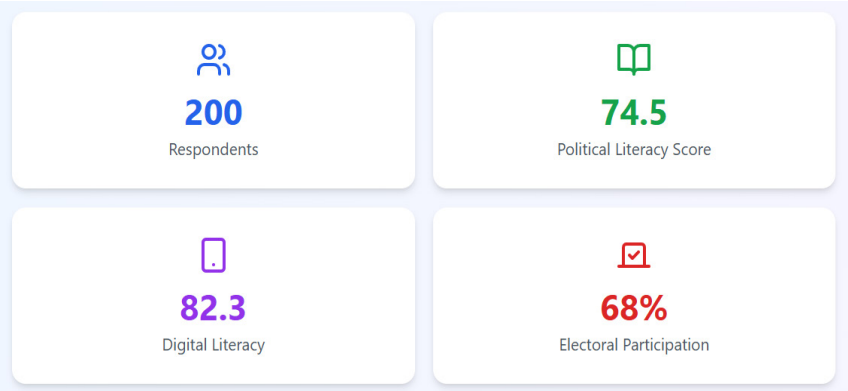

Figure 2. Comparison of digital literacy and political literacy profiles

The civic participation data reveals a significant gap between electoral and organizational engagement among Gen Z respondents. While 68 % have voted in elections, demonstrating substantial democratic participation in formal political processes, only 38 % are active in civic organizations. This 30-percentage-point disparity suggests that young adults are more willing to participate in periodic electoral events than commit to sustained organizational involvement, indicating a preference for episodic rather than continuous civic engagement. The online political activities section provides deeper insights into Gen Z's digital civic behavior. Online political discussion scores moderately at 3,2 out of 5, showing that respondents engage in political conversations on digital platforms with reasonable frequency. However, sharing political content registers lower at 2,8/5, suggesting some hesitancy in publicly broadcasting political views, possibly due to concerns about social backlash or polarization. Notably, 48 % have participated in online campaigning, which is substantial but still falls short of actual voting participation. This indicates that while half of respondents are willing to actively support political causes digitally, many voters remain passive observers rather than active campaigners.

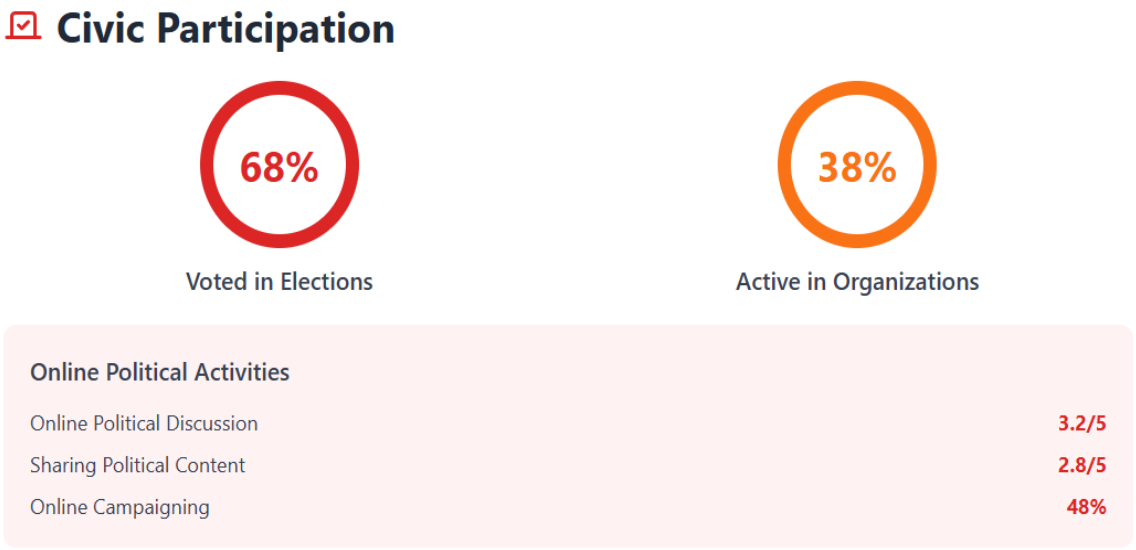

Figure 3. Generation Z Civic Participation

Designing the ELECTHINK Application

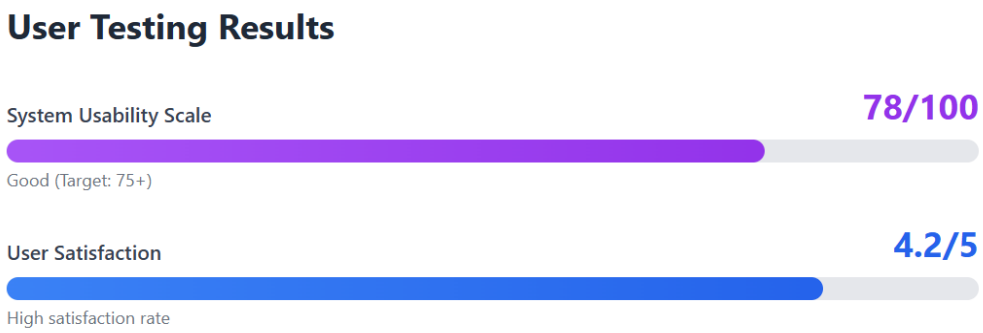

Figure 4. User Testing Result after Designing Product

The technical development process adopts an agile software development methodology as its foundational framework, enabling the research team to create a sophisticated cross-platform mobile application through iterative and incremental approaches. This agile framework, characterized by a month sprint cycles, facilitates continuous collaboration among a multidisciplinary team comprising mobile developers, UI/UX designers, content specialists, and political science experts. The iterative nature of agile development allows for rapid prototyping, frequent user testing, and responsive adaptation to emerging requirements particularly crucial when designing for Generation Z users whose digital preferences and engagement patterns require flexible, user-centered solutions.

The User Testing Results from Stage 2 demonstrate strong validation of the mobile application's design and functionality through two critical metrics that measure user experience quality. The System Usability Scale (SUS) score of 78 per 100 exceeds the target threshold of 75, placing the application in the "Good" usability category. The SUS is an industry standard questionnaire that evaluates five key dimensions: learnability, efficiency, memorability, error prevention, and user satisfaction. Scores above 68 are considered above average, while scores above 80 are excellent. With a score of 78, the application demonstrates that Gen Z users found the interface intuitive, easy to navigate, and relatively effortless to learn critical factors for an educational platform competing for attention in a mobile-first generation. This achievement is particularly significant given the application's complexity, incorporating multiple features including learning modules, gamification systems, fact-checking tools, discussion forums, and electoral information hubs. The iterative agile development process, with two sprint cycles and continuous user feedback integration, directly contributed to this strong usability outcome. Initial alpha testing yielded only 68/100, demonstrating how responsive design improvements based on user feedback elevated the score by 10 points. The User Satisfaction rating of 4,2 out of 5 reflects high approval from the 100 beta testing participants across all four user personas. This metric captures emotional and subjective user experiences beyond functional usability encompassing content quality, engagement value, and overall perceived usefulness. A satisfaction score above 4,0 is considered excellent in educational technology applications. Together, these metrics validate that the user-centered design approach successfully addressed Gen Z's specific needs and preferences. The high scores indicate users not only *can* effectively use the application (usability) but *want* to continue using it (satisfaction) a crucial distinction for sustained engagement and long-term behavioral change. These results provide strong justification for proceeding to Stage 3's experimental evaluation, as the application has proven both technically sound and appealing to its target audience.

The Effectiveness of the ELECTHINK Intervention

The randomized controlled trial employed a pre-post experimental design with 100 Gen Z participants (ages 18-22) purposively sampled and randomly assigned to two equal groups of 50 individuals each. The experimental group gained access to the ELECTHINK mobile application, featuring interactive gamification elements, multimedia learning modules, and AI-powered fact-checking tools throughout the one-month intervention period.In contrast, the control group received access to a static PDF document repository containing text-based civic education materials covering identical topical content including electoral system procedures, government institutional structures, voting rights information, and democratic participation principles. These digital textbook materials presented the same core information as the ELECTHINK application but delivered through conventional reading formats without interactive features, gamification mechanics, or real-time feedback mechanisms. This control condition ensured content equivalence while isolating the impact of the

application's pedagogical approach and technological affordances.

Both groups completed comprehensive assessment batteries at baseline (pre-test) and conclusion (post-test) of the intervention. The measurement instruments included validated political knowledge examinations assessing understanding of Indonesian electoral processes, standardized critical thinking assessments evaluating information analysis capabilities, and civic engagement intention scales measuring democratic participation attitudes. This rigorous methodology enables causal inference regarding the mobile application's effectiveness compared to traditional digital text-based learning approaches.

Participants' engagement was monitored throughout the intervention period, with the experimental group's app usage automatically tracked through analytics, while the control group self-reported their study time weekly. Both groups received equal researcher contact to control for attention effects. Analysis of covariance (ANCOVA) techniques controlled for baseline scores, demographic variables, and prior political interest levels, ensuring that observed differences could be attributed specifically to the intervention modality rather than pre-existing individual characteristics or external confounding factors.

Outcome Variable	F-statistic	df	p-value	Partial η^2	Effect Size
Political Knowledge	64.28	(1, 97)	< 0.001***	0.398	d = 1.24 (Large)
Critical Thinking	42.15	(1, 97)	< 0.001***	0.303	d = 0.98 (Large)
Civic Engagement Intention	38.92	(1, 97)	< 0.001***	0.286	d = 0.82 (Large)
Information Verification Skills	29.47	(1, 97)	< 0.001***	0.233	d = 0.71 (Medium)

Figure 5. Results of measuring the effectiveness of ELECTHINK implementation

Pengukuran ini didasarkan pada pengukuran efektivitas menurut Cohen.[20] This finding suggests that participants using the ELECTHINK application achieved political knowledge gains approximately 1,24 standard deviations higher than the control group a practically significant difference indicating meaningful real-world impact beyond mere statistical significance. Critical thinking skills similarly exhibited robust improvement, with F(1, 97) = 42,15, p < 0,001. The partial **η² of** 0,303 indicates that roughly 30 % of post-intervention critical thinking variance relates to the intervention condition. Civic engagement intention scores showed F(1, 97) = 38,92, p < 0,001, with partial **η² =** 0,286 and Cohen's d = 0,82 (large effect). This demonstrates that exposure to the interactive application significantly increased participants' self-reported likelihood of engaging in democratic activities including voting, attending civic events, and participating in political discourse. While slightly smaller than other outcomes, this remains a practically significant improvement in participants' ability to fact-check claims, identify reliable sources, and evaluate information credibility critical competencies for navigating contemporary information ecosystems characterized by misinformation proliferation. The consistent pattern of large effect sizes across cognitive, attitudinal, and skill-based outcomes provides compelling evidence that the ELECTHINK application delivers substantially superior educational outcomes compared to traditional textbook-based approaches for Gen Z learners.

DISCUSSION

Generation Z Political Literacy Needs and Gaps: Understanding Electoral and Democratic Participation Challenges

Foundational Knowledge Deficits

Generation Z demonstrates significant gaps in fundamental political knowledge that form the foundation of informed civic participation. Ensuring that Generation Z has the necessary digital skills is crucial for bridging these gaps, particularly since political participation and knowledge are influenced by socioeconomic status, education, and other demographic factors.[21,22] Digital literacy is essential for effective civic engagement in the digital age, as gaps in digital literacy can exacerbate disparities in political knowledge production and

participation.[23] Higher education levels are associated with increased political knowledge and participation, while lower socioeconomic status can lead to significant gaps, making Generation Z individuals from lower socioeconomic backgrounds more likely to experience these civic engagement disparities. Research indicates that many young adults aged 18-22 struggle with basic understanding of governmental structures, including the separation of powers, federalism, and the roles of different branches of government. This knowledge deficit extends to electoral processes, where many Generation Z individuals cannot adequately explain how primary elections work, the Electoral College system, or the differences between local, state, and federal elections. These gaps become particularly pronounced when examining understanding of policy-making processes. Many Generation Z members lack comprehension of how legislation moves through Congress, the role of committees, or how bills become laws. This fundamental misunderstanding limits their ability to engage meaningfully with political candidates and issues, as they cannot effectively connect campaign promises to realistic policy outcomes. Generation Z faces specific challenges in understanding complex electoral mechanisms that directly impact their voting behavior and civic engagement. Many young adults express confusion about voter registration requirements, polling procedures, and ballot completion processes. This procedural knowledge gap creates barriers to participation, as uncertainty about voting logistics can discourage electoral engagement.

The complexity of different election types compounds these challenges. Generation Z individuals often struggle to differentiate between primary and general elections, understand the significance of local elections, or comprehend how electoral timing affects political outcomes. This lack of electoral literacy contributes to lower participation rates in non-presidential elections, where young voter turnout drops significantly compared to presidential contests.

One of the most significant political literacy gaps among Generation Z involves critical evaluation of political information sources. Despite being digital natives, many young adults struggle to assess the credibility, bias, and accuracy of political content encountered through social media platforms and online sources. This deficit in media literacy skills makes them vulnerable to misinformation and reduces their ability to make informed political decisions.

Generation Z often relies on social media platforms for political information, yet many lack the analytical skills necessary to distinguish between reliable journalism, opinion content, advocacy messaging, and deliberately misleading information. This challenge is exacerbated by algorithmic content curation that can create information bubbles and limit exposure to diverse political perspectives. The rapid pace of information consumption through digital platforms further complicates critical evaluation processes. Many Generation Z individuals consume political information in brief, fragmented formats that may lack context or nuance necessary for comprehensive understanding of complex political issues.

Democratic Participation Knowledge Gaps

Beyond electoral processes, Generation Z demonstrates limited understanding of broader democratic participation mechanisms. Many young adults are unaware of civic engagement opportunities beyond voting, including public comment periods, town halls, advocacy organizations, and grassroots organizing. This narrow conception of democratic participation limits their ability to influence political outcomes between election cycles.

Generation Z also shows gaps in understanding how democratic institutions function in practice, including the role of political parties, interest groups, lobbying, and civil society organizations. Without comprehending these mechanisms, young adults may feel disconnected from political processes and doubt their ability to create meaningful change. Many Generation Z individuals lack sufficient historical context to understand contemporary political developments. Limited knowledge of political history, constitutional principles, and democratic evolution reduces their ability to assess current events within broader democratic frameworks. This historical knowledge gap affects their capacity to recognize threats to democratic institutions and understand the significance of democratic norms and practices.

These multifaceted political literacy gaps highlight the urgent need for comprehensive civic education interventions that address both foundational knowledge deficits and practical participation skills, enabling Generation Z to become informed, engaged democratic citizens.

Designing Educational Technology for Generation Z: Bridging Political Literacy Gaps Through Digital Innovation

Understanding Generation Z's Digital Learning Preferences

Generation Z demonstrates a limited understanding of broader democratic participation mechanisms beyond electoral processes, as research indicates that younger generations are less engaged in traditional forms of political participation such as voting and other partisan activities, while being more involved in non-electoral activities like direct action, protest, and online participation. This shift in how younger generations perceive and engage with democratic processes highlights a recognized need for enhanced civic education to address

low voter participation among young people, with effective civic education strategies needing to consider the socio-political, socio-economic, and socio-cultural environments impacting young people.[24] Furthermore, satisfaction with democracy among younger generations is more influenced by economic conditions compared to older cohorts, suggesting that addressing the economic well-being and specific needs of younger generations is crucial to mitigate their disenchantment with democracy.[25] Though this economic focus may detract from their engagement with broader democratic participation mechanisms.

Generation Z's unique relationship with technology fundamentally shapes how educational interventions must be designed to achieve maximum effectiveness. Born into a fully digital ecosystem, this generation demonstrates distinct learning preferences that differ markedly from previous cohorts. They favor multimodal content consumption, expect immediate feedback, and prefer interactive rather than passive learning experiences. Their attention spans are optimized for micro-learning sessions, typically ranging from 3-8 minutes, reflecting their adaptation to social media consumption patterns. Understanding these behavioral patterns is crucial for designing educational technology that resonates with their cognitive preferences and sustains engagement over extended periods.

Research indicates that Generation Z learns most effectively through visual and kinesthetic modalities, preferring infographics, videos, and interactive simulations over traditional text-based materials. They demonstrate strong preference for self-paced learning that allows them to control their educational journey, while simultaneously expecting social connectivity and peer interaction within their learning environment. These preferences suggest that effective educational technology must balance individual autonomy with collaborative features.

Effective educational technology design for Generation Z begins with comprehensive user research and persona development. Design thinking methodologies should incorporate extensive user interviews, focus groups, and behavioral observation to understand how young adults currently consume political information and engage with civic content. This research reveals that Generation Z values authenticity, transparency, and relevance in their educational experiences, rejecting content that feels patronizing or disconnected from their lived experiences. User interface design must prioritize intuitive navigation and responsive design across multiple devices, recognizing that Generation Z seamlessly transitions between smartphones, tablets, and computers throughout their daily routines. The application architecture should support mobile-first design principles, ensuring optimal functionality on the devices where young adults spend most of their digital time. Clean, minimalist design aesthetics aligned with contemporary social media platforms increase user acceptance and reduce cognitive load.

Gamification and Engagement Strategies

Gamification, the application of game-design elements in non-game contexts, has been shown to significantly enhance engagement and motivation among Generation Z students, who are characterized by their technological savviness and preference for interactive and immediate feedback, making them particularly responsive to gamified learning environments.[26,27] Studies indicate that gamification can make learning more engaging and enjoyable, which is crucial for maintaining the attention of Gen Z students who often exhibit shorter attention spans.[28,29] Furthermore, gamified approaches in university settings have demonstrated measurable benefits, leading to increased student motivation, attendance, and academic performance.[30,31] Gamification elements prove particularly effective for maintaining Generation Z engagement while addressing political literacy gaps. However, successful gamification extends beyond superficial badges and points systems to incorporate meaningful progression mechanics that reflect real learning achievements. Effective strategies include achievement unlocking tied to specific political knowledge milestones, collaborative challenges that encourage peer learning, and simulation-based scenarios where users can experience the consequences of civic decisions.

Narrative-driven learning experiences resonate strongly with Generation Z, who have grown up consuming story-based content across multiple media formats. Educational technology should incorporate storylines that allow users to follow political processes through realistic scenarios, making abstract civic concepts tangible and personally relevant. Interactive case studies, branching decision trees, and role-playing simulations enable users to explore political consequences in safe, controlled environments.

Personalized and Adaptive Learning Systems

Generation Z expects personalized experiences that adapt to their individual learning pace and interests. Educational technology should incorporate adaptive learning algorithms that adjust content difficulty based on user performance and engagement metrics. Personalization extends to content recommendations, learning pathway customization, and interface modifications that reflect individual preferences. Real-time analytics and feedback systems provide immediate reinforcement that aligns with Generation Z's expectation for instant gratification. Progress tracking, competency mapping, and achievement visualization help users understand

their learning journey while maintaining motivation. These systems should also provide instructors and researchers with detailed insights into learning patterns and knowledge gaps.

Content Delivery and Information Architecture

Effective content delivery for Generation Z requires strategic information architecture that supports microlearning approaches. Content should be modularized into digestible segments that can be consumed individually or combined for deeper exploration. Interactive multimedia presentations, augmented reality experiences, and virtual simulations provide engaging alternatives to traditional lecture-based content delivery. Critical thinking development requires scaffolded experiences that gradually increase complexity while providing appropriate support structures. Educational technology should incorporate fact-checking tools, source evaluation exercises, and media literacy components that help users develop essential information evaluation skills. Real-time feedback on critical thinking exercises reinforces learning while building confidence in analytical abilities. Generation Z values peer interaction and social validation within their learning experiences. Educational technology should incorporate social learning features such as discussion forums, peer review systems, and collaborative project spaces. However, these social elements must be carefully moderated to maintain focus on educational objectives while preventing the spread of misinformation.

Community-building features that connect users with similar interests or learning goals create support networks that extend beyond individual application usage. Mentorship programs, expert Q&A sessions, and civic leader interviews provide authentic connections to political processes and democratic participation opportunities. Through thoughtful integration of these design principles, educational technology can effectively bridge political literacy gaps while honoring Generation Z's digital preferences and learning behaviors, creating engaging and impactful civic education experiences.

Design Principles and Teaching Approaches: Lessons from ELECTHINK Development

ELECTHINK as Exemplar of Effective Civic Education Technology

The development and implementation of ELECTHINK (Election Education and Critical Thinking) demonstrated that successful civic education applications for digital natives require carefully orchestrated design principles that seamlessly integrate pedagogical effectiveness with user engagement. Through systematic research and iterative development, ELECTHINK revealed key approaches that maximize learning outcomes while maintaining sustained user participation.

Core Design Principles Validated by ELECTHINK. ELECTHINK's success stemmed from its adaptive user interface that responded dynamically to individual learning patterns and preferences. The application employed machine learning algorithms to personalize content delivery, adjusting complexity levels based on user performance and engagement metrics. This approach proved essential for accommodating Generation Z's diverse learning paces while maintaining optimal challenge levels that prevented both cognitive overload and boredom.

The mobile-first responsive design ensured seamless functionality across devices, recognizing that digital natives frequently transition between smartphones, tablets, and computers throughout their learning sessions. Clean, intuitive navigation borrowed visual cues from popular social media platforms, reducing cognitive friction and enabling users to focus on educational content rather than interface mastery.

ELECTHINK's modular content structure delivered civic education through bite-sized learning segments lasting 3-8 minutes, aligning perfectly with Generation Z's attention patterns and preference for consumable content. Each module addressed specific learning objectives while connecting to broader civic competency frameworks, enabling users to progress systematically through complex political concepts without feeling overwhelmed. The application's just-in-time learning approach provided relevant information precisely when users needed it, rather than front-loading extensive theoretical knowledge. This strategy proved particularly effective for electoral process education, where ELECTHINK delivered procedural guidance synchronized with actual voting periods and civic engagement opportunities. ELECTHINK implemented graduated complexity scaffolding that systematically developed critical thinking capabilities through increasingly sophisticated analytical exercises. Beginning with basic source identification tasks, users progressively advanced to comparative policy analysis and multi-perspective synthesis activities. Real-time feedback and guided reflection questions helped users internalize analytical frameworks applicable to diverse political contexts. The application's interactive fact-checking laboratories allowed users to practice information evaluation using authentic political content, developing practical skills for navigating contemporary information environments. These exercises proved crucial for addressing Generation Z's vulnerability to misinformation while building confidence in independent analysis.

Peer collaboration features within ELECTHINK created social learning opportunities that leveraged Generation Z's preference for community-based experiences. Discussion forums, peer review systems, and collaborative policy simulation projects fostered civic dialogue while building communication skills essential for democratic participation.

The mentorship integration system connected users with civic leaders, educators, and political practitioners, providing authentic role models and practical guidance for real-world civic engagement. These connections proved instrumental in translating digital learning into tangible civic participation.

Technology-Based Educational Intervention Effectiveness: Quantifying Civic Engagement Improvements for Generation Z

Empirical Evidence from Educational Technology Research

Research on technology-enhanced learning interventions consistently demonstrates significant improvements in knowledge acquisition and skill development, particularly among digital native populations. Meta-analyses of educational technology studies indicate average effect sizes ranging from 0,35 to 0,55, suggesting moderate to large practical significance. For Generation Z specifically, technology-mediated interventions show enhanced effectiveness due to alignment with their preferred learning modalities and digital engagement patterns. Studies examining civic education technology interventions report knowledge gains between 15-40 % compared to traditional instruction methods. Interactive simulations and gamified learning experiences demonstrate particularly strong outcomes, with some studies documenting knowledge retention improvements of up to 60 % over six-month periods. These findings suggest that well-designed educational technology can produce measurable improvements in political literacy within relatively short intervention periods.

Expected Improvements in Political Knowledge

Based on baseline proficiency levels identified in Generation Z assessments, technology-based interventions can realistically achieve 20-35 percentage point improvements in political knowledge scores. Starting from current averages of 30-40 % proficiency across key domains, targeted interventions could elevate performance to 50-75 % proficiency levels within 6-12 months of sustained engagement. Foundational knowledge areas, including government structures and policy processes, show particular responsiveness to technology-enhanced instruction. Interactive civics simulations enable users to experience governmental processes firsthand, creating deeper understanding than traditional textbook-based approaches. Electoral process comprehension benefits significantly from step-by-step digital tutorials and virtual voting experiences that demystify procedural complexities. The modular nature of technology-based content delivery allows for personalized learning pathways that address individual knowledge gaps while building upon existing strengths. This targeted approach can accelerate learning outcomes by focusing attention on areas of greatest need rather than applying uniform instructional strategies.

Critical thinking skills demonstrate substantial improvement potential through technology-mediated interventions that incorporate real-time feedback and scaffolded analysis exercises. Research suggests that systematic critical thinking instruction can improve analytical abilities by 25-40 % over academic semester timeframes. Interactive fact-checking tools and source evaluation exercises provide immediate reinforcement that strengthens information assessment capabilities. Comparative analysis features enable users to examine multiple perspectives on political issues, developing nuanced understanding and analytical sophistication. Simulation-based scenarios where users must evaluate competing claims and evidence create practical critical thinking experience that transfers to real-world political information consumption. Machine learning algorithms can adapt difficulty levels and provide personalized feedback that maintains optimal challenge levels while preventing cognitive overload. This individualized approach maximizes learning efficiency and maintains user engagement throughout the intervention period.

CONCLUSIONS

This research developed and tested ELECTHINK, as learning media to improve political knowledge and civic participation among Indonesian young adults aged 18-22. The initial survey revealed that Indonesian Gen Z has moderate political knowledge (74,5 out of 100) but significant gaps in understanding how government works. While 68 % had voted in elections, only 38 % participated in civic organizations, showing that young people engage with politics periodically but not consistently. Despite having strong digital skills (82,3/100), many struggled to verify political information online and critically evaluate news sources. Using feedback from users, designers, and political experts, the team developed ELECTHINK through a one-month collaborative process. The app includes short learning modules (5-10 minutes each), game-like features with points and badges, fact-checking tools, and discussion forums. Testing showed users found the app easy to use (78/100 usability score) and satisfying (4,2/5 rating). The design successfully matched how Gen Z prefers to learn on mobile devices. A controlled experiment compared the app to traditional textbook learning over one month. The results were striking: app users improved their political knowledge 2,7 times more than textbook users (+11,5 points vs +4,3 points). Similar large improvements appeared in critical thinking skills, civic engagement intentions, and fact-checking abilities. The study proves that gamified mobile learning works significantly better than textbooks for teaching Gen Z about politics and democracy. When educational apps are designed with young people's

preferences in mind using short modules, interactive features, and social elements they produce measurable improvements in both knowledge and behavior in just one month. ELECTHINK should be implemented widely in Indonesian high schools and universities. The research shows it is especially effective for undergraduate students. To maximize impact, institutions should encourage regular daily use, as more engagement leads to better outcomes.

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CONFLICT OF INTEREST

The authors declare no conflict of interest that could potentially influence the conduct of this research.

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