

Challenges and Opportunities for Designing and Implementing Ubiquitous Game-Based Learning to Cultivate Digital Citizenship in Thailand

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Abstract: Digital citizenship has become an essential aspect of modern education. As technology becomes increasingly ubiquitous daily, there is a growing need to cultivate digital citizenship skills among students worldwide. Few studies have explored the potential of game-based learning using ubiquitous technologies to enhance digital citizenship education. Game-based learning has emerged as a promising approach to engage learners and promote the development of these crucial competencies. Moreover, ubiquitous learning approaches can provide seamless educational experiences across various contexts and devices. This paper proposes a comprehensive framework for designing and implementing a ubiquitous game-based learning system to foster digital citizenship in the Thai educational context. Drawing on existing research, this study analyzed the challenges and opportunities associated with this endeavor, addressing considerations around technology integration, pedagogical design, and implementation strategies. The study revealed that a ubiquitous game-based learning system could leverage AI-powered personalization to tailor learning experiences and provide real-time feedback to cultivate digital citizenship among Thai K-12 students. The findings also provide valuable insights for researchers, educators, and policymakers interested in leveraging innovative learning approaches to nurture digitally literate and responsible citizens in Thailand.

Keywords: Digital education, essential skill, teaching and learning strategy, design and development

1. Background and Motivation

Digital citizenship is a broad and multifaceted concept. It generally refers to the responsible and ethical use of technology and digital spaces, encompassing the ability to participate effectively and responsibly in the online world. It ensures equal access to digital opportunities, empowers people to leverage technology for social change and civic engagement, and develops critical thinking, media literacy, and ethical online conduct skills (Mossberger et al., 2007; Jones et al., 2023). As an evolving concept, digital citizenship requires ongoing reflection and adaptation to keep pace with technological advancements. In the 21st century, cultivating digital citizenship has become crucial as technology has become deeply integrated

into various aspects of our lives (Melhuish et al., 2018; Cortesi et al., 2020). Fostering digital citizenship skills among K-12 students has become a growing global concern as technology becomes increasingly integrated into our lives. Key issues include cyber safety and well-being, such as cyberbullying and online harassment, as well as mental health impacts from excessive screen time (Melhuish et al., 2018; Tapingkae et al., 2020; Jones et al., 2023). There is also a digital literacy and skills gap, with students needing critical thinking skills to navigate information overload and unequal access to digital literacy training. Additionally, ethical and responsible technology use, including privacy and data protection and digital etiquette, is crucial (Devaux et al., 2017). To address these concerns, organizations and educators are working to integrate digital citizenship into curricula, provide teacher training, and engage parents and communities in a collaborative effort to empower students to become responsible, informed, and ethical digital citizens (Mossberger et al., 2007; Curran & Ribble, 2017; Melhuish et al., 2018; Martin et al., 2020; Jones et al., 2023). This concern is reflected in Thailand's strong commitment to fostering digital citizenship and integrating technology into its education system through comprehensive policies and initiatives.

In recent years, the Thai government has strongly committed to fostering digital citizenship and integrating technology into its education system. Key initiatives include a dedicated Digital Literacy curriculum, strategies to promote digital citizenship among secondary school students, and the integration of ICT to support personalized and lifelong learning. These efforts align with Thailand's broader digital development goals, highlighting the critical role of digital citizenship and technology integration in driving economic and social progress (EdTech in South-East Asia, 2023). The Thai government has implemented comprehensive policies and initiatives to foster digital citizenship and integrate technology into its education system. Developing and implementing a dedicated Digital Literacy curriculum is at the core of these efforts. Recognizing secondary school students' unique needs and challenges, the Ministry of Education has implemented specific strategies to promote digital citizenship within this age group. These strategies focus on integrating digital literacy into the curriculum and encouraging safe online practices among adolescents. In addition to curriculum development, the Ministry of Education emphasizes the integration of ICT to support personalized and lifelong learning experiences. It includes promoting digital skills through STEM education, coding, and active learning approaches. The goal is to create engaging and tailored learning environments catering to student's diverse needs and interests, enhancing their overall educational experience. These educational initiatives align with Thailand's broader digital development goals, as outlined in the Thailand 4.0 initiative and the Ministry of Digital Economy and Society's long-term plans. These national agendas underscore the importance of digital transformation in driving economic and social progress and highlight the critical role of digital citizenship and ICT integration in the education sector. By fostering digital literacy and integrating technology into education, Thailand aims to prepare its students for the demands of the digital age and ensure they are equipped with the necessary skills to thrive in a rapidly evolving technological landscape. Moreover, the Thai government has recognized the importance of digital citizenship and has taken steps to integrate it into the national education curriculum. Digital literacy and responsible technology use are now essential skills for Thai students to develop. However, implementing digital citizenship education has faced several challenges, including limited proper teaching and learning strategies, teacher preparedness, and student engagement. Addressing these challenges is crucial for enhancing the effectiveness of digital citizenship initiatives and ensuring students develop the necessary skills for the digital age (Martin et al., 2020; Poompimol et al., 2023).

Digital game-based learning offers numerous benefits, making it a popular approach to enhancing education. It enhances student engagement and motivation, fosters essential skills like problem-solving and collaboration, provides personalized learning experiences, and offers real-world relevance (Alt, 2023; Ratnasari et al., 2023; Mohammed et al., 2024; Tonbuloğlu, 2024). As Thailand continues to prioritize digital transformation, digital game-based learning can be key in cultivating digital citizenship among its students (Tapingkae et al., 2020; Panjaburee et al., 2024). Ubiquitous learning systems further enhance game-based learning by supporting contextual and personalized learning, allowing seamless transitions between

learning contexts, and increasing accessibility through mobile devices (Chang et al., 2009; Huh et al., 2016; Srisuwan & Panjaburee, 2020; Poompimol et al., 2024). Ubiquitous DGBL creates more immersive, personalized, and engaging experiences for learners. Integrating digital games and ubiquitous learning systems into education can cultivate digital citizenship by developing essential skills, fostering active engagement, and providing personalized learning experiences. However, implementing a ubiquitous game-based learning system to cultivate digital citizenship in Thailand presents challenges and opportunities.

Therefore, with the previous studies, this paper examined the potential challenges and opportunities for designing and implementing a ubiquitous game-based learning system to cultivate digital citizenship in Thailand. The next sections will show three successful studies in Thailand regarding contextual game-based learning and ubiquitous game-based learning approaches for fostering essential skills in K-12 Thai students. Each study will be critically analyzed to highlight key factors that can inform the design and implementation of a ubiquitous game-based learning system to cultivate digital citizenship in Thailand.

2. Case Studies of Digital Citizenship in Thailand

2.1 Case I: Effects of a formative assessment-based contextual gaming approach on students' digital citizenship behaviours, learning motivations, and perceptions (Tapingkae et al., 2020)

This study explored the impact of integrating formative assessment and contextual gaming on secondary school students in Thailand. Recognizing the importance of digital citizenship, the researchers aimed to address the challenges of traditional lecture-based teaching by incorporating digital game-based learning. A quasi-experimental design involved 115 seventh and eighth graders divided into experimental and control groups. The experimental group used a formative assessment-based contextual gaming approach, while the control group followed conventional learning methods. Results indicated that students in the experimental group exhibited significantly improved digital citizenship behaviors, particularly in reducing online harassment victimization and perpetration. Additionally, these students showed higher learning motivation and positive perceptions of the learning process than the control group. The study concluded that the integrated approach enhanced students' digital citizenship and increased their engagement and motivation through interactive and personalized learning experiences. This research provides valuable insights for educators aiming to foster digital citizenship in a technologically evolving educational landscape.

Particularly, the study designed and developed a learning environment by integrating formative assessment and contextual gaming. It aimed to enhance digital citizenship among secondary school students. That is to say, the study leveraged the strengths of both approaches to create a dynamic and interactive learning environment. Formative assessment involves ongoing evaluative processes that provide instant feedback during gameplay, helping students understand and correct their mistakes with supplementary materials. This mechanism tailored the learning experience to individual performance, encouraging continuous improvement through iterative practice and tracking progress. Contextual gaming placed students in simulated real-world scenarios, such as cyberbullying and online safety, where they applied their knowledge to solve problems. This approach fostered critical thinking and problem-solving skills, making learning more relevant and engaging. The game used multimedia elements like text, images, animation, and narration to create immersive experiences, capturing students' attention and enhancing their understanding. By integrating these components, the game adapted difficulty based on performance, making learning fun and engaging, and increasing motivation to be good when using digital tools. Students repeatedly practiced good decision-making, developing better digital citizenship behaviors and reducing negative actions like online harassment. This integrated approach thus helped them develop essential digital citizenship skills in an engaging and supportive environment.

However, some challenges need to be addressed when applying this contextual gaming approach to cultivate digital citizenship. While the study provided valuable insights, the ubiquitous element was not fully explored. Implementing a ubiquitous game-based learning system would require further considerations around device accessibility, seamless transitions between learning contexts, and continuous monitoring and feedback (Kanagarajan & Ramakrishnan, 2017; Yadav & Oyeler, 2020). That is to say, it is crucial to ensure the availability of devices and internet connectivity across different learning environments, both in and out of the classroom. Additionally, the system would need to provide personalized guidance and assistance. Another challenge is the scalability of the approach, as the study only involved a limited number of participants in a specific region. Scaling up the implementation to a larger student population across Thailand would require careful planning, adequate resources, and systematic teacher training and support.

2.2 Case II: Ubiquitous game-based learning with a multimedia debriefing on cyberbullying during the COVID-19 pandemic (Poompimol et al., 2024)

The study, conducted during the COVID-19 pandemic, addressed the need for engaging and effective online educational tools by integrating ubiquitous learning with a digital board game to enhance students' understanding of cyberbullying. Involving 56 middle school students from grades 7-9, the study used a repeated measure experiment with pre-test, mid-test, and post-test assessments to evaluate changes in cyberbullying knowledge, attitudes, empathy, and intention to defend victims. The intervention involved students participating in ubiquitous learning activities using the collaborative digital board game "Dysturbia" and a multimedia debriefing session based on Kolb's experiential learning cycle. The game simulated real-world cyberbullying scenarios, promoting teamwork and empathy, while the multimedia debriefing helped students reflect on their in-game experiences and connect them to real-world implications. Findings showed significant improvements in students' cyberbullying behaviors and positive perceptions of the learning activities. The study concludes that integrating ubiquitous learning with a digital board game and multimedia debriefing significantly enhances students' understanding and behaviors related to cyberbullying, highlighting the potential of game-based learning combined with reflective debriefing to create an engaging and effective educational experience, especially in an online learning context necessitated by the pandemic.

Regarding the design and development, the study utilized ubiquitous learning activities involving a collaborative digital board game called "Dysturbia" and a multimedia debriefing session based on Kolb's experiential learning cycle to enhance students' understanding of cyberbullying. "Dysturbia" simulates real-world cyberbullying scenarios, requiring students to make decisions, engage in problem-solving, and promote teamwork and empathy. The game was accessed via a learning management system (LMS), enabling students to learn anytime and anywhere using their mobile devices. After gameplay, students participated in a multimedia debriefing session to help them reflect on their in-game experiences, connect these experiences to real-world implications, and reinforce the learning objectives. This debriefing session used text, audio, and animation to support students' cognitive information processing and enhance their understanding of cyberbullying. Integrating these elements provided a comprehensive and engaging learning experience, significantly improving students' knowledge, attitudes, empathy, and intention to defend cyberbullying victims.

Although this study demonstrated the effectiveness of ubiquitous game-based learning with multimedia debriefing in the context of cyberbullying education, the personalized learning aspect and transferability to other digital citizenship domains warrant further exploration. The personalized learning afforded by ubiquitous systems could be leveraged to provide customized feedback, scaffolding, and guidance to students based on their needs and progress (Hwang, 2014; Nandigam et al., 2014; Virtanen et al., 2017). Additionally, the potential of this approach to cultivate broader digital citizenship skills should be investigated. Therefore, future research should aim to develop and evaluate ubiquitous game-based learning systems that can adaptively tailor the learning experience to individual student's needs and preferences. In Thailand, this integrated approach could create an effective learning system for cultivating comprehensive digital citizenship competencies across various

relevant domains, including online safety, responsible technology use, digital ethics, and civic engagement.

2.3 Case III: Effects of a personalized game on students' outcomes and visual attention during digital citizenship learning (Panjaburee et al., 2024)

The study explored the impact of a personalized educational game on students' learning outcomes and visual attention in digital citizenship education. The study employed a quasi-experimental design with 110 students divided into experimental and control groups. The experimental group used a personalized gaming approach incorporating concept-effect propagation, fuzzy logic, and decision tree methods, while the control group used a conventional gaming approach. Results showed that the experimental group had significantly higher digital citizenship knowledge, improved perceptions, motivations, and attitudes, and better visual attention and engagement as measured by eye-tracking. This research underscores the potential benefits of integrating AI-driven personalization in educational games to enhance student engagement and learning outcomes, aligning with constructivist and multimedia learning theories. The study provides practical insights for educators and game developers in designing effective educational games and highlights the importance of personalized feedback in educational settings. However, the findings are specific to the gaming environment used, suggesting the need for future research with larger and more diverse samples and longitudinal studies to explore long-term impacts.

The study designed and developed a personalized gaming approach for digital citizenship education by integrating concept-effect propagation, fuzzy logic, and decision tree methods. The game tailored individual learning experiences and decision-making patterns to provide a contextually relevant and engaging educational environment. Concept-effect propagation was used to construct a digital citizenship concept-effect propagation table (CEPT), mapping storytelling scenarios to digital citizenship scales. Test items and student responses were analyzed to diagnose learning issues using a max-min composition method, while fuzzy logic provided nuanced, personalized feedback based on students' performance. Decision trees guided students through the game by offering various scenarios and decision paths, which were recorded and analyzed to adapt the learning content dynamically. This approach aimed to address individual learning needs, enhance student engagement, and improve learning outcomes by providing immediate, personalized feedback and tailored educational experiences within the game.

The contributions of the study led us to explore the potential of ubiquitous game-based learning systems with AI-powered personalization for cultivating digital citizenship in Thailand. AI-powered personalization could afford the ubiquitous learning system with the capability to adaptively tailor the learning content, feedback, and scenarios to individual student's needs, preferences, and progress (Xie et al., 2019; Ouyang & Jiao, 2021; Ingkavara et al., 2023; Komalawardhana & Panjaburee, 2024). It had the potential to significantly improve student engagement, motivation, and learning outcomes in digital citizenship education. That is to say, such an integrated approach could leverage the benefits of immersive gameplay, adaptive feedback, and contextualized learning to create a comprehensive and engaging digital citizenship learning experience.

Regarding the 3 case studies, it was found that educational games and ubiquitous game-based learning systems have shown promising results in enhancing students' learning performance, engagement, and digital citizenship competencies. Therefore, in this current study, we propose a research framework to investigate the design, implementation, and evaluation of a ubiquitous game-based learning system for digital citizenship education in Thailand.

3. Promising Conceptual Framework of Ubiquitous Game-based Learning to Cultivate Digital Citizenship in Thailand

In the current paper, digital citizenship refers to the responsible and ethical use of technology and digital spaces. It encompasses the skills needed to participate effectively and responsibly in the online world, including critical thinking, media literacy, ethical online conduct, and leveraging technology for social change and civic engagement. Recently, fostering digital citizenship skills among students has become crucial for ensuring they can navigate the digital landscape safely and responsibly. On the other hand, ubiquitous game-based learning (UGBL) is an educational approach that combines the engaging and interactive elements of digital games with the principles of ubiquitous learning. UGBL provides seamless educational experiences across various contexts and devices, allowing students to learn anytime and anywhere. This approach leverages the motivational aspects of games to enhance learning engagement and uses ubiquitous technologies to create continuous and context-aware learning experiences. Therefore, the proposing research framework aims to design, develop, and evaluate a UGBL system for cultivating digital citizenship in Thai secondary schools.

3.1 Challenges and Opportunities

Table 1 critically analyzes key factors among 3 case studies to reveal the challenges and opportunities of the UGBL system to cultivate digital citizenship in Thailand. Key factors include AI-powered personalization, digital citizenship learning outcomes, curriculum alignment, student engagement, technology integration, and pedagogical design. The results also refer to Case Studies I, II, and III findings to highlight insights.

Table 1. *Challenges and Opportunities among 3 Case Studies*

Factor	Description	Challenges	Opportunities	References
AI-Powered Personalization	Integrates AI technologies to provide personalized learning experiences, adaptive learning paths, personalized feedback, and data-driven insights.	Developing and maintaining AI algorithms and systems that effectively personalize learning.	Enhancing student engagement and learning outcomes through adaptive learning paths and personalized feedback.	Case III
Digital Citizenship Learning Outcomes	Focuses on fostering comprehensive digital citizenship skills, including online safety, digital literacy, ethical technology use, and civic engagement.	Addressing the broad scope of digital citizenship skills and ensuring consistent and effective teaching practices across different educational settings.	Promoting well-rounded digital citizens who can navigate the digital world responsibly and contribute positively to digital communities.	Case I, II
Curriculum Alignment	Integration of digital citizenship and game-based learning into the existing curriculum.	Difficulty in aligning game-based learning activities with the national curriculum and	Curriculum reforms and guidelines supporting the integration of digital citizenship	-

Factor	Description	Challenges	Opportunities	References
		assessment standards.	education and innovative teaching methods.	
Student Engagement	Strategies to motivate and engage students in game-based learning activities that promote digital citizenship.	Varied student interest and engagement levels, potential for distraction, and the need for age-appropriate content.	Interactive and immersive learning experiences through contextual gaming and personalized feedback.	Case I, III
Technology Integration	Effective use of ubiquitous technologies to support seamless learning experiences across different contexts and devices.	Ensuring consistent and reliable technology integration across various learning environments.	Leveraging mobile and ubiquitous technologies to provide continuous and context-aware learning opportunities.	Case II
Pedagogical Design	Designing game-based learning activities that effectively promote digital citizenship skills, such as critical thinking, ethical behavior, and online safety.	Creating pedagogically sound and engaging game-based learning activities that address diverse learning needs and contexts.	Innovative instructional designs incorporating real-world scenarios and formative assessments to foster digital citizenship.	Case I, II

3.2 Design and Implementation

Regarding these challenges and opportunities, it could propose the design and implementation strategy of a UGBL system for cultivating digital citizenship in Thailand. That is to say, this current paper considered the key factors outlined in Table 1 and integrated them into a comprehensive framework, as shown in Table 2. It was found that the UGBL system to cultivate digital citizenship in Thailand should include developing contextual digital games accessible across devices, integrating AI for adaptive learning and personalized feedback, and aligning with national education standards.

Table 2. *Design and Implementation Strategy of a UGBL System for Cultivating Digital Citizenship in Thailand*

Component	Design	Implementation
Ubiquitous Learning Environment	- Develop digital games that simulate real-world scenarios relevant to digital citizenship (Case I, II). - Utilize cloud-based platforms for seamless	- Select or develop a learning management system supporting ubiquitous learning and game-based activities.

Component	Design	Implementation
	access across devices (Case II). - Incorporate game design elements like challenges and rewards (Case I, III).	- Collaborate with educators and game designers for content development. - Conduct pilot tests in selected schools for feedback and adjustments.
AI-Powered Personalization	- Implement AI algorithms for adaptive learning paths (Case III). - Use AI for real-time, personalized feedback (Case III). - Leverage data analytics for continuous improvement (Case III).	- Apply AI method to create gaming pathways for individual students. - Establish continuous monitoring for data collection and analysis.
Digital Citizenship Learning Outcomes	- Develop game scenarios for online safety and cyberbullying prevention (Case II). - Create activities enhancing digital literacy and critical thinking (Case I, II). - Promote ethical technology use and civic engagement (Case I).	- Align game-based activities with national education standards and curricula. - Engage parents and community members through workshops and awareness programs.
Monitoring and Evaluation	- Develop formative and summative assessment tools (Case I, III). - Use qualitative and quantitative methods for comprehensive data collection (Case I, II, III). - Conduct longitudinal studies (Case II, III).	- Establish a mechanism for monitoring and evaluation, including specific metrics and timelines. - Use evaluation data for continuous improvement.

4. Conclusions

This study proposes a ubiquitous game-based learning framework to cultivate digital citizenship among Thai K-12 students. The UGBL system leverages AI-powered personalization to tailor learning experiences and provide real-time feedback, enhancing student engagement and outcomes. The key success factors include infrastructure readiness, teacher preparedness, curriculum alignment, and engaging learning experiences. Challenges involve developing and maintaining AI algorithms and addressing the broad scope of digital citizenship skills. However, opportunities exist to leverage government initiatives, improve digital infrastructure, and design innovative instructional approaches. Continuous monitoring and evaluation will ensure the system's effectiveness and scalability. The proposed UGBL system aims to foster well-rounded digital citizens who can navigate the digital world responsibly and contribute positively to their communities, supporting Thailand's digital development goals.

This study's theoretical implications significantly advance the understanding of integrating ubiquitous game-based learning to cultivate digital citizenship. The framework bridges the gap between digital citizenship theory and practical, technology-enhanced

educational strategies. It emphasizes the importance of contextual and immersive learning environments, supported by AI-powered personalization, in enhancing student engagement and learning outcomes. The study contributes to the literature by demonstrating how game-based learning seamlessly integrates with ubiquitous technologies to provide continuous, context-aware educational experiences. It also highlights the role of assessments in tracking and improving digital citizenship competencies. The study offers a comprehensive approach that can inform and guide future research and policy-making in educational technology, providing a scalable and adaptable model for other regions and educational contexts.

The practical implications of this study are significant for educators, policymakers, and technology developers. For educators, the UGBL system can transform classroom practices by offering continuous, engaging, and context-aware learning experiences that adapt to individual student needs. Educators are also encouraged to collaborate with curriculum developers to design activities and assessments that align with digital citizenship outcomes, focusing on fostering critical thinking, ethical technology use, and responsible online behavior. For policymakers, the framework of this study provides valuable insights for developing supportive policies, including allocating resources for teacher training, enhancing digital infrastructure, and promoting the integration of digital citizenship in national curricula. Technology developers are encouraged to create flexible, user-friendly systems that support teacher customization and student engagement.

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