CHAPTER II

REVIEW OF RELATED LITERATURE

In this chapter, the researcher presents the definition and principles of Web3 technology, the role and characteristics of educational games, the application of prototyping and simulation approaches in game development, and the potential of Web3 in transforming future learning platforms.

2.1. Critical Thinking

Critical thinking includes the component skills of analysing arguments, making inferences using inductive or deductive reasoning, judging or evaluating, and making decisions or solving problems (Halpern, 2013). Background knowledge is a necessary but not sufficient condition for enabling critical thought within a given subject (Ennis, 2018). Critical thinking involves both cognitive skills and dispositions. These dispositions, which can be seen as attitudes or habits of mind, include open and fair-mindedness, inquisitiveness, flexibility, a propensity to seek reason, a desire to be well-informed, and a respect for and willingness to entertain diverse viewpoints (Halpern, 2013). Challenges or puzzles integrated into the game will likely demand logical reasoning and decision-making skills (Ennis, 2018).

2.2. Problem Solving

Problem-solving is a process, which involves systematic observation and critical thinking to find an appropriate solution or way to reach the desired goal. The framework of problem-solving consisted of two major skills: observation and

critical thinking skill. Observation skill refers to collecting data, understanding and interpreting the meaning of the information using all the senses. Critical thinking involves the individual's ability to do the following: conceptualizing, logical reasoning, applying strategy, analytical thinking, decision making and synthesizing to solve any problem (Md, 2019). Problem-solving is also defined as a cognitive process that focused on accomplishing an objective for which the students do not primarily know a solution technique.

2.3. Mobile-Assisted Language Learning (MALL)

MALL as of Mobile-Assisted Language Learning is a scholarly resource that explores the concepts of mobile learning (m-learning) and mobile-assisted language learning (MALL). It explores how mobile technologies are transforming educational practices, especially in the context of language learning, by offering new opportunities for interaction, personalization, and engagement (Çakmak, 2019). This theoretical framework is particularly relevant to this research as the Web3-integrated educational game developed in this study operates on mobile devices, making English language learning more accessible and engaging for students who, as shown in Chapter 4's findings, all have access to smartphones and spend considerable time using mobile devices.

MALL is associated with the usage technology especially mobile phone technology in the field of language learning. Unlike learning in the conventional study, in MALL, the students are no need to sit in the class or at a computer to get learning materials. MALL comes up to help learners learn in new ways, it is about how the ability of the students to learn anywhere and anytime. Students have chance

to study a second language in a classroom or specific area but they also possible to learn it using mobile phone when they desire and where they are. This learning tool provides many advantages, such as the easiness of access resources, user friendly, low cost, etc. These factors allow language learners to access learning materials and communicate with their teachers or facilitators and peers with no time and space constraints. Because of its portability, mobile technology is a growing trend in a wide range of activities in modern life such as: communication, entertainment, banking and education. One of the reasons why mobile devices more accessible to all type users compared to computers is low cost. In fact, MALL can be considered an ideal solution to language learning barriers in terms of time and place (Nuraeni et al., 2020).

2.4. WEB3

Web3 technologies and protocols are essential for the growth and development of decentralized applications and networks. These technologies enable the creation of secure, transparent, and decentralized systems that allow for greater trust and innovation (Ray, 2023). The implementation of Web3 features in educational contexts offers unique opportunities to enhance student motivation through ownership-based reward systems, as demonstrated in Chapter 4's findings where 100% of students found the blockchain-based rewards encouraging. In this thesis, the Web3 components ERC-20 and ERC-1155 are specifically utilized through the Thirdweb SDK to create an innovative learning environment that addresses the student engagement challenges identified in Chapter 1.

a) ERC20

ERC20 is a standardized token interface on the Ethereum blockchain designed for fungible tokens. A fungible token is like a regular coin or a point in a game each one is exactly the same as the others and can be exchanged freely. For example, if you have five ERC20 tokens and someone else has five, you can swap them without any difference, just like trading five-dollar bills or arcade tokens.

The ERC20 standard defines basic functions such as transferring tokens between users, checking how many tokens an account has, and allowing someone else to spend tokens on your behalf. In real life, ERC20 tokens are used for things like cryptocurrencies (e.g., USDT, DAI) or reward points in digital platforms. In the context of an educational game, ERC20 tokens can be used as in-game currency or reward points, allowing students to earn, spend, or trade points for achievements or items (Ethereum.org, 2024).

b) ERC1155

ERC1155 is a flexible token standard that allows a single smart contract to manage multiple types of tokens—both fungible and non-fungible—at the same time. Imagine a vending machine that can dispense both identical snacks (fungible tokens) and unique collectible toys (non-fungible tokens) from the same slot. This makes ERC1155 more efficient and cost-effective, especially for games or applications with many different digital assets.

With ERC1155, you can transfer batches of different tokens in a single transaction, saving time and reducing transaction fees. For example, in a game, ERC1155 can represent coins, badges, and unique items all within one contract. In

an educational game, this means students could receive both standard rewards (like points) and unique digital badges or certificates, all managed easily and efficiently (Quicknode, 2024b).

c) ERC721

ERC721 is a token standard created for non-fungible tokens (NFTs), which are unique digital items that cannot be exchanged on a one-to-one basis. Think of ERC721 tokens like collectible trading cards—each card has its own identity and value, and swapping one for another is not the same as trading identical coins.

ERC721 tokens are commonly used for digital art, collectibles, and certificates. In an educational game, ERC721 could be used to represent unique student achievements, such as a special certificate for completing a challenging level or a one-of-a-kind badge for outstanding performance. Each ERC721 token is unique and can be owned, transferred, or displayed as proof of accomplishment (Quicknode, 2024).

2.5. Educational Game

Educational games are a subcategory of serious games specifically designed for educational purposes. Unlike traditional games primarily focused on entertainment, educational games incorporate learning objectives and content. They offer a unique learning experience by combining gameplay elements with educational content. This interactive approach can enhance engagement, motivation, and knowledge retention (Noemí & Máximo, 2014). Educational games can be used to teach various subjects, from math and science to history and language

arts. They can also be employed to develop specific skills, such as critical thinking, problem-solving, and creativity. By making learning fun and interactive, educational games can create a more enjoyable and effective learning environment.

2.6. GameFi

GameFi is a recent development that combines gaming with decentralized finance. It's a type of decentralized application (dApp) that uses blockchain technology to create a gaming ecosystem where players can earn rewards and use digital assets. This approach aims to enhance the gaming experience and offer players new opportunities for financial gain (Coinbase, 2024).

2.7. Related Studies

Educational Games for Learning (Noemí & Máximo, 2014). This research examines successful serious games and how they can positively impact learning. It focuses on the role of tutoring in guiding students through these games and explores the skills and abilities that can be developed through this approach.

The evaluation of an educational game to promote pre-service teachers' self-regulated learning (Barz et al., 2024). This study evaluates Regulatia, an immersive online educational game designed to help preservice teachers develop self-regulated learning skills. Based on Zimmerman's model, players explore an underwater kingdom and learn self-regulated learning strategies while playing. The goal of this research is to assess the game's usability and user experience to inform future improvements.

Play to Earn Web 3.0: The Future of Gaming and Marketing (Şahin et al., 2023). The "play-to-earn" (P2E) model, powered by blockchain technology, has revolutionized the gaming industry. This research explores the complex world of Web 3.0 games, where players actively create and manage virtual worlds. In this new environment, marketing strategies must adapt to the changing dynamics. This paper reviews existing research on P2E games, focusing on their economic and governance frameworks, the advantages of blockchain technology, and potential risks like deflationary rewards and unfair distribution. It suggests new marketing approaches that prioritize transparency, fairness, and consumer protection in the context of Web 3.0.

Digital learning preferences among Indonesian university students (Hidayat et al., 2022). This research examined learning preferences among Generation Z students in Indonesian educational settings, finding strong preferences for digital and interactive content over traditional text-based learning. The study provides valuable insights into how modern students prefer to engage with educational materials, which directly informs the design of educational games such as the one developed in this thesis.

Student Engagement in Digital Learning Environments (Rachels & Rockinson-Szapkiw, 2018). This study found that students' favourable attitudes toward educational games correlate with better learning outcomes. Their research demonstrated that educational games most effectively support learning when closely aligned with curricular objectives, a principle that guided the development of the Web3-integrated educational game in this study.

Technology Usage Patterns in Indonesian Educational Settings (Pratolo & Solikhati, 2020). This research observed Indonesian students' technology usage patterns in educational contexts, with particular attention to the digital access gap and mobile device prevalence. Their findings reflect similar patterns observed in this study's target demographic, where smartphone access is universal but other computing device access is limited.

Digital literacy and gamification in language education (Heidari & Tabatabaee-Yazdi, 2021) demonstrates how gamified elements enhance student engagement in technology-integrated learning environments. Their research confirms that reward systems and interactive challenges significantly boost motivation in digital language learning.

Impact of Interface Quality on Educational Games (Koivisto & Hamari, 2019). This study established that visual design quality substantially influences learning effectiveness in educational game environments. Their research highlights the importance of user interface design in educational technology, a consideration that informed both the development and evaluation phases of this study's game prototype.

Blockchain-Based Educational Applications (Chen et al., 2018). This recent research corroborates that blockchain-based educational applications provide distinctive ownership experiences unattainable through conventional platforms. Their work offers contemporary support for the integration of Web3 technologies into educational contexts, aligning with the technological approach taken in this thesis.

Gamification in English language learning (Kaya & Sagnak, 2022) demonstrates significant positive impacts on secondary students' motivation and achievement. Their systematic review found gamified approaches particularly effective for vocabulary acquisition and grammar retention in ESL contexts.