

# iLearning Education Challenge: Combining the Power of Blockchain with Gamification Concepts

Surta Wijaya<sup>1</sup>, Abigail Husain<sup>2</sup>, Mackenzie Laurens<sup>3</sup>, Andzelika Birgithri<sup>4</sup>,

<sup>1</sup> Master of Information Technology, University of Raharja, Indonesia <sup>2</sup> Dept. Digital Business, Mfinitee Incorporation, South Africa <sup>3</sup>Dept. Information System, Ilearning incorporation, Colombia <sup>4</sup>Dept.

Administration, Ilearning incorporation, Estonia

<sup>1</sup>surta.wijaya@raharja.info, <sup>2</sup>Husain2Abig@mfinitee.co.za, <sup>3</sup>Mackenzie.Laurens@ilearning.co, <sup>4</sup>andzelikabir@ilearning.ee

## Article Info

### Article history:

Received month dd, yyyy

Revised month dd, yyyy

Accepted month dd, yyyy

### Keywords:

iLearning Education

Blockchain Integration

Gamification

Secure Learning Experiences

Agile Development



## ABSTRACT

The adoption of online learning in colleges as a response to the COVID-19 pandemic has profoundly influenced education. Knowledge acquisition dramatically depends on a person's interest and willingness to learn. A platform that fosters student motivation in effectively completing activity hours is required. The available learning strategies include collaborative and creative learning, which aim to attain successful graduation outcomes with the assistance of the Independent Campus program. This project aims to develop gamification strategies that enhance students' creativity, innovation, and interactivity by integrating principles of learning and play. Furthermore, blockchain-based learning platforms can be a regulatory mechanism for ensuring secure and pleasurable learning experiences while supporting esteemed educational institutions. By implementing gamification tactics in conjunction with blockchain technology, all devices linked to the network will be transformed into nodes or servers. This study employs agile development methodologies, namely iterative and incremental models, to design distributed storage blockchain algorithms. The GamiChain iLearning educational model, which incorporates gamification blockchain, is constructed using IPFS. GamiChain, a gamification blockchain, can effectively assist the Independent Campus initiative by providing students with the necessary resources to cultivate their potential and produce exceptional and successful graduates.

*This is an open access article under the [CC BY 4.0](#) license.*



## Corresponding Author:

Surta Wijaya

Master of Information Technology, University of Raharja, Indonesia

Email: surta.wijaya@raharja.info

## 1. INTRODUCTION

The unforeseen and unparalleled emergence of the COVID-19 pandemic has imposed an acute imperative for the seamless integration of education into the realm of online learning. This heightened demand for adaptability and innovation in the face of unprecedented challenges has taken on an unprecedented urgency [1]. Consequently, students have found themselves grappling with an overwhelming sense of ennui and tedium in their educational journeys, leading to a palpable decline in adaptability and creativity within the educational sphere [2]. In the domain of education, the learning process is a dynamic, student-centered expedition, steered by the relentless pursuit of academic objectives. Effectively managing this intricate process necessitates that educators possess profound pedagogical competence, which includes not only the capacity to discern the unique needs and aptitudes of individual students but also the acumen to devise and execute educational strategies,

meticulously assess learning outcomes, and unlock the latent potential latent within each student [3]. Hence, it has become increasingly evident that the integration of a student-centric approach to learning, complemented by the judicious utilization of Blockchain gamification techniques, is instrumental in the establishment of a highly autonomous and self-directed educational ecosystem. This groundbreaking approach holds the potential to elevate problem-solving prowess by amalgamating gamification and blockchain technologies within the educational realm, infusing educational content with elements of gaming to render the learning experience more enjoyable and immersive [4]. This entails the transparent and immutable documentation of a wide array of educational activities, encompassing lectures, assignments, and assessments, all while ensuring the utmost security and integrity of data [5]. The introduction of blockchain technology into the educational landscape is poised to revolutionize the entire paradigm, proffering a decentralized and cryptographically secure system that promises to be a transformative force [6]. At the core of this transformation lies GamiChain, an innovative and student-centered platform that synergizes gamification and blockchain technology. The principal objective of GamiChain is to invigorate and kindle motivation, fostering an educational milieu marked by a student-centric approach to Independent Campus learning, and fortified by the pioneering application of blockchain gamification techniques [7]. In the broader context of this research endeavor, the primary aim is to augment motivation in the establishment of a robust academic foundation, underpinned by a student-centric approach to Independent Campus learning and energized by the imaginative deployment of blockchain gamification techniques [8]. The overarching aspiration is to forge an education ecosystem 4.0 that not only supports government initiatives for open campus programs but does so by harnessing the transformative potential of GamiChain as the foundational framework [9]. This gamification-based educational tool, buttressed by blockchain technology, exhibits prodigious potential to effectively confront and surmount the multifaceted challenges that pervade the educational realm [10]. It possesses the capacity to fundamentally reshape the educational experience, rendering it more captivating and enjoyable for the millennial generation in Indonesia, thereby bridging the chasm between traditional and contemporary pedagogical methodologies. Moreover, this groundbreaking application aspires to cultivate an ecosystem of student ingenuity, empowering learners in their quest for self-directed education, while simultaneously nurturing a heightened sense of competition that propels them on their path to becoming exceptional individuals [11]. Furthermore, it is endowed with the capability to represent learning achievements in the form of precise and trustworthy certificates, which bear significant value in the professional landscape [12]. Notably, this program also emerges as a promising solution for Islamic Universities seeking to disrupt the prevailing open learning ecosystem, especially in the domain of Independent Campus education, thereby contributing to the advancement and enhancement of educational practices within these institutions [13].

## 2. LITERATURE REVIEW

According to T Ramadhan et al. (2021) [14], there are two main approaches to using games in education: gamification and game-based learning. The use of game elements, such as health points or leaderboards, used in non-gaming platforms, is called gamification. On the other hand, game-based learning involves creating complete games where players have to use the given instructions to win. The focus of this research is the topic of blockchain, which has developed rapidly in recent years. This research breaks down blockchain components into smaller parts that can be understood and used in the applications created. This method allows students studying IT to learn at their own pace. The study also investigates the possibility of creating two games designed and created by individuals who have sufficient technical and artistic skills to be assets in their own right. This step is done to get a better picture of the research subject and to collect better data for further analysis.

The use of gamification in blockchain systems was researched by Kartini et al. (2021) [15]. Due to its many advantages, blockchain is an important technology in many types of applications. These include transparency, high availability, interoperability, strong data consistency, and immutability. However, blockchain systems still face many problems. These include motivation issues, people issues, and miners' involvement and participation issues. Gamification is proposed as a solution to overcome this problem. However, additional research is still needed regarding the use of gamification in blockchain systems. Therefore, this research seeks to find out why and how gamification is used in blockchain systems. The research results show that gamification is integrated into blockchain systems for various purposes, such as increasing data validation and trust and encouraging users and miners. Additionally, the study found that points and challenges are the most commonly used game components in blockchain systems, and Ethereum is the most frequently used blockchain platform.

The Q study of Aini et al. (2020) [16] discusses the major changes that have occurred in the world of

Indonesian education since the Industrial Revolution 4.0 emerged. The adoption of blockchain technology in education is a significant change. By using conventional teaching methods, such as manual recording of assignments, face-to-face communication, and the risk of assignment manipulation, this research tries to overcome several problems. Gamification is an idea that drives the application of blockchain technology in education. Gamification is a learning method that uses game elements to increase student engagement and encouragement. In this case, blockchain is used to secure and manage learning data so that students can learn more safely and effectively. Gamification methods based on blockchain technology are used in higher education management. The aim is to make learning methods more interesting for students because many students prefer playing games rather than learning conventionally. Therefore, this research aims to improve the quality of learning in Indonesia in the context of the Industrial Revolution 4.0 by utilizing blockchain technology and gamification ideas.

### 3. METHOD

This study employs an agile development approach that relies on an iterative and incremental model. It involves the creation of a distributed storage blockchain algorithm, with the GamiChain iLearning model being built using IPFS. This application, based on gamification, enhances student motivation during lectures, resulting in a more participatory and efficient learning experience. The advantages of Blockchain are significant due to their reliability, visibility, decentralization, and absence of intermediaries [17].

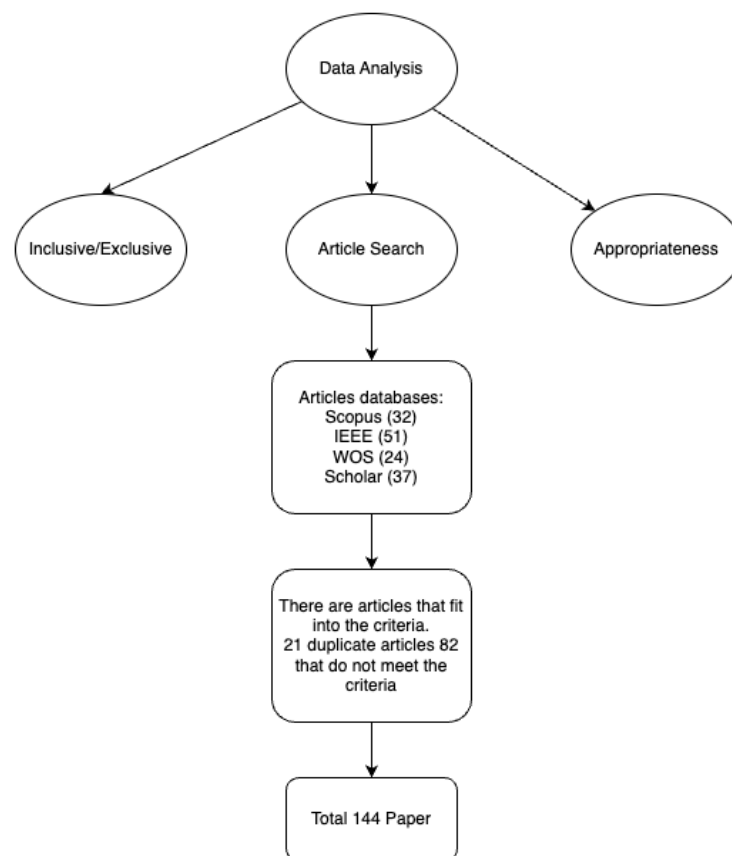


Figure 1. Search flow Literature review

As illustrated in Figure 1, the intricate web of agile development methodologies is poised to yield a bounty of substantial research accomplishments. The inception of this research endeavor embarked upon the initial phase, which entailed the meticulous execution of a systematic literature review (SLR) with the objective of encapsulating a comprehensive survey [18]. This ambitious undertaking involved an exhaustive analysis of a corpus comprising 120 erudite scholarly articles, with a particular focus on the domains of Massive Open Online Courses (MOOCs), gamification, and blockchain. From this extensive survey, a selective process identified 21 articles that were deemed most pertinent and germane for detailed data analysis. However, it was during this phase that a critical realization dawned – the prevailing approach for addressing issues inherent to student activities under the Merdeka Belajar Kampus Merdeka (MBKM) initiative had, on a larger scale, proven to be less effective. Consequently, there arose an exigent need to develop a robust instructional design framework that would not only augment student engagement but also serve as a catalyst for fostering motivation, thereby amplifying the volume of hours students dedicate to academic pursuits. To this end, the iLearning GamiChain emerges as a sophisticated design application that is seamlessly integrated with the Blockchain gamification-based iLearning paradigm. The construction of the GamiChain iLearning model is rooted in the agile development methodologies, relying upon iterative and incremental models. It harnesses a spectrum of programming languages tailored for the construction of distributed storage blockchain algorithms and the InterPlanetary File System (IPFS). As the research progresses to its experimental phase, the model is rigorously executed on a local blockchain, thus validating the practicality of the developed functionalities while aligning them with the desired criteria. Upon the successful completion of the testing phase, the research transitions into a phase where the GamiChain iLearning model is simulated in conjunction with the Renewable Energy Portfolio Standard (RPS) [19]. This simulation serves as a pivotal resource that will be harnessed by the Merdeka Belajar Kampus Merdeka (MBKM) ambassadors, students, and partners, all with the overarching objective of fortifying global competitiveness [20]. The GamiChain iLearning Model is meticulously scrutinized to ascertain its alignment with the multifarious requirements of MBKM ambassadors, students, and partners. This scrutiny hinges on an exhaustive analysis of the numerous challenges, couched within contemporary literature, that pervade the implementation of gamification and Blockchain Techniques across diverse sectors. Notably, this analysis brought to the fore the glaring absence of a platform capable of adequately supporting the activity hours mandated under the MBKM initiative. In light of these findings, the research charts a forward path, articulating a comprehensive solution that addresses the three distinctive issues through three diverse approaches: platform development, gamification strategies, and the integration of blockchain-based iLearning education [21]. The presence of blockchain technology not only benefits students by positioning them as integral nodes within the system but also grants universities the capacity to obviate the need for on-site servers, thus contributing to cost reduction, given their seamless integration into the blockchain network. The third phase of this multifaceted research journey is marked by the initiation of rigorous testing and assessment of the GamiChain iLearning Model within the blockchain network. In this phase, the construction of the model designed to execute simulations on the local blockchain network necessitates the utilization of eight specific tools, including ethereum, ganache, metamask, solidity, IPFS, Web3JS, react, and hdwallet provider. These tools collectively facilitate the evaluation process, encompassing a sequence of trials that span the examination of gamification functions, the implementation of transaction data distribution through smart contracts, the enforcement of access control restrictions, the allocation of data objects into IPFS, and the seamless integration of the local ethereum blockchain network.

#### 4. RESULT AND DISCUSSION

This part presents the findings of the investigation and offers a thorough analysis. Results can be displayed in various formats such as photos, graphs, algorithms, and other visual aids, which facilitate comprehension for readers. Discussion can be conducted inside many subchapters. In this section, a comprehensive explanation is provided for the design of both the Logic algorithm and the GamiChain algorithm. This study examines the process of constructing Smart Contracts with the Solidity programming language. There exist distinct variables and functions designed to manage assets within a decentralized network that operates independently of any government or controlling entity. Retrieve the data desired by the asset owner for storage. In this scenario, the smart contract will verify certain metadata and store various asset parameters from the user's assets as an array to prevent duplication. Once the assets have been inspected and confirmed as non-duplicates, the smart contracts will be executed, resulting in the creation of new transactions on the Blockchain.

This function is accountable for transferring assets into the GamiChain decentralized network. The response status is utilized to communicate information regarding the condition of the monitored asset. In the event that the process fails as a result of issues with the monitored assets, an error message will be shown. Various nodes can establish communication and coordination by exchanging messages. This distributed system is more secure due to its distribution across multiple nodes.

The innovation of this research lies in the utilization of blockchain technology in education to establish a more advanced education system. This system incorporates decentralized storage mechanisms and smart contracts, resulting in a more efficient system compared to traditional learning platforms. The research conducted data analysis by examining pertinent articles obtained from internet databases, including IEEE, Scopus, WoS, and Scholar. All four databases are recognized as repositories of top-notch papers. Their influence on education and information technology has been substantial, commencing with a search for papers dated November 2020. The categories assigned are determined by the correspondence between the research's abstracts, keywords, and titles, and the research's scope. Perform a keyword search using the following terms: "Online Learning Model," "Gamification and Blockchain," "Gamification of MBKM learning," and "Educational blockchain." Subsequently, meticulously peruse the papers in order to amass a total of 150 articles from globally acclaimed scholarly journals. Finally, it was concluded that 21 articles from the 2017-2021 period met the criteria to be selected as peer-reviewed journals. Figure 3 depicts the utilization of VOSviewer in this study to visually represent and investigate bibliometric maps. In the end, these discoveries will provide a strong foundation for creating new frame designs. The GamiChain iLearning Model implemented in the Independent Campus Program represents a significant advancement in the field of education. Figure 4 illustrates the three defining traits of smart contracts: autonomy, decentralization, and self-sufficiency. Smart contracts will be utilized to enhance the security of these assets by eliminating the need for third parties in the blockchain. After obtaining a user's assets, the smart contract will analyze the metadata of the assets and generate new components. Figure 2 depicts the smart contract architecture. Each contract will be issued a 20-byte address. Once the contract code is inputted into the blockchain, it becomes immutable and cannot be altered. In order to execute a transaction, the user is required to transmit it to the contract address.

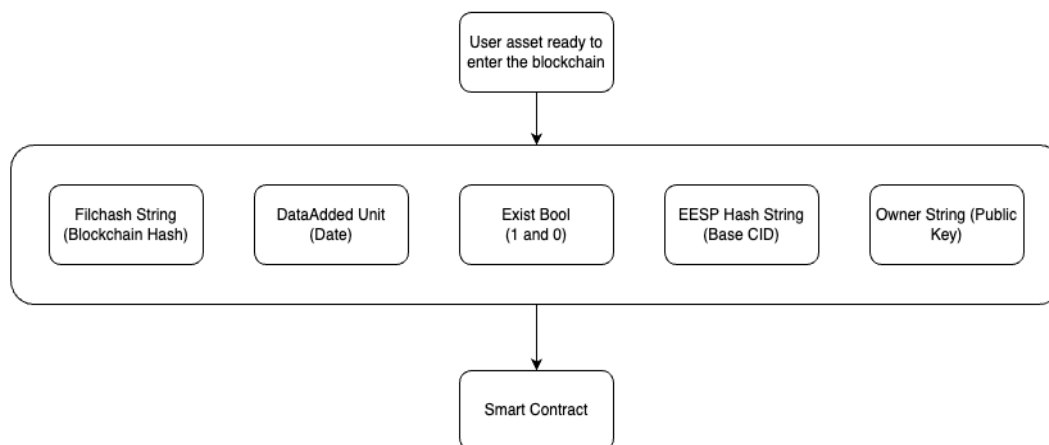


Figure 2. Gamification Structure in Smart Contracts

Figure 3 illustrates the gamification framework within smart contracts. Each consensus node, often referred to as miners, will execute these transactions in the network to achieve consensus on their execution. The objective of this project is to utilize smart contracts for the automated issuance of degree certificates on the blockchain upon completion of the degree. The findings will lead to the resolution of unmanaged hazards, bureaucratic processes, human intervention, and fraudulent activities. Illustrates the MBKM student node, which stores information in the form of an ID from a device that has been successfully linked to the Blockchain network. Subsequently, the address serves as a node that may be publicly distributed, enabling direct connection between MBKM students and ambassadors and the device. This is followed by status logs,

which serve as a means of authentication to determine whether the device is currently connected or not. The "network peers" section provides details about all the peers or nodes that are now linked to a decentralized network. Once users have verified that all connections are established, they can proceed to upload files by simply dragging and dropping them. In addition, users have the capability to search for files solely using the CID. The research proposes the development of a distributed student learning scheme using consensus methods and smart contracts. This scheme aims to enhance the quality of education and establish an official learning standard that is not constrained by time and geography.

## 5. CONCLUSION

In summary, this research offers a profound insight into the transformative potential of integrating gamification and blockchain technology within the realm of education, a realm that has undergone a rapid and profound evolution in response to the COVID-19 pandemic. The research underlines the pressing need for adaptive and innovative solutions within the online learning environment, a need heightened by the pandemic's unforeseen challenges. This study's primary objective is to engineer a paradigm shift in the educational landscape, one that not only rekindles student motivation and engagement but also augments the educational process with enhanced transparency and security, a feat made possible through the creation of the GamiChain iLearning model.

Moreover, this research signals a noteworthy departure from conventional education, placing a heavy emphasis on automating the issuance of degree certificates using blockchain technology. This innovation marks a pivotal turning point in the realm of academic recognition, eliminating bureaucratic bottlenecks, reducing the potential for fraudulent activities, and streamlining the certification process. It's particularly significant in the context of the Independent Campus Program, offering a dynamic and highly secure means of verifying academic achievements.

In the broader context, this research is emblematic of the ongoing transformation of the education sector into a more advanced, student-centric system. By harnessing the power of blockchain's decentralization and reliability, the GamiChain iLearning model promises to bridge the traditional and contemporary pedagogical methodologies. This not only enriches the learning experiences of students but also promises to redefine the future of education itself, wherein innovation, engagement, and secure documentation of achievements are at the forefront of the educational paradigm.

## SUGGESTION

This research has the potential to be expanded into the development of an integrated Blockchain educational platform that can be used in collaboration with other universities. Additionally, further analysis can be conducted.

## REFERENCES

- [1] U. Rahardja, F. Andriyani, and T. Triyono, "Model scheduling optimization workforce management marketing," *Aptisi Transactions on Management (ATM)*, vol. 4, no. 2, pp. 92–100, 2020.
- [2] T. Hariguna, U. Rahardja, and A. Ruangkanjanes, "The impact of citizen perceived value on their intention to use e-government services: an empirical study," *Electronic Government, an International Journal*, vol. 16, no. 4, pp. 426–440, 2020.
- [3] Q. Aini, A. Anoesyirwan, and Y. Ana, "Effect of cloud accounting as income statement on accountant performance," *Aptisi Transactions On Management (ATM)*, vol. 4, no. 1, pp. 13–21, 2020.
- [4] Q. Aini, M. Budiarto, P. O. H. Putra, and N. P. L. Santoso, "Gamification-based the kampus merdeka learning in 4.0 era," *IJCCS (Indonesian Journal of Computing and Cybernetics Systems)*, vol. 15, no. 1, pp. 31–42, 2021.
- [5] Z. M. Yaseen, I. Ebtehaj, S. Kim, H. Sanikhani, H. Asadi, M. I. Ghareb, H. Bonakdari, W. H. M. Wan Mohar, N. Al-Ansari, and S. Shahid, "Novel hybrid data-intelligence model for forecasting monthly rainfall with uncertainty analysis," *Water*, vol. 11, no. 3, p. 502, 2019.

- [6] R. Widayanti, Q. Aini, H. Haryani, N. Lutfiani, and D. Apriliasari, "Decentralized electronic vote based on blockchain p2p," in *2021 9th International Conference on Cyber and IT Service Management (CITSM)*. IEEE, 2021, pp. 1–7.
- [7] G. Genoveva, J. Syahrivar, and E. S. Ariestiningsih, "Technology readiness during the covid-19 pandemic: Lessons learned from indonesia," *CommIT (Communication and Information Technology) Journal*, vol. 17, no. 1, pp. 93–102, 2023.
- [8] Q. Aini, N. Azizah, R. Salam, N. P. L. Santoso, and S. Millah, "ilearning education based on gamification blockchain," *Indonesian Journal of Electrical Engineering and Computer Science*, vol. 26, no. 1, p. 531, 2022.
- [9] H. Nusantara, P. A. Sunarya, N. P. L. Santoso, and S. Maulana, "Generation smart education learning process of blockchain-based in universities," *Blockchain Frontier Technology*, vol. 1, no. 01, pp. 21–34, 2021.
- [10] H. Nusantara, R. Supriati, N. Azizah, N. P. L. Santoso, and S. Maulana, "Blockchain based authentication for identity management," in *2021 9th International Conference on Cyber and IT Service Management (CITSM)*. IEEE, 2021, pp. 1–8.
- [11] Q. Liu, Q. Guan, X. Yang, H. Zhu, G. Green, and S. Yin, "Education-industry cooperative system based on blockchain," in *2018 1st IEEE international conference on hot information-centric networking (HotICN)*. IEEE, 2018, pp. 207–211.
- [12] H. Sun, X. Wang, and X. Wang, "Application of blockchain technology in online education," *International Journal of Emerging Technologies in Learning*, vol. 13, no. 10, 2018.
- [13] J. Rooksby and K. Dimitrov, "Trustless education? a blockchain system for university grades," *Ubiquity: The Journal of Pervasive Media*, vol. 6, no. 1, pp. 83–88, 2019.
- [14] T. Ramadhan, Q. Aini, S. Santoso, A. Badrianto, and R. Supriati, "Analysis of the potential context of blockchain on the usability of gamification with game-based learning," *International Journal of Cyber and IT Service Management*, vol. 1, no. 1, pp. 84–100, 2021.
- [15] S. Santoso, E. P. Harahap, A. Khoirunisa, K. Zelina *et al.*, "A systematic review through intellectual based blockchain-intermediary," in *2021 9th International Conference on Cyber and IT Service Management (CITSM)*. IEEE, 2021, pp. 1–7.
- [16] U. Rahardja, Q. Aini, and A. Khoirunisa, "The effect of rinfogroups as a discussion media in student learning motivation," *Aptisi Transactions on Management (ATM)*, vol. 2, no. 1, pp. 79–88, 2018.
- [17] Q. Aini, M. Budiarto, P. H. Putra, A. Khoirunisa, N. Santoso, and U. Rahardja, "Gamified education practice: Designing with e-commerce and ilearning concept," *Int. J. Psychosoc. Rehabil*, vol. 24, no. 7, 2020.
- [18] Q. Aini, A. Badrianto, F. Budiarty, A. Khoirunisa, and U. Rahardja, "Alleviate fake diploma problem in education using block chain technology," *J. Adv. Res. Dyn. Control Syst*, vol. 12, no. 2, pp. 1821–1826, 2020.
- [19] C.-W. Yu, C.-M. Chao, C.-F. Chang, R.-J. Chen, P.-C. Chen, and Y.-X. Liu, "Exploring behavioral intention to use a mobile health education website: An extension of the utaut 2 model," *Sage Open*, vol. 11, no. 4, p. 21582440211055721, 2021.
- [20] U. Rahardja, "Risk assessment, risk identification, and control in the process of steel smelting using the hiradc method," *APTISI Transactions on Management*, vol. 7, no. 3, pp. 261–272, 2023.
- [21] M. Kamil, J. Rianto, and D. Suprayogi, "Management of deciding decision making final project advisor in optimizing learning," *Aptisi Transactions On Management*, vol. 2, no. 2, pp. 168–176, 2018.