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iLearning education based on gamification blockchain

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ABSTRACT

The online learning process implemented in universities due to COVID-19 has brought significant disruption to education. Interest and motivation to learn are very important in the learning process. It takes a platform that supports students to be motivated in running the activity hours well. Learning techniques that can be chosen are collaborative and creative learning in achieving effective graduate outcomes with the support of the Merdeka Campus program. This research aims to make gamification techniques to make students more creative, innovative, and interactive by utilizing the concepts of learning and playing. Furthermore, a learning platform based on blockchain technology can support quality universities as a layer of control in implementing security and fun learning. With gamification techniques in collaboration with blockchain technology, all devices connected to the network will become nodes or servers. This study uses agile development methods based on iterative and incremental models to create a distributed storage blockchain algorithm, and IPFS used to build the GamiChain iLearning education model (gamification blockchain). It can be concluded that GamiChain (gamification blockchain) can support the Merdeka Campus program, which can provide facilities for students to develop their potential and prepare excellent and outstanding graduates.

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1. INTRODUCTION

The sudden COVID-19 pandemic requires educational elements to maintain online learning. Current conditions are urgent for innovation and adaptation related to available technology to support the learning process [1]. These problems cause students to experience boredom in the learning process, so that they are less adaptive and less creative [2]. The learning process is an activity undertaken by students to achieve educational goals so that pedagogic competence needs to be mastered by a teacher to be able to manage to learn effectively, which includes the ability to recognize each student, plan and implement education, evaluate learning outcomes, and able to develop the potential of students to be actualized [3].

Therefore, it is believed that the contribution of implementing a student-centered learning process using Blockchain gamification techniques is the key to creating a very independent learning ecosystem [4]. Therefore, problem-solving can be transformed with a combination of gamification and blockchain, making the learning process more enjoyable with game techniques [5], where activities such as learning, lecture assignments, and assessments are documented transparently and have very reliable security [6].

The presence of blockchain technology in the world of education is expected to be a new pioneer by offering cryptographic and decentralized systems [7]. This student-centered learning process is called

GamiChain (gamification blockchain) [8]. The urgency of this program is to encourage increased motivation in building an educational environment through the implementation of the GamiChain program [9]. The specific purpose of this research is to increase motivation in constructing an academic background with a focus on student-centered Merdeka Campus learning based on blockchain gamification techniques to create an educational 4.0 ecosystem in support of the GamiChain-based free campus government program (blockchain gamification) [10].

This Blockchain gamification-based learning application can be a solution and have a targeted impact in solving problems in education [11]. This application can transform the learning process in Indonesia more enjoyed by the millennial generation [12]. This application aims to encourage an ecosystem of student creativity in independent learning and a more competitive spirit to compete to become superior individuals [13]. And can display learning outcomes in the form of accurate certificates in origin and can be used in the industrial world [14]. This application is also a solution for Islamic Universities that want to disrupt the free learning ecosystem-Merdeka Campus [15].

2. METHOD

This research uses agile development method based on the Iterative and incremental model by creating a distributed storage blockchain algorithm, and IPFS used to build the GamiChain iLearning model [16]. This gamification-based application increases student motivation in carrying out lectures so that the learning process can be more interactive and efficient. The benefits of Blockchain are also crucial because they are trusted, transparent, distributed, and without third parties.

Figure 1 describes the agile development method that can result in research achievement. At the initial stage of the study, which was to summarize the survey by conducting a systematic literature review (SLR) of 120 scientific articles related to MOOC, gamification, and blockchain until finally 21 articles were counted as data analysis [8]. Furthermore, identifying problems that occur in student MBKM activities has proven to be ineffective in carrying out massively [17]. So a design of an effective and significant learning model was made to increase interest and create motivation for student activity hours [18]. The application design that synergizes with the iLearning model based on Blockchain gamification is iLearning GamiChain [19]. Agile development method based on iterative and incremental model with a programming language to create distributed storage blockchain algorithm and IPFS is used to build GamiChain iLearning model [20]. Then at the trial stage, run the model using the local blockchain to ensure the feasibility of the functionality that has been created, whether it meets the desired criteria or not after passing the trial phase, then simulating the GamiChain iLearning model synergized with renewable energy portfolio standard (RPS) to be used by MBKM ambassadors, students, and partners to increase global competitiveness. It evaluated GamiChain's iLearning model to facilitate the needs of MBKM ambassadors, students, and partners [21].

Figure 1. Agile development methodology

Figure 2 explains the flow chart of this scientific research which consists of 3 (three) stages. The first phase identifies the problem analysis with a literature review and comments on the latest technology [22]. The literature review has been widely stated that the research challenges and issues of gamification and Blockchain techniques in various sectors. And found no platform supports MBKM activity hours [23]. The second phase is designing a design to solve these 3 problems with 3 methods: platform, gamification, and

Blockchain [24]. The presence of blockchain has benefits for students as nodes themselves [25]. For universities, there is no need to provide on-premise servers, reducing costs more efficiently because they are interconnected with the Blockchain network [26]. And the third phase of testing and evaluating the GamihCain iLearning model on the blockchain network begins with building a model to perform simulations on the local Blockchain network [27]. Build the model using eight tools, namely ethereum, ganache, metamask, solidity, IPFS, Web3JS, react, and hdwallet provider [28]. Furthermore, the evaluation process can be carried out with a series of trials, from testing the gamification function, executing data distribution transactions with smart contracts, limiting access control, distributing data objects into IPFS, and integrating the ethereum local blockchain network [29].

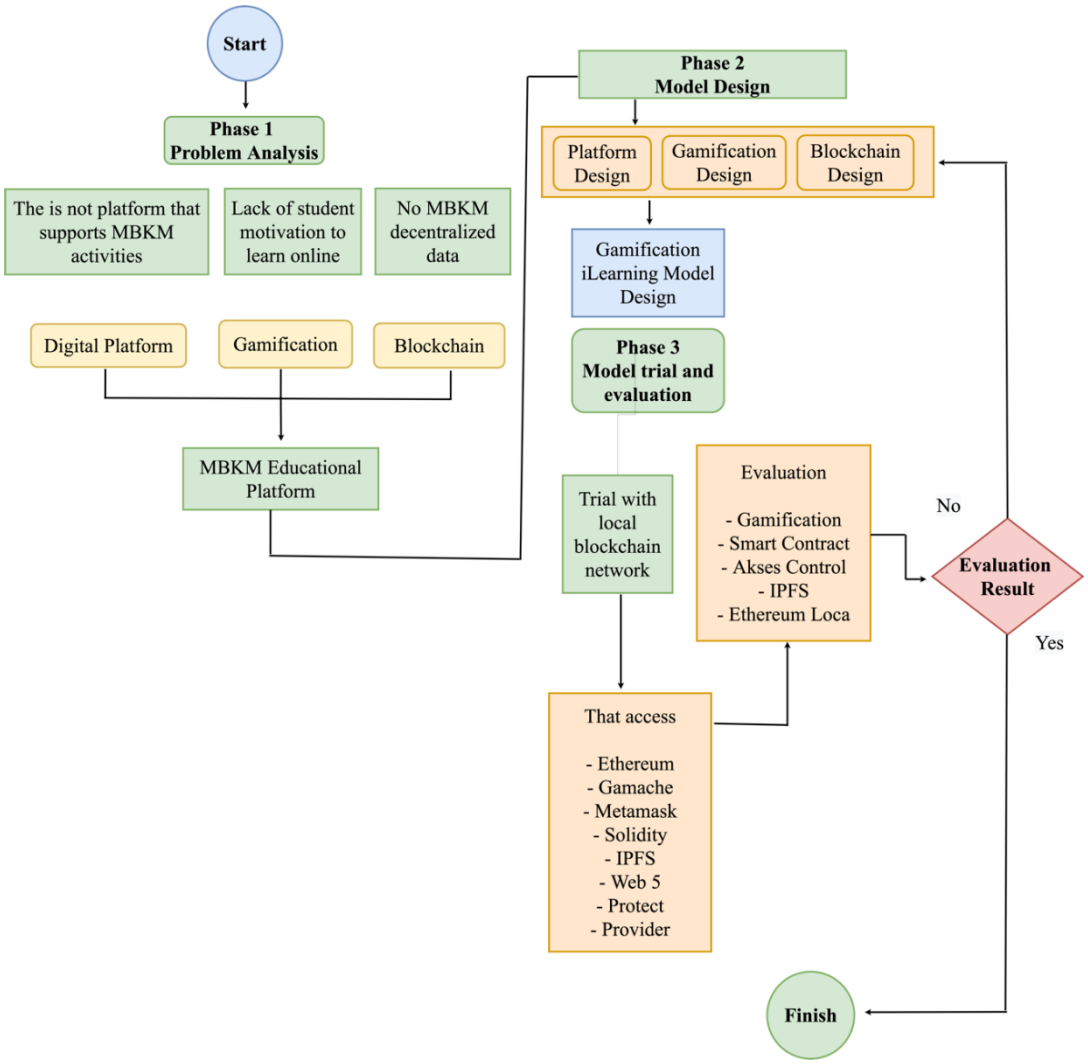

Figure 2. GamiChain iLearning framework

3. RESULTS AND DISCUSSION

In this section, it is explained the results of research and at the same time is given the comprehensive discussion. Results can be presented in figures, graphs, algorithm and others that make the reader understand easil. The discussion can be made in several sub-sections.

3.1. Alghorithm design

The GamiChain logic and algorithm are detailed in length in this section. This study looks at how to construct Smart Contracts using the Solidity programming language. There are unique variables and functions for dealing with assets integrated on a decentralized network where no government or entity controls them as shown in Algorithm 1.

Algorithm 1: Store File to Blockchain

```
* @param   string $document_key
     * @return array
     */
    public static function sign ($document_key, $actions, $docWidth,
$signing_key, $public = false) {
        if (!empty($signing_key) && !$public) {
            $request = Database:table ("requests")->where("signing_key",
$signing_key
            $sender = Database:table ("users")->where("id", $request->sender)-
>first();
            $userName = $request->email;
            $user = Auth:user();
            $userName = $user->fname.' '.$user->lname;
            $signature = config("app.storage")."signatures/".$user->signature;
        }else if ($public) {
            $userName = "Guest";
        }
```

Get the data that the asset owner wants to store in this case the smart contract will check some metadata and store some asset parameters that come from the user asset as an array to ensure that the asset to be stored is not duplicated, after going through the process of checking and stating that the asset is not duplicated, smart contracts will be executed and new transactions will be created on Blockchain as shown in Algorithm 2.

Algorithm 2: GamiChain Get File

```
$document = Database::table("files")->where("document_key", $document_key)-
>first();
$pdf = new PDF(null, 'px');
$pdf->SetAutoPageBreak(FALSE, PDF_MARGIN_BOTTOM);
$inputPath = config("app.storage")."files/".$document->filename;
$outputName = Str::random(32).".pdf";
$outputPath = config("app.storage")."/files/". $outputName;
$pdf->numPages = $pdf->setSourceFile($inputPath);
$actions = json_decode(base64_decode($actions), true);
$templateFields = array($docWidth);
$signed = $updatedFields = $editted = false;
if (env("PKI_STATUS") == "Enabled") {
}
```

This function is responsible for saving assets to the GamiChain distributed network. Response status is used to convey information about the quality of monitored assets; if the process fails due to the monitored asset, an error message will be displayed. And various nodes can communicate and coordinate by forwarding messages. This distributed system is more secure because the system is spread across multiple nodes.

3.2. Analysis GamiChain

The novelty in this research is the use of blockchain technology in education for a quality higher education system with decentralized storage mechanisms and smart contracts, thus becoming an effective system from the previous learning media. Data analysis was carried out in this research by reviewing relevant articles sourced from online databases, namely IEEE, Scopus, WoS, Scholar. The four databases are known as article indexers with high quality. They have a significant impact on education and information technology, starting with the search for articles from November 2020 [30]. The categories issued are based on abstracts, keywords, and titles that match the scope of the research. Search by keyword: "Online Learning Model," "Gamification and Blockchain," "Gamification of MBKM learning," "Educational blockchain." Furthermore, carefully literate articles to collect 150 articles from world-reputed journals. Finally concluded 21 articles with the period 2017-2021 met the criteria to be selected as peer-reviewed journals.

In Figure 3 the analysis in this study uses VOSviewer to visualize and explore bibliometric maps. Ultimately the findings will serve as a solid foundation for synthesizing a new frame design. For the GamiChain iLearning model in the Merdeka Campus Program and become a transformation step that builds breakthroughs in the world of education.

Figure 4 describes autonomy, decentralization, and self-sufficiency which are three features that define the characteristics of smart contracts. In this asset, blockchain will be provided with assistance by smart contracts to eliminate the presence of third parties so that their security will be guaranteed. Once the user's asset has been acquired, the smart contract will check the asset's metadata and create a new element.

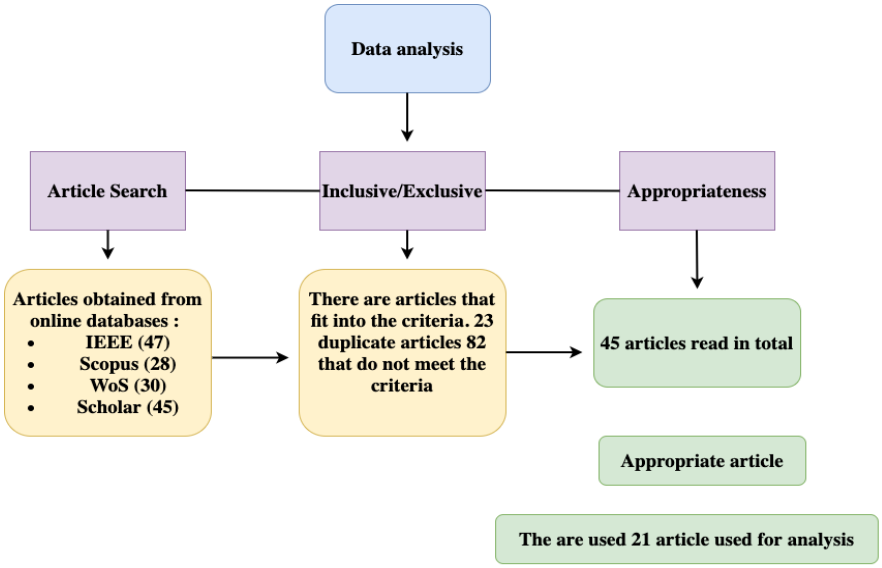

Figure 3. Systematic literature review

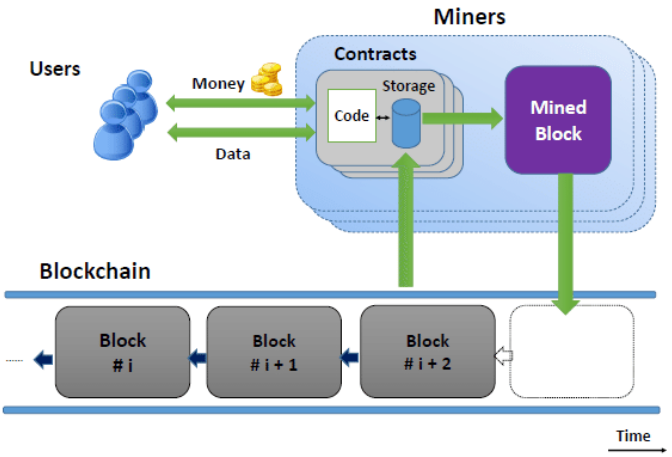

Figure 4. Smart contract system

Figure 5 illustrates the smart contract's architecture. A 20-byte address will be assigned to each contract. Once a contract code has been put into the blockchain, it cannot be modified. To perform transactions, users must send them to the contract address. These transactions will then be performed by each consensus node (also known as a miner) on the network to achieve an agreement on its performance. This study aims to use smart contracts to automate the issue of degree certificates on the blockchain when a degree is completed. Unmanaged risk, bureaucracy, human interference, and fraud will all be addressed as a result of the findings.

Figure 6 depicts MBKM student nodes that contain information in the form of IDs from devices that have successfully connected to the Blockchain network. Furthermore, the addresses are the nodes that can be disseminated to the public so that MBKM students and ambassadors can connect directly to the device, followed by the Logs status, which functions as an authentication whether the device is connected or not. Furthermore, the network peers section contains information about all peers or nodes currently connected to a decentralized network. After confirming that everything is connected, users can upload files by dragging & dropping. In addition, users can also search for files simply by using the CID. The contribution of this research is as follows, we can create a student learning scheme that is distributed according to a consensus mechanism and smart contracts to improve quality in the field of education and become an official learning standard that is not limited by space and time.

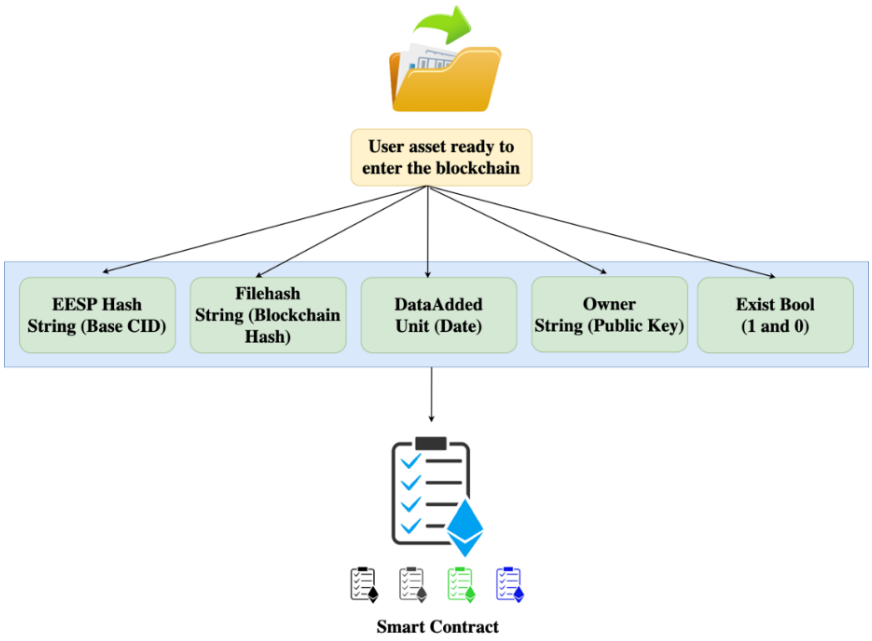

Figure 5. Structure of smart contract GamiChain

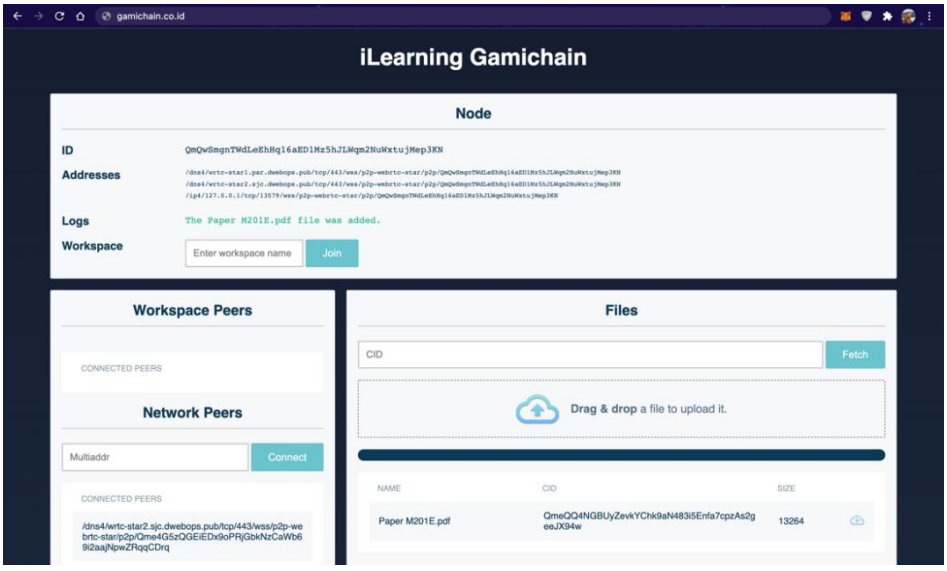

Figure 6. Decentralized GamiChain iLearning

4. CONCLUSION

This research suggest safe student learning schemes to build a public higher education system that is not limited by space and time and adapts to the needs of the times. GamiChain learning can increase students' and teachers' motivation to build a more transparent, safe, and enjoyable educational environment. The findings implementation of GamiChain impacts the results of lecture documentation being permanently converted, formally distributed, and recording all information into smart contracts to become the official learning standard. The aims of this paper of Gamichain can improve the asset security in distributed storage processes according to consensus mechanisms and smart contracts to enhance the quality in the field of education in the future. This makes it easier for everyone to get original information that is accurate, fast and guaranteed. This research can be further developed towards implementing an integrated Blockchain education platform with other institutions and further analysis.

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