AI and Blockchain: potential and challenge for building a smart E-Learning system in Vietnam

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Abstract. Smart E-Learning is an education form, in which information technology plays an important role. Smart E-Learning utilizes the achievements of modern technologies such as artificial intelligence (AI). So, it can help to gain the ability of connectivity, sharing, convenience, and flexibility for learners. All activities including teaching, learning, discussing, testing, and grading, are well done over the internet environment. However, some potential risks can cause participants, especially, about data privacy. The issue is a big challenge for developing applications for smart E-Learning. Therefore, the goal to combine E-Learning with Blockchain technology to improve security for smart E-Learning is necessary. In this paper, we discuss potential and challenge for applying AI and Blockchain for developing applications for smart E-Learning in Vietnam. We also propose to combine independent testing models integrated with AI and Blockchain into the same smart E-Learning system.

Keywords: AI, Blockchain, Smart Education, Smart E-Learning, Smart University.

1. Introduction
Nowadays, we usually hear about the terminology “Industry 4.0”. Industry 4.0 is the trend focusing on automation and exchanging data. About the technical aspects, Industry 4.0 includes a set of modern technologies related to new generation networks (4G, 5G, etc.), smart sensors, RFID (Radio-frequency identification), Internet of Things (IoT), cloud computing, cognitive computing, Big Data, Augmented Reality (AR), cyber-security, etc. Industry 4.0 appeared everywhere and in all fields of life. For education, Industry 4.0 also created a new trend: “learn anywhere, anytime”. It is a base to make a so-called terminology – smart E-Learning. Smart E-Learning is becoming a global trend that can break the barrier of physical distance between nations.

In recent years, many universities in Vietnam applied training models of smart E-Learning. This training method still goes hand in hand with the traditional training method. With the help of the internet, E-Learning is an advanced tool used for distance-training classrooms. This training form is more helpful in the COVID-19 pandemic. We also note that smart E-Learning is a high level of E-Learning. In smart E-Learning, there is an appearance of smart elements that better serve participants. In E-Learning and smart E-Learning, participants (teachers, students) can access online resources anywhere and anytime. They also can discuss related topics without the restriction of space and time. Although E-Learning, as well as smart E-Learning, has some limitations that require the participants need to have technological knowledge, fast-enough connectivity, etc., we cannot negate its advantages.
E-Learning systems are usually developed based on the Web platform. With many achievements of Web 4.0, E-Learning systems become smarter and safer. In this paper, we discuss AI and Blockchain technology and their potentials to apply for E-Learning systems.

2. Literature review
In the world, there have been several E-Learning applications integrated advanced technologies such as Elsa Speak. Elsa Speak is an English teaching website with an effective and impressive application of AI technology [2]. It also has a mobile version for Android and iOS. Elsa Speak focuses on tutoring English pronunciation in the best way. AI technology integrated with Elsa Speak is most evident in its ability to recognize voices effectively. Through this speech analysis, Elsa Speak will assess how well your English-speaking ability is. From there, propose appropriate methods to improve your English-speaking ability.

In the study [19], the authors presented a qualitative assessment method by using a sampling method to evaluate the effectiveness of the use of Elsa Speak to improve English pronunciation of students. The study was implemented for students in the first semester of the training year 2018-2019 of a practical training program named STKIP Muhammadiyah Enrekang. Scores of testing English pronunciation was taken before and after using Elsa Speak by recording to compare the results. The results are presented in Table 1. We can see that Elsa Speak improved English pronunciation skills for students much.

Table 1. Improvement of testing English pronunciation after using Elsa Speak

| Description               | Types of Test                  | Total Score     |
|---------------------------|--------------------------------|-----------------|
|                           | Words Pronunciation            | Sentences Pronunciation | Raw Scores | Individual Scores |
| Before using Elsa Speak   | 63                             | 31              | 94         | 23.5               |
| After using Elsa Speak    | 224                            | 55              | 279        | 69.6               |

Figure 1. Duolingo application for iOS system
Like Elsa Speak, Duolingo [3] is also a notable name in the application of AI technology for Education. This application is also available for both Android and iOS. An example of the graphical user interface of iOS system is presented in Figure 1. Developers of Duolingo said that this application has been integrated with AI technology for researching and identifying user behaviour. From there, it is possible to create tests that best suit the current ability of the learner. This has made Duolingo attract a lot of users of all ages because everyone can easily find for themselves the most favourite learning program possible. In the study [18], the authors developed an online learning method for Hungarian, Japanese, Korean, Portuguese, and Vietnamese languages based on Duolingo. The obtained results showed that the system can process multilingual tasks effectively and very fast.

In Vietnam, the online training solution named VNPT E-Learning [4] integrates the electronic contract function of Blockchain to manage and award certificates to learners, monitor the learning process: store the learning history, remind students to study and allow teachers/parents/training managers to manage learning process.

VioEdu LMS [5] of FPT corporation is another smart AI learning assistant launched in 2019 with outstanding features that aggregate training process: data on learning behaviours and knowledge of students will be summarized, analysed by AI, and then it finds out the strengths as well as the knowledge gaps to propose learning pathways that suit your competence. As a result, each skill, depending on nature, will be cultivated, or promoted separately, helping them to learn the right focus and not spread out.

ViettelStudy learning social network [6] was developed by Viettel Group in 2018 based on a combination of 3-in-1 technology: social networks connectivity, training management systems, e-commerce to help teachers connect with students and parents; provide lessons, quizzes, and mini-games that support the learning process and reinforce knowledge. Learning content is developed by teachers, reputable content development companies, and educational institutions across the country. Also, based on student information, strengths, and weaknesses, combining with Bigdata technology and AI, one can analyse the learning behaviour of students, suggest helpful topics for students to learn more effectively.

Universities in Vietnam have initially studied and implemented E-Learning models. Several schools also have initially implemented training support software and produced positive results: Vietnam National University Ho Chi Minh City, Vietnam National University, University of Economics Ho Chi Minh City, Hanoi University of Science and Technology, Da Nang University, Can Tho University, etc.

The popularity of E-Learning is different from various regions, for example, the most thriving in North America and western Europe. E-Learning is also very promising for regions of Asia. In some recent studies, people mainly focus on the application of AI or Blockchain technologies. Ashok K and Lalith P [11] proposed Jill Watson (JW) - a virtual teaching assistant for E-Learning based on the MOOCs (Massive open online courses) online training system to improve learning and ability of interaction between teachers and students. The system could automatically answer students’ questions naturally and continuously. Niranjana. M et al. [13] used the Bayes network model to design a system to automatically answer questions as a virtual assistant (Chatbot). The system extracts the keywords in the questions, then parses the vocabulary on the Bayes probability model platform to choose the highest answer corresponding to the question. The answer content in the data is then converted into a synthesized voice. Kamalakkannan S [14] proposed the model of the integrated intelligent learning environment (ILE: Integrated Intelligent Learning Environments) for students to practice programming and analyse the current working situation. Han Sun et al. [10] focus on blockchain technology from the basic technical principles as well as application aspects and proposed a solution to the E-Learning problems based on blockchain technology.

3. Problem formation: applicability of AI and blockchain in E-Learning

From the literature review, one can see that the application of AI or Blockchain for E-Learning is separate. With our endeavour, we still cannot find out any solutions based on combining both AI and Blockchain technology for E-Learning. Therefore, a combination of AI and Blockchain technology for E-Learning is the goal of this study.
3.1. E-Learning
We usually hear about E-Learning, E-Learning system. So, what is E-Learning? E-Learning is an abbreviation of “Electronic Learning”. There are various definitions for E-Learning. In general, E-Learning is a terminology that describes learning and teaching activities based on information and communication technology [1]. Some important advantages of E-Learning are easy accessing, convenience, flexibility for education and it can be self-orientation, self-adjustment. Resource for education can be synchronized easily. It can allow many people to participate in courses and it is better for self-learning and learning by a group. There are two key factors in E-Learning systems:

- **LMS** - Learning Management System is a service system that distributes and searches content, other online resources to support participants. It also follows a learning process including testing, grading.
- **LCMS** - Learning Content Management System is a multi-user environment, in which participants can implement the following actions: creating, storing, reusing, managing, and sharing learning contents in a digital form in a central data warehouse.

3.2. Artificial Intelligence and Blockchain
Artificial Intelligence (AI) is the simulation of human intelligence for a machine to solve theoretical and practical problems. In this way, the machine is programmed and can think like humans and can mimic human actions. On the other hand, AI is machine intelligence made by humans. AI can be trained, can think, and can self-study from sources of large knowledge. AI can control devices, plan for works, answer questions independently from humans, recognize and differentiate objects, etc.

Blockchain technology is a series of immutable timestamped data records managed by computer clusters that are not owned by any entity. A blockchain is caused by a block and a chain. A block contains data, hash codes of current and previous blocks. Blockchain technology is used for storing and transmitting information by continuously linked blocks and these blocks can be extended by time. Important characteristics of blockchain technology: unchangeability, security, and explicitness.

3.3. Application of AI and Blockchain for E-Learning
As abovementioned, AI can help to improve the ability of interaction of teachers and students, and Blockchain technology can make the learning environment to become explicit. Figure 2 showed the potential of using AI and Blockchain for E-Learning.

![Figure 2. Potential of using AI & Blockchain for E-Learning](image)

Role of AI. All E-Learning activities are aimed at creating a virtual assistant that is like a teacher who follows the learning progress. Learners can interact directly with this virtual assistant, and they will be
guided completely with the help of the large data warehouse. This is a useful tool, helping learners improve their knowledge and skills. On the other hand, AI can also focus on personalizing learning experiences such as being able to design a specific training program that is appropriate for each age, needs, interests, and abilities of learners. In particular, improving the ability to analyze data and behavior of learners, training activities will give an impressive and attractive learning experience. Besides, with the help of AI, the interaction with learners is greatly improved, all issues are solved and answered quickly. That brings exciting feelings to the learners.

Role of Blockchain technology. Blockchain can help manage the training process. All information about the training process will be stored on the blockchain system such as managing transcripts, academic achievement, exam results, etc. These data are stored securely, regardless of variable, and may be permanent. Blockchain can help solve fraud issues in the exam system. With the mechanism to protect against data changes in Blockchain technology, changing exam results will not be possible. Besides, the smart contract of the blockchain shows the applicability in assessing the capacity of the training institution.

4. Approach combining AI and blockchain to E-Learning
In this paper, we propose to use AI and Blockchain for various tasks in the E-Learning process:

4.1. Result Assessment, Certification by Blockchain Technology in E-Learning
In the study [12], the author combined the private part and public part of Blockchain to integrate the functionality of the E-Learning system. Otherwise, the author also combines with other E-Learning platforms to create a complete system for assessing and managing the training process. The system has the participation of learning user nodes and education authority nodes. Figure 3 presents the application of Blockchain for assessing academic results and certification of E-Learning systems.

Learning user: any individual who wants to participate in E-Learning, they must register a personal account and participate in the E-Learning system as a learning user node is shown in Figure 3(a). Like other Blockchain systems, the system will define an authenticated wallet. After that, the system will create at least one credit wallet of the course based on the learner's account and the number of credits generated by the learning activities of learners; and that credit wallet is added to the individual course credit wallet. After completing a course, learners can use accumulated credits in exchange for the digital certificates of the respective courses, and the certificate of the academic achievement score is taken and accumulated in the certificate wallet as a basis for rewarding.

Education authority: Training institutions consist of one or more schools that can join the network and they are defined as an education authority node, providing online courses as well as separate assessment systems according to the smart contract corresponding to the number of credits required when a learner officially joins the course is shown in Figure 3(b). When a smart contract of the training institution is confirmed with the list of learners, this contract is proposed to be deployed on the blockchain system. After that, the smart contracts from the learners are actively implemented, and educational institutions are no longer involved in the learning assessment and management process. According to the different roles of education authority nodes and their relationships, the E-Learning evaluation and certification system includes two types of the blockchain (private and public) and 3 kinds of networks:

- **LUN**: Learning User Network: A peer-to-peer (P2P: Peer-to-Peer) architecture is completely decentralized, including the nodes of learners participating in the E-Learning system is shown in Figure 3(c). All information about academic records, academic achievements, and certificates achieved by learners corresponding to personal account information has been verified on the system. Here, learners can send information anonymously through a private account provided through LUN to contact or exchange with each other.

- **Education Certification Network (ECN)**: Like LUN, the P2P model is fully decentralized to all nodes of the educational institution in the system is shown in Figure 3(d). Corresponding to each ECN, an educational certificate is issued by the public blockchain system (EC Public Blockchain), all nodes in the ECN will join in the management and decentralized storage of data of the public blockchain.
• *Learning Assessment Local Networks* X (LALN-X): where X is the educational institution participating in the E-Learning and each LALN is a local area network was built by an education authority located in the purple enclave of training facilities and participant nodes is shown in Figure 3(e). Corresponding to LALN-X of the educational institution X has an internal learning evaluation system stored on the private blockchain (LA Private Blockchain-X). Learner data in LALN-X is evaluated and converted automatically into complete credits by activating smart contracts that are deployed on the private blockchain. The accumulated credits are then packaged into blocks and stored continuously on LA Private Blockchain-X as proofs to provide digital certificates upon completion of the course.

![Figure 3. Assessment of academic results and Certification in E-Learning system using Blockchain](image)

4.2. **Building a Virtual Assistant for E-Learning using AI**

In the study [15], the author used AI to develop a virtual assistant (Chatbot) integrated into E-Learning as in Figure 4. In the system, there are the following modules:

- Learning interface (Front-End): provides a friendly interface for learners (such as computers, smartphones, tablets, etc.)
System management (Back-Office): this module is used to manage activities that students do not see, run implicitly below. Closely associated with the knowledge base module, tasked with processing, and archiving business data.

Knowledge Base: this module is a special form of database, where information is processed by a server for managing information and trained scientific knowledge, divided into 2 categories: User data (including all application such as for learners and teachers, managers, etc.) and Learning objects (a collection of contents, real items performance and evaluation items that are connected on a single learning objective);

A virtual assistant (E-Learning BOT): is the most important module of the system including the following basic components:

- Interaction Quality Tracker: monitoring interaction between learners and virtual assistants (Chatbot). It also evaluates conversation logs according to the quality indicators, as well as highlighting significant aspects of the human-machine interface.
- Human-Computer Interaction Supervisor: monitor conversation dialogue, track interaction duration, identify ambiguous questions, record unfocused interaction sessions, and ask for community support if unable to give correct answers.
- Context-Aware Information Manage (Context-Aware Information Manage): this is a module that allows controlling conversations based on parameters (such as student profiles, learners' positions, etc.).
- Inference Engine: Designed to provide correct answers to learners through an LDA (Latent Dirichlet Allocation) algorithm and Workflow Manager. This function is divided into two phases, the first stage defines an entity describing a certain field of knowledge, supported by a pre-trained knowledge law; The second stage defines a workflow control module. In this way, conversations (through word analysis) will be considered and selected for the appropriate answer to that conversation.

![Chatbot integrated with AI for E-Learning](image)

**Figure 4.** A Chatbot integrated with AI for E-Learning
5. Conclusions
E-Learning is an inevitable trend in the future. Thanks to this technology, learners can take courses anywhere, anytime. Virtual teachers own a large knowledge because it is linked to an extremely large database of knowledge. It is very necessary to understand the structure of the E-Learning system to gradually improve and apply modern technologies such as AI and Blockchain. Therefore, we can increase the efficiency and explicitness of the training. Also, E-Learning systems integrated with AI and Blockchain tend to apply technology in education and training. However, in this study, the integration of AI and Blockchain was applied independently to address the various functions of E-Learning. In the future, we look forward to the combination and interaction between these two technologies to provide the best solution for learners.

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