Blockchain-based Credit Transfer for Higher Education Institutions

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ABSTRACT: *This paper presents a course transfer architecture for transferring students' credits and experience to courses at a tertiary education institution with smart contracts stored in a blockchain network. The factors used in the transfer comparison process are divided into three parts: (1) the qualifications of the applicant for the transfer; (2) the conditions of a course transfer; and (3) the criteria for a course transfer. The result is a credit transfer equivalency architecture for transferring experience and credits to courses in higher education institutions. The work of the credit transfer architecture for transferring experiences into courses in higher education institutions consists of two parts as follows: (1) import data such as portfolio, qualifications, and knowledge; (2) process, which is a smart contract in Blockchain. If the conditions are correct, credits will be transferred to equip the transfer of experience to courses at tertiary education institutions, between disciplines or universities.*

Keywords: Blockchain, Smart contract, Higher education institutions, Credit transfer, Data sharing

1. Introduction

The transfer of experience to courses at institutions of higher education can be transferred between universities and between disciplines or students who have not graduated but want to come back to study. At present, technology is used to help compare the transfer of a large number of credits, such as artificial intelligence technology (Kittiviriyakarn, Nilsook, & Wannapiroon, 2020) and blockchain technology (Turkanović et al., 2018) (Muneeb et al., 2022). Blockchain technology plays a wide variety of roles today in all areas including business and economics, medicine, education, agriculture, etc. Blockchain is seen as a revolutionary solution, dealing with modern technological issues such as decentralization, credibility, identity data ownership and making informed decisions (Karafiloski & Mishev, 2017).

In particular, in education, Blockchain has been used in issuing transcripts, certificates and benchmarking experiences, such as a review of the use of blockchain in higher education and experimental implementation of blockchain-based university transcripts. To empower students and fit into today's more dynamic society (Arndt & Guercio, 2020). It offers a prototype implementation of an environment based on the open-source Ark Blockchain platform. Based on the peer-to-peer network, it represents the credits that students earn from successfully completed courses (Turkanović et al., 2018). It examines eligibility requirements and identifies potential directional perception gaps for future

functionality with smart contract models and formal requirements (Tolmach et al., 2022). It also offers a framework to verify academic certificates and credits of students enrolled in universities that can be digitally transferred between stakeholders (Srivastava et al., 2019). From the study of documents and related research, this paper proposes the concept of transferring experience to courses in higher education institutions using blockchain technology with the correlation conditions made on smart contracts. This paper is structured as follows: first, the Introduction, and then the Related Work; this is followed by a discussion of transfers for exemption from studying courses, and the Proposed Architecture. The study closes with the Conclusion.

2. Related Work

The study considered papers and research on the theory involved in this article from various sources such as SCOPUS, IEEE, Science Direct, etc.

2.1 Blockchain

Blockchain is a combination of techniques, cryptography, mathematics, algorithms, and distributed consensus algorithms. It consists of six main components: decentralized, transparent, anonymous, consensus base immutable open source (Saleh, Ghazali, & Rana, 2020). Blockchain is a distributed database technology consisting of a transactional database of different users. It is designed to deal with databases in the form of shared data in a distributed manner. The blockchain represents distributed ledger technologies (DLTs), allowing the sharing of ledgers of transactions that are read, validated, and stored in clusters (Belotti et al., 2019). Shared database storage technology, also known as DLT, is a form of data recording that ensures security. The previously recorded data cannot be changed or edited, and all users see the same set of information. It uses cryptography principles and distributed computing capabilities to create a reliable mechanism (Services, 1924).

It can be concluded that blockchain is a shared database or DLT data storage technology. Data previously recorded cannot be changed or edited and all users see the same set of information using encryption principles (cryptography) and the ability of distributed computing to create a reliable mechanism. The characteristics of blockchain are shown in Figure 1.
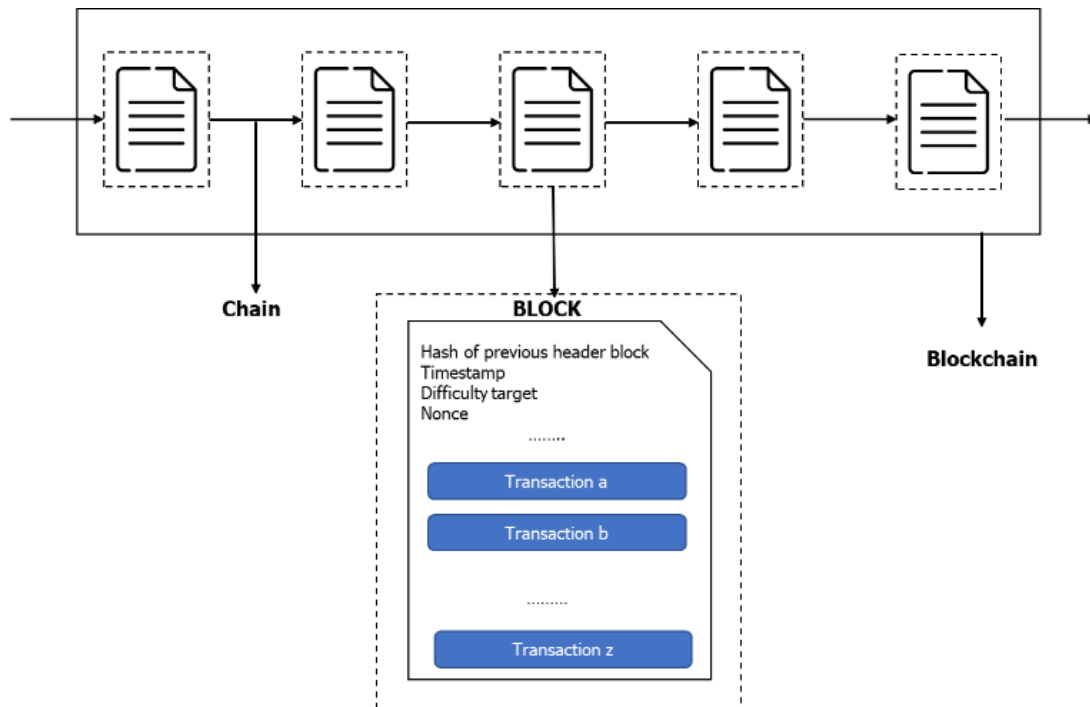
Figure 1. The structure of the blockchain.

The documents and related research were synthesized using content analysis. The issues, components, and processes of blockchain are summarized in Table 1.

Table 1. The components and processes of blockchain

Topics	Concept/Component	Process	Reviews
Blockchain	Blockchain technology consists of 2 components: (1) Block (2) Chain.	(1) Create: Create a block containing transaction request instructions. (2) Broadcast: Distribute this new block to all nodes in the system to update new blocks and record transactions to the account. (3) Validation: Validation using the consensus algorithm. (4) Confirmation: Confirmation of the transaction. (5) Add to the chain: Put the block in line with the previous block.	(Belotti et al., 2019; Muneeb et al., 2022; Niranjanamurthy et al., 2019; Rahman et al., 2022; Services, 1924; Yermack, 2017; Bucea-Manea-toniş et al., 2021; Andrian, Kurniawan, & Suhardi, 2018; Koç et al., 2018)

The results of the synthesis of blockchain components and processes are described as follows. Blockchain has three main components: (1) a block is divided into two parts: a block header section and a block data chain section, which remember every transaction of every part of the system; (2) consensus is the formulation of agreements and consensus among the members of the Blockchain network; and (3) validation is a review of the validity of the system and every node in the system.

Blockchain has a five-step process: (1) Create: it creates a block containing transaction request; (2) Broadcast: it distributes this new block to all nodes in the system to update new blocks and record transactions to the account; (3) Validation: Algorithm-based validation; (4) Confirmation: Confirmation of the transaction and (5) Add to the chain: Bring the block in line with the previous block.

2.2 Smart Contract

A smart contract takes place in blockchain technology. It is a contract written in a computer program that is automatically executed when pre-defined conditions are met. A smart contract contains transactions to be stored. It is primarily replicated and updated in distributed blockchain and is a blockchain-based computer program (Zheng et al., 2020). Smart contracts store the terms or agreements of contracts in the form of computer code, which is stored on the network blockchain (Services, 1924). Smart contracts are used as computer programs that run on blockchain networks. It can display triggers, conditions and business logic to enable complex programmable transactions (Xu et al., 2016) and the terms of a specific agreement or contract using software code and computer infrastructure (Muneeb et al., 2022).

Therefore, it can be concluded that a smart contract is used to write computer programs to verify the terms of various agreements. It is a self-regulating execution according to the terms and conditions specified. An example of a smart contract is shown in Figure 2.
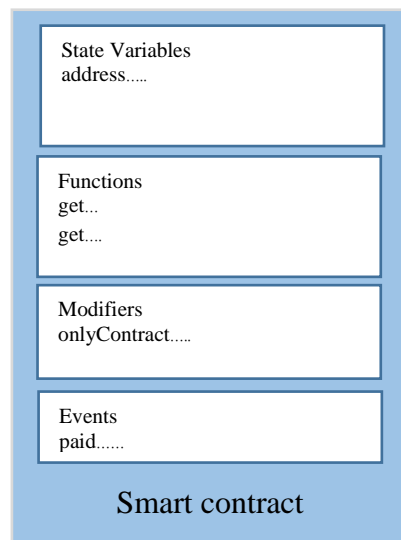
```
┌─────────────────────────────────┐
│  ┌───────────────────────────┐  │
│  │ State Variables           │  │
│  │ address.....              │  │
│  │                           │  │
│  └───────────────────────────┘  │
│  ┌───────────────────────────┐  │
│  │ Functions                 │  │
│  │ get...                    │  │
│  │ get....                   │  │
│  └───────────────────────────┘  │
│  ┌───────────────────────────┐  │
│  │ Modifiers                 │  │
│  │ onlyContract.....         │  │
│  └───────────────────────────┘  │
│  ┌───────────────────────────┐  │
│  │ Events                    │  │
│  │ paid......                │  │
│  └───────────────────────────┘  │
│          Smart contract         │
└─────────────────────────────────┘
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Figure 2. Smart contract

Again, the relevant documents and research were synthesized using content analysis. The composition and process of smart contract work is summarized in Table 2.

Table 2. The concept and processes of smart contract

Topics	Concept/Component	Process	Reviews
Smart Contract	A smart contract is a code on the terms of a transaction that can be executed manually. It stores the terms or agreements of the contracts in a computer code with a decentralized consensus that is secure and standardized, which allows users to automate actions on blockchain platforms.	(1) Create an agreement. (2) Triggering events identifies events/purposes. (3) Publish a distribution to users who have signed up to purchase according to the terms specified. (4) Termination of the agreement when there is a buyer (5) Report run when the user reports a violation, after the user transfers the deposit to contract publish.	(Belotti et al., 2019; Hewa, lianttila,& Liyanage, 2021; Image, 2021; Mishra et al., 2021; Sergey & Hobor, 2017; Services, 1924; Tolmach et al., 2022; Zhao et al., 2019; Abbas, 2020; Alshahrani, 2022)

The composition and process results of the smart contract are as follows. Smart contracts are computer codes and decentralized consensus models that are secure, automated and standardized. Standardization allows users to automate actions on blockchain platforms.

The work process has five steps: (1) create an agreement; (2) triggering events identifies events/purposes; (3) publish a distribution to users who have signed up to purchase according to the terms specified; (4) termination of the agreement when there is a buyer, and (5) report run when the user reports a violation, after the user transfers the deposit to contract publish.

2.3 Credit transfer

Credit transfer refers to the receipt of credits for courses completed at one institution or program upon transfer to another or courses taken in one program that can be transferred to the same program at another institution or another program at the same or new institution (Haiden Heath, 2021). Credit transfer refers to the process by which students learn in one organization and become officially recognized by another (Milian & Munro, 2020). Students who complete courses and programs from equivalent institutions or agencies will receive transfer credit. Courses or

programs undertaken at the post-secondary or other institutional levels will be considered through credit transfer (Senate & Provost, 2014).

Processes of credit transfers are as follows: (1) The process of considering the student's work. It is suggested that failures on the part of the program do not need to be redeemed for the student to progress or be rewarded based on their performance. They are registered, however, usually, no credit is given for failed parts of the program; (2) remuneration, which is a process for determining the overall performance of students and that can recommend credits for the part of the program that the student does not meet (Pollard, Hadjivassiliou, & Swift, 2017). The credit transfer process consists of the following factors. First, the evaluation of the subjects requested for assessment from hours; training for not less than the number of hours of coursework required or content consistent with the course group subjects at the vocational level, at least 60%; a vocational certificate and at least 75% bachelor's degree in technology, considering the information from the preliminary interview, job characteristics, workplace, and experience. Second, the assessment, transfer of knowledge, and experience using a variety of methods that cover the objectives of the curriculum, course performance and course content. This will be at the discretion of the assigned committee (Kittiviriyakarn, Nilsook, & Wannapiroon, 2020).

In conclusion, credit transfer is the process by which student learning is completed in one organization and accepted by another organization or a different program at the same institution.

The documents and related research were synthesized using content analysis. The issues, components and processes of credit transfer work are summarized in Table 3.

Table 3. Results of the synthesis of credit transfer constituents and processes

Topics	Concept/Component	Process	Reviews
Credit transfer	The process by which student learning is completed in one organization and accepted by another organization or a different program in the same institution.	(1) Consider the student's performance/level of academic performance by the assessment committee. (2) Evaluate students' grades.	(About Learn.org,2022; LISBDNETWORK, 2022 Al-Kurdi, El-Haddadeh, & Eldabi, 2018; Bucea-Manea-toniş et al., 2021; Miranda et al., 2021; Abbas, 2020; Turkanović et al., 2018; Milian & Munro, 2020; Senate & Provost, 2014))

The process is as follows: (1) to consider students' performance/grades by the assessment committee; (2) to assess students' grades.

2.3.1 Course transfer comparison factors

There are five factors for transfer comparison criteria: (1) the applicant's qualifications for the transfer; (2) the conditions for the transfer comparison; (3) the knowledge of the applicant for the transfer; (4) the experience of the applicant for the transfer, and (5) the professional standard (Kittiviriyakarn, Nilsook, & Wannapiroon, 2020). The European Credit Transfer and Accumulation System (ECTS) is a framework for a higher education grading system developed by the European Commission and agreed by EU member states; it is student-centered. Factors used in the transfer comparison were as follows: (1) previous academic achievement; (2) qualifications; (3) experience; and (4) learning curve (Guide, n.d.).

The transfer student's factors include the following: (1) knowledge; (2) skills; and (3) sufficient specific competence prior to joining any program or course at the transfer institution.

The four factors of transfer comparison can be summarized as follows: (1) the applicant's qualifications; (2) the conditions of the transfer; (3) the applicant's knowledge of the transferor; and (4) the experience of the transfer applicant.

2.4 Data sharing

Data sharing is performed by uploading raw data or metadata so data can be published. A central server collects uploaded data and displays them in a private network which requires very low latency for best performance. Collaborate by experimental and observational data available. Sharing information between organizations, especially corporate ecosystems or affiliates. This is the result of new privacy technologies that revolutionize the way we think

about encryption, which makes it possible to share information securely (Kowalczyk & Shankar, 2017). Data sharing refers to the collection of practices, technologies and cultural elements and the legal framework related to transactions in all types of digital data between different types of organizations (Wilbanks & Friend, 2016). Data sharing is a practice of giving partners access to information they do not have access to in their data systems. Sharing information enables stakeholders to learn from each other and work together on shared priorities (To, 2020). Therefore, data sharing is the process of sharing information with partners so that they can share information securely. The documents and related research were synthesized using content analysis. The issues, components and processes of data sharing work are summarized in Table 4.

Table 4. Results of the synthesis of data sharing constituents and processes

Topics	Concept/Component	Process	Reviews
Data sharing	The process of sharing information with partners for safe sharing of information includes the following elements: (1) Metadata (2) Content (3) Server/Storage (4) Security (5) Information.	(1) Input (2) Upload (3) Sharing (4) Reuse	(Fan et al., 2018; Hoang, Lehtihet, & Ghamri-Doudane, 2020; Kang et al., 2019; Kowalczyk & Shankar, 2017; Naz et al., 2019; Wilbanks & Friend, 2016; Shrestha et al.,2020 ; M Report, 2017; To, 2020)

The process is as follows: (1) input; (2) upload; (3) sharing; (4) Reuse.

The relationship of the theory involved in this article is shown in Figure 3.
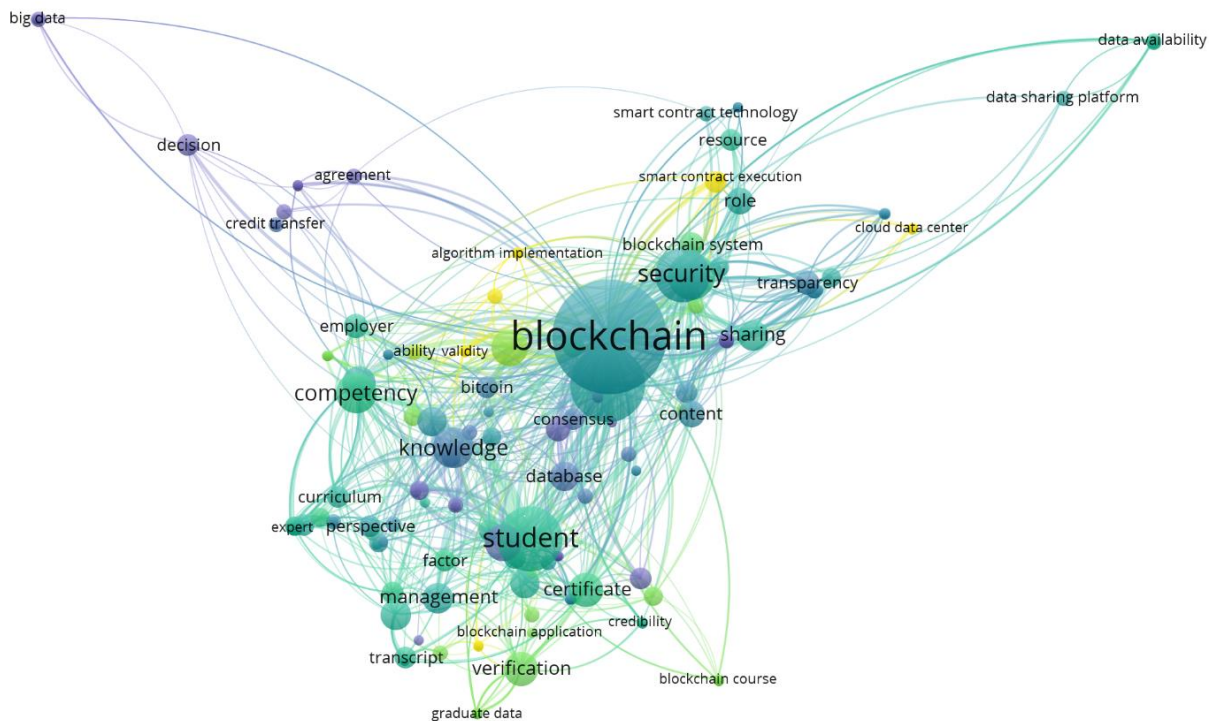
Figure 3. Blockchain data relationship

3. Transfers for exemption from studying subjects at Rajabhat Universities in the south

Rajabhat Universities in the South consist of five universities, namely, Surat Thani Rajabhat University. Phuket Rajabhat University Nakhon Si Thammarat Rajabhat University Songkhla Rajabhat University and Yala Rajabhat University. Studies have shown that all Rajabhat Universities transfer course credits to transfer experience across the five courses in higher education institutions. According to Rajabhat University, an equivalency transfer for exemption from studying subjects means taking a course that has already been studied or bringing training results or results of non-formal education or formal education to request exemption from repeating a course (Uoilu, n.d.). Phuket Rajabhat University also include taking the course content from Rajabhat Institutes, and other higher education institutions, that have been studied, including informal education, without having to study that course again (Rule-Credit-Bank-64.Pdf, n.d.). The transfer for exemption from coursework brings the grades of courses in university courses or courses of other higher education institutions for students who have previously studied informal education, training, or work experience to consider, compare, transfer and assess according to the university's curriculum without having to study that course again (Announcement-on-Criteria-and-Methods-for-Evaluating-Transfer-of-Grades-Bachelors-Degree-2019.Pdf, n.d.). It can be concluded that comparing course credits for transferring experience to courses in higher education institutions means bringing the results of courses in university courses or courses of other higher education institutions of students who have previously studied informally or have training or work experience, to request an exemption from repeating a course.

3.1 Criteria for transfer of courses

The Ministry of Universities regarding the criteria for the transfer of bachelor's degree results Entering the system of education in 2002 consists of the qualifications of those who have the right to request for transfer of academic results. and criteria for equipping courses and transferring credits during formal education and non-formal and/or informal education into the formal education system. The documents and related research on criteria for transferring academic results of Rajabhat Universities in the south were synthesized using content analysis. It is divided into issues regarding the qualifications of the applicant to transfer conditions for comparing the transfer and the criteria for comparing the transfer. According to the 2015 Undergraduate Program Standard Criteria, the curriculum consists of the following: (1) curriculum consisting of fields of study, (2) curriculum structure consisting of general education courses, specific courses, and free elective courses; and (3) courses consisting of course codes, subject names, number of theoretical sessions, practical sessions, credits and course descriptions. This is explained in Tables 5, 6 and 7.

Table 5. Qualifications of bachelor's degree transferees of Rajabhat Universities in the south

Qualifications	Nakhon Si Thammarat Rajabhat University (Uoilu, n.d.)	Surat Thani Rajabhat University (*Announcement-on-Criteria-and-Methods-for-Evaluating-Transfer-of-Grades-Bachelors-Degree-2562.Pdf*, n.d.)	Phuket Rajabhat University(*Rule-Credit-Bank-64.Pdf*, n.d.)	Songkhla Rajabhat University (*2020-07-01_590.PDF*, n.d.)	Yala Rajabhat University (Exemption from the Department of Education Standards, Department of Education Services, Office of the University Yala, n.d.)	Synthesis
Graduates from Rajabhat University or other universities.	✓	✓	✓	✓	✓	✓
Those who have studied for a bachelor's degree but did not graduate.	✓	✓	✓	✓		✓
Students who have completed an associate degree/vocational certificate/or equivalent from other institutions.	✓		✓	✓	✓	✓

Qualifications	Nakhon Si Thammarat Rajabhat University (Uoilu, n.d.)	Surat Thani Rajabhat University (*Announcement-on-Criteria-and-Methods-for-Evaluating-Transfer-of-Grades-Bachelors-Degree-2562.Pdf*, n.d.)	Phuket Rajabhat University(*Rule-Credit-Bank-64.Pdf*, n.d.)	Songkhla Rajabhat University (*2020-07-01_590.PDF*, n.d.)	Yala Rajabhat University (Exemption from the Department of Education Standards, Department of Education Services, Office of the University Yala, n.d.)	Synthesis
Those who are studying at the university change their program of subjects.	✓	✓	✓	✓		✓
Those who studied informally and/or vocational training or work experience.	✓	✓	✓	✓		✓
Must not be excluded from educational institutions, disciplined or during the study break.	✓		✓	✓		✓

The qualifications of bachelor's degree transferees of Rajabhat Universities in the south are as follows: (1) Those who graduated from Rajabhat University or other universities. (2) Those who have studied for a bachelor's degree but did not graduate. (3) Students who have completed a diploma/high vocational certificate/or equivalent from other institutions. (4) Those who are studying at the university who change their subject program. (5) Those who studied informally or undertook vocational training or work experience. (6) Must not be excluded from educational institutions, disciplined or during a study break.

Table 6. Criteria for bachelor's degree transferees of Rajabhat Universities in the south

Rules	Nakhon Si Thammarat Rajabhat University (Uoilu, n.d.)	Surat Thani Rajabhat University (*Announcement-on-Criteria-and-Methods-for-Evaluating-Transfer-of-Grades-Bachelors-Degree-2562.Pdf*, n.d.)	Phuket Rajabhat University (*Rule-Credit-Bank-64.Pdf*, n.d.)	Songkhla Rajabhat University (*2020-07-01_590.PDF*, n.d.)	Yala Rajabhat University (Exemption from the Department of Education Standards, Department of Education Services, Office of the University Yala, n.d.)	Synthesis
It is a course or a group of courses that request exemption from the results of a higher education program or its equivalent, the Office of the Higher Education Commission or a government agency authorized under the law.	✓	✓	✓	✓	✓	✓
The total number of exempted credits must not exceed two-	✓	✓	✓	✓		✓

Rules	Nakhon Si Thammarat Rajabhat University (Uoilu, n.d.)	Surat Thani Rajabhat University (*Announcement-on-Criteria-and-Methods-for-Evaluating-Transfer-of-Grades-Bachelors-Degree-2562.Pdf*, n.d.)	Phuket Rajabhat University (*Rule-Credit-Bank-64.Pdf*, n.d.)	Songkhla Rajabhat University (*2020-07-01_590.PDF*, n.d.)	Yala Rajabhat University (Exemption from the Department of Education Standards, Department of Education Services, Office of the University Yala, n.d.)	Synthesis
thirds of the minimum total credits for the course being studied.						
Upon exemption, the student must have spent at least one academic year at the university.	✓	✓	✓	✓		✓
It is a course or a group of courses with a course description covering not less than three-fourths of the course, excluding grades.	✓	✓		✓		✓
The transfer credit of course is to be completed in the first semester.		✓	✓	✓	✓	✓
Those who studied informally. The knowledge must be comparable to the courses in the university course.	✓	✓	✓	✓		✓
Those who have completed both short-term and long-term training courses from educational institutions/university courses/public and private agencies must have at least the time spent training in the course and assessed on a level basic score.	✓	✓	✓	✓		✓
In the case of training, the number of hours provided in training is not less than 80 percent of the number of hours taught in the system of the subjects requesting the exemption.	✓	✓	✓	✓		✓

The criteria for bachelor's degree transferees of Rajabhat Universities in the south are as follows: (1) It is a course or a group of subjects requesting an exemption from the results of a higher education program or its equivalent, the Office of the Higher Education Commission, or a government agency with legal authority to certify. (2) The total number of exempted credits must not exceed two-thirds of the minimum total credits for the course being studied. (3) Upon exemption, they must spend at least one academic year at the university. (4) It is a course or a group of courses

with a course description covering not less than three-fourths of the course that excludes academic results. (5) The transfer credit of course is to be completed in the first semester. (6) Those who studied informally must have knowledge comparable to the courses in the university course. (7) Those who have completed both short-term and long-term training courses from educational institutions/university courses/public and private agencies must have at least the time spent training in the course and assessed as a point value. (8) In the case of training, the number of hours arranged in training is not less than 80 percent of the number of hours taught in the system of the subjects requesting the exemption.

Table 7. Conditions for transfer of bachelor's degree at Rajabhat Universities in the south

Conditions	Nakhon Si Thammarat Rajabhat University (Uoilu, n.d.)	Surat Thani Rajabhat University (*Announcement-on-Criteria-and-Methods-for-Evaluating-Transfer-of-Grades-Bachelors-Degree-2562.Pdf*, n.d.)	Phuket Rajabhat University(*Rule-Credit-Bank-64.Pdf*, n.d.)	Songkhla Rajabhat University (*2020-07-01_590.PDF*, n.d.)	Yala Rajabhat University (Exemption from the Department of Education Standards, Department of Education Services, Office of the University Yala, n.d.)	**Synthesis**
Students who wish to transfer credits must have completed no more than 10 years of study.	✓	✓			✓	✓
Those who have been transferred to waive grades will not be eligible for an honors degree.	✓	✓	✓	✓		✓
Coursed with a score of not less than "C" or "P" or other equivalent scores and an assessment of not less than 2.00 or "Pass".	✓	✓	✓	✓		✓
Credits must be greater than or equivalent to the subjects for which the academic results are to be waived.	✓	✓		✓		✓
Recording the results of the exemption of academic results, the letter P/T is displayed without considering the cumulative mean.	✓	✓	✓	✓	✓	✓
The transfer of academic results and the exemption of the coursework under this regulation fee must be paid according to the announcement of the university.	✓	✓	✓	✓		✓
The assessment method must be recorded as follows: "P"(Pass) refers to courses that can be transferred without calculating the cumulative average.	✓	✓	✓	✓		✓

Conditions	Nakhon Si Thammarat Rajabhat University (Uoilu, n.d.)	Surat Thani Rajabhat University (*Announcement-on-Criteria-and-Methods-for-Evaluating-Transfer-of-Grades-Bachelors-Degree-2562.Pdf*, n.d.)	Phuket Rajabhat University(*Rule-Credit-Bank-64.Pdf*, n.d.)	Songkhla Rajabhat University (*2020-07-01_590.PDF*, n.d.)	Yala Rajabhat University (Exemption from the Department of Education Standards, Department of Education Services, Office of the University Yala, n.d.)	**Synthesis**
"CS" (Credits from Standardized) refers to credits earned by evaluating the written test experience using the standardized test. "CE" (Credits from Examination) means credits from the written examination assessment. "CT" (Credits from Training) means credits from the assessment of training experience according to the specified course. "CP" (Credits from Portfolio) means credits from the portfolio assessment experience and written exam.						

The conditions for transfer of bachelor's degree at Rajabhat Universities in the south are as follows: (1) Students who wish to transfer credits must have completed no more than 10 years of study. (2) Those who have been transferred for exemption of grades will not be eligible for an honors degree. (3) Coursed with a score of not less than "C" or "P" or other equivalent scores and an assessment of not less than 2.00 or "Pass". (4) Credits must be greater than or equivalent to the subjects for which the academic results are to be waived. (5) Recording the results of the exemption of academic results, the letter P/T is displayed without taking into account the cumulative mean. (6) The transfer of academic results and exemption from studying subjects under this regulation fee must be paid according to the university announcement. (7) The assessment method is recorded as follows: "P" (Pass) refers to courses that can be transferred without calculating the cumulative average; "CS" (Credits from Standardized) refers to credits from the written test experience assessment using the Standardized test; "CE" (Credits from Examination) means credits from the written exam assessment; "CT" (Credits from Training) means credits from the assessment of training experience according to the specified course and "CP" (Credits from Portfolio) means credits from the portfolio presentation experience assessment and written exam.

4. The Proposed Architecture

After consulting the relevant literature, this study proposes an architecture of transfer comparison systems in higher education institutions using smart contracts in blockchain as shown in Figure 4.
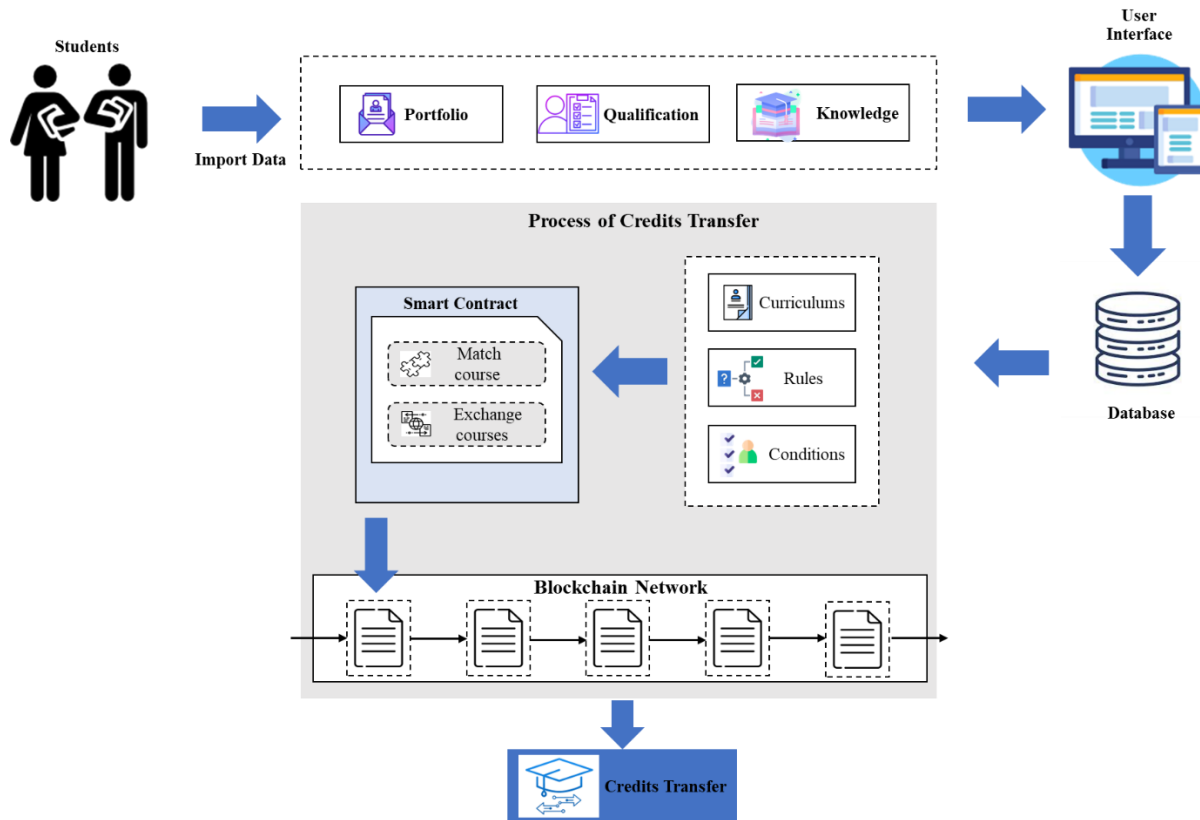
Figure 4. the architecture of a course transfer

Figure 4 the architecture of a course transfer architecture for transferring experience to courses at a tertiary education institution, it was found that the people involved in the system were students are described as follows: (1) The portfolio is the personal information of the transferee. (2) Qualifications are the characteristics of the learners. (3) Knowledge is a transcript showing academic results and various certificates of the transfer applicant. Then, the data from all three aspects is brought into the transfer comparison process as follows: (1) Check the rules for transfer comparisons (Rules). (2) Check the conditions of the transfer (Conditions). (3) Check with the course to which you wish to transfer (Curriculum). If correct, then compare the transfer by checking the conditions of the smart contract in the blockchain. If the transfer comparison conditions are met, the transfer will be compared and transfer the cost of the transfer. If it is by consensus, the result of the course transfer will be sent to the learner as well as the grade report.

5. Conclusion

This paper presented the architecture for transferring students' credits and experience on courses in higher education institutions with smart contract. The architecture consists of two parts as follows: (1) import data is the receiving data such as portfolio, qualifications, and knowledge; (2) process of credits transfer is the work of smart contract in Blockchain, which will check the conditions of the transfer. If the conditions are correct, the course credits will be transferred to the course at a higher education institution; then, transfer credits will be transferred to avoid having to repeat courses at the new institution.

6. Acknowledgement

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