A Tentative Idea of Virtual Simulation Experiment of FOF Based on Blockchain

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Abstract. With the modernization of education, National Virtual Simulation Experimental Teaching Project has become an important measure to reform the existed teaching method. This paper proposes and expounds a tentative idea of virtual simulation experiment of FOF. Firstly, it introduces this experiment’s necessity, lists its core elements, and analyses its advantages and competitiveness. And then it explains experiment’s principles and lists operation steps. Finally, it illustrates anticipated outcomes of the experiment and makes the summary of this experiment’s advantages and prospects.

1. Introduction

1.1. The significance of National Virtual Simulation Experimental Teaching Project
The national virtual simulation experiment teaching project, led by the Chinese Ministry of Education, is an important measure to promote the integration of modern information technology into experimental teaching projects, expand the breadth and depth of experimental teaching content, extend the time and space of experimental teaching, and improve the quality and level of experimental teaching. Virtual simulation experiments create virtual and vivid environments for students to participate in experiments that are difficult or costly to carry out in the real world. In such experiments, students can deepen their understanding of theoretical knowledges and broaden their horizons by putting what they have learned into practice through computer simulation. Therefore, designing virtual simulation experiment is a vital measure of educational modernization.

In order to strengthen students’ understanding of securities investment knowledges, a video-game-like FOF investment simulation platform based on Blockchain technology is designed to create a virtual securities investment environment for them. In this experiment, students will act as a fund manager to construct a FOF fund and mange it on the platform.

1.2. The concept, Advantages and Potential Development Prospects of FOF
The FOF (Fund Of Funds) is a fund that specializes in investing in funds. It does not invest directly in stocks or bonds. Instead, it invests in other securities investment funds to indirectly hold securities assets such as stocks and bonds. In the case that the fund has already dispersed the risk by investing in different assets, the FOF uses professional investment technical means to construct the fund portfolio to achieve
the purpose of diversifying the risk again. Thomas Meyer and Pierre-yves Mathonet\cite{1} define FOF as a carrier for bringing together a large number of investors, with unique professional advantages in terms of added value, optimization of funds, provision of resources, diversification of incentive mechanisms, etc. Capital can be invested in diversified fund portfolios through this carrier. 

Diversified investment management and risk diversification are the main advantages that FOF has always emphasized. Private equity funds (referring to the securities investment fund which collects funds from specific investors in a private way and invests with specific targets) typically invest in multiple projects at the same time, while FOF uses private equity funds as part of its investments. Diversified management can be carried out in a wider area by FOF (industry, investment stage, etc.), so as to achieve risk management and decentralization (Xiaofeng He, 2008)\cite{2}. Wolf and Wunderli (2011)\cite{3} verify the effectiveness of the statistical techniques for building FOF by establishing equity portfolios with different weights. The results show that the return of investment portfolio based on past income data is higher than that of simple investment portfolio (such as equal weight portfolio) at the same risk, which shows that statistical technology can play a positive role in FOF investment. According to the comparison of a FOF fund portfolio and CSI 300 Index conducted by ZHENG Xia in 2019\cite{4}, FOF portfolio funds surpass the CSI 300 index most of the time, showing its outstanding profitability and risk diversity.

In March 1985, the first FOF in the US market was first launched by Vanguard. After more than 30 years of development, FOF expanded rapidly in terms of quantity and the scale of funds under management. As of June 2017, according to ICI, the Association of American Investment companies, FOF grew from $14.26 billion in the early 1990s to $3.53 trillion. China's FOF started relatively late. In the measures for the Operation and Administration of Public offering Securities Investment funds issued by the China Securities Regulatory Commission in 2014, the concept of public offering fund FOF was formally put forward. By the end of 2017, 6 of the 29 public FOF on the market had been accepted, a total scale of more than 13 billion yuan. With the rapid development of China, FOF is predicted to follow the development tract of that in US and form a mature and huge market. FOF has great development prospects in China, Xiaofeng He (2010)\cite{5} said, for the reason that it can solve the problem of information inequality and find the best PE (private equity).

1.3. The Necessity of Blockchain Technology in Virtual Simulation Experiment

Students in the experiment will act as FOF fund managers to invest other funds. During this process, plenty of transaction information will be produced and thus need to be stored in a reliable way as they are vital reference to evaluate managers’ performance. In the previous centralized recording mode, data are stored in a third-party database. If the database is maliciously attacked, the data is at risk of being tampered with. The Blockchain technology, however, can solve such problem by its tamper-proof feature.

Blockchain can be understood as a distributed ledger that stores data through a chain of blocks where each one is chained to the former block by referring its hash value (as Figure 1 shows each block will contain the previous block’s hash value), updates data using a consensus algorithm, and secures data transmission and access using cryptography. Distributed ledger means that all participants will store the same copy of data, just as Figure 1 shows that Node A to D having the same blockchain. According to YU Ge (2019)\cite{6}, data tampering can be verified by the hash values of the blocks before and after, so tampering with the data and being recognized by all participants require a high cost in computing power to regenerate a new block, which is more difficult than traditional centralized database. Therefore, since unilateral tampering is invalid and tampering all blocks is almost impossible, Blockchain is an optimal way to store the information in this experiment.

According to the characteristics of the participating nodes, the Blockchain is divided into Public Blockchain, Consortium Blockchain, and Private Blockchain. This platform uses Consortium Blockchain, a Blockchain that is only open to members of a particular group (all experiment participants).
2. Experiment Principles and Steps

2.1. Overview

This experiment relies on the self-developed FOF fund construction and virtual trading simulation platform based on Blockchain. With the virtual simulation technology of contextualization, gamification, and role-playing, students can participate in investment simulation as virtual fund managers in the platform. Students open the platform software on the computer and act as virtual fund managers to build and invest in portfolio funds. Each manager selects various investment funds in the market to form their FOF portfolio funds. The performance of each fund (FOF) will be recorded in real-time in the Blockchain. During the experiment, the platform will generate the performance ranking of funds and fund managers, forming a competitive environment.

2.2. The Framework of Platform

Figure 2 expound the framework of platform and its major components.
The fund construction and trading platform based on AI and blockchain used in this experiment is mainly composed of data system, model system and basic service components.
The data system consists of a data source and a block chain: the data source can obtain and import all kinds of investment fund data in reality. The block chain is used to record all the transaction data of the platform.
The model system consists of artificial intelligence model base and quantitative investment model base: the artificial intelligence model base contains the trained fund style classification model and fund manager investment portrait model. The quantitative investment model base is some quantitative models for students' reference and direct transfer.
The basic service component includes all the service components that maintain the normal operation of the platform, including network communication components, user management components, data processing components, interface components and so on.
2.3. Specific Operation Steps

1) Students register and log in to the platform, enter the initialization role, and play the role of virtual fund managers.
2) Students can view the existing market data of all kinds of investment funds in the platform for analysis and screening.
3) Each fund manager has the same amount of initial money in the game, which can be used to purchase funds. Based on basic theories and methods of quantitative investment, the allocation of FOF portfolio funds is carried out.
4) The data of all kinds of investment funds and portfolio funds constructed by students will be recorded in the Blockchain in real-time for the fund managers to view and refer to.
5) The platform will generate performance reports and investment style reports of funds and fund managers based on transaction data for fund managers to review.
6) The platform can generate ranking information from all transaction and performance data.
7) Students conduct phased retrospective analysis and performance attribution according to transaction records and rankings.
8) Students adjust investment and fund construction strategies dynamically.
9) Students with spare capacity can develop their own AI model and connect it to the platform using the interface provided by the platform.

Figure 2. Platform Framework.
3. Evaluation Method
The data of the platform are stored in the way of block chain to ensure that students' transaction data are stored in an open, transparent, untampered and traceable way. Through the acquisition of the record of students' rate of return, each student's rate of return on investment and its changes are clearly presented, which can be directly used as an objective and powerful criterion to evaluate students' investment ability.

4. Expected Outcomes of Experiment

4.1. Consolidating Investment Knowledge by Putting Theory into Practice
In the previous teaching methods, students only pay attention to textbook theory knowledge and ignore its practical value. Students have no chance to in-depth understand how to solve the problems encountered in actual securities investments by deploying this knowledge. So, students will forget the knowledge soon once finishing final tasks.
However, by introducing this experiment to students, they can have opportunities to experience the whole process of investment strategy making and execution. During process of investment, students have to deploy their knowledge learned at courses in order to make an optimal strategy and change dynamically. Their understanding to investment theories will strengthen with frequent use. Therefore, it is likely for students to keep knowledge in mind for a long period of time after final examines.

4.2. Experience the Real Life of Fund Managers
The experiment creates a virtual environment for students to experience the real life of fund managers. The market changes all the time, so students have to stay tight to the variation of market and change their strategy accordingly in order to make greater profit, otherwise they will be abandoned by their customers and lose their jobs. So such experiment not only helps students to consolidate knowledge but also cultivates their sensibility to markets, which is indispensable for their future career.

4.3. Learning the Basic Principles of Blockchain and Its Application
Blockchain technology is famous for its use in cryptocurrency, but as an advanced storage technology, it can do more than Bitcoins. Students can learn Blockchain’s decentralized, tamper-proof, traceable characteristics and the mechanism beneath them, which enable them to be versatile and competitive managers in the future career. Besides, we hope such attempt to use Blockchain as storage method can broaden the application of Blockchain and has a positive impact on the future application of new technologies in the financial industry.

5. Continuous Construction Plan of National Virtual Simulation Experimental Teaching Project

5.1. Continuous Construction and Service Plan of the Project
The second phase of the construction plan mainly includes two aspects. Firstly, it is to improve the editability of the virtual simulation platform, continue to improve the platform interface, support students to access more flexible quantitative investment strategies, and also provide teaching channels for zero-basic students to gradually learn programming to build more complex quantitative models. The other is to increase the number of financial products supported by the platform to provide the necessary targets for the construction of a more complex portfolio.

5.2. Teaching Promotion and Application Plan for Colleges and Universities
On the basis of the existing network teaching platform, we will establish a unified virtual simulation experiment teaching platform, improve the network construction, and expand the opening for financial universities, financial science and technology or quantitative investment and training institutions in Guangdong Province, as well as national financial colleges and universities.
The teaching promotion plan is as follows: the experimental team will further integrate the development achievements of portfolio fund construction and investment, blockchain, big data, artificial intelligence and other disciplines, as well as the quantitative multi-factor model of quantitative investment academic
literature and financial institution research reports. According to the construction progress of the project, all experimental projects will be gradually opened to domestic colleges and universities free of charge.

5.3. The Promotion and Application Plan for the Society
On the basis of teaching promotion and application for colleges and universities, we will further cooperate with financial industry associations and financial institutions, absorb the latest technological innovation achievements of the financial industry, and achieve a larger scope and higher level of experimental project sharing. We will jointly develop virtual simulation projects of new technologies, new models, new strategies and new algorithms in Finance science and technology and quantitative investment, so as to realize in-depth cooperation in personnel training and enterprise technology research and development.

6. Conclusion
Given that previous courses’ teaching methods have some deficiencies, we firmly believe this tentative idea of virtual simulation experiment can ameliorate those problems and ignite finance major student’s enthusiasm to fund investment. Through this experiment, students will have a further understanding of potential FOF fund and consolidate their investment knowledge by practicing. The use of Blockchain technology as a reliable storage method to save transaction data in the platform is an attempt to broaden its original use of cryptocurrency and act as an instructor to introduce Blockchain’s basic mechanisms and applications to students. Therefore, we believe this tentative idea of virtual simulation experiment can facilitate students’ study and broaden their horizons.

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