Research on Curriculum Reform and Laboratory Construction through Academia-industry Integration in Quantitative Investment

Shuo Wen (Alex)
Saxo Fintech Business School, University of Sanya, Sanya, Hainan, China.

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Corresponding author: Shuo Wen (Alex), Saxo Fintech Business School, University of Sanya, Sanya, Hainan, China.

Abstract
The “Academia-industry Integration” is the key to solve the problem that the theory and teaching method are detached from practice in industry in higher education institutions. Therefore, discussing and exploring the curriculum reform through academia-industry integration as well as the research on the related laboratory construction is a very important and meaningful thing. This article takes the field of quantitative investment as a case study and conducts a deep analysis of the curriculum reform system and laboratory construction in terms of four steps: Firstly, the article introduces the background of the academia-industry integration in higher education institutions; then we discuss the method of curriculum reform analysis in terms of necessity and feasibility of curriculum reform as well as the laboratory construction and analyze their feasibility level comparing with other existing cases; then we logically sort out the framework of the construction of quantitative investment laboratories; finally, we analyze the benefits of curriculum reform and laboratory construction and clarifies their importance for the future construction and development of higher education institutions.

Keywords
Academia-industry integration, method of curriculum reform analysis, the framework of laboratory construction, benefit analysis

1. Introduction
1.1 Macro-background analysis
The financial industry is a hallmark industry that has arisen in the context of modern society and global economic integration. With the deepening of the development of economic globalization and financial integration as well as the informationization in financial industry, the solution of major socio-economic issues, especially in terms of financial problems, needs more knowledge and skills in a wider range of fields, which leading to higher demands for the knowledge structure and capabilities of financial management talents (Qiao Xingwang, 2007). Hence, higher education in finance must adapt to the current trend of development in the internet, big data, and fin-tech and respond to the new trend of economic and financial development by committing itself to training senior application-oriented, composite, and innovative talents in financial industry. Meanwhile, the exploration of training senior application-oriented, composite, and innovative talents in finance is also the in-depth implementation of the requirements of the “National Mid and Long-Term Education Reform and Development Plan (2010-2020)” and the “National Mid and Long-Term Talent Development Plan (2010-2020)” for higher education in China.
Applied colleges and universities are important places for training senior skilled professional talents as well as the applied studies. Practical training bases are also one of the important links in the training of applied undergraduate students in universities, and an important way to implement the principle of linking theory with practice, cultivate students' ability to analyze and solve problems, improve their social awareness and practical skills, and generate more employment opportunities. With the deepening of vocational education, the environment of laboratories has been greatly improved, but due to source limitations, some laboratories also have drawbacks such as unreasonable structures and resource waste. Therefore, improving laboratory construction and upgrading on the basis of existing laboratories, making full use of existing hardware sources and adding software systems, making laboratories more professional and closer to the operation of the institution in financial industry, has become an urgent need (Zhang Youxin, 2009).

1.2 The current situation of the demand for Fin-tech talent

In August 2019, “Zhongguancun Internet Finance Research Institute” and “Zhongguancun Financial Technology Industry Development Alliance” led a visit to financial technology companies, investigating the companies from several dimensions including talent supply and demand, the professional ability requirements of talent, and the confusion of companies in hiring. Through the survey, it was found that the top ten in-demand positions (as shown in Figure 1) in the financial technology industry over the past three years are software engineers, product managers, operation managers, WEB front-end development engineers, architects, algorithm engineers, mobile development engineers, testing engineers, data analysts, and machine learning engineers. These positions are essential for maintaining rapid development in the current financial technology industry, especially in the field of quantitative investment. The importance of data analysis talent is increasing with the increasing application of big-data analysis in the internet industry.

![Figure 1. Job description in Fin-tech field.](image-url)

The Research Institute of Lagou Data released the "2021 Financial Technology Industry Talent Trend Report", which is based on the recruitment data of over 1.22 million Internet enterprises and 33 million job-seeking behaviors of Internet job seekers collected by Lagou. The report analyzes the development trend, supply and demand, and current situation of financial technology industry talent. The report shows that in the first half of 2021, the overall job demand in Lagou's finance industry increased by 43%, ranking among the top 10 growth industries. The demand for technical and R&D talent in traditional financial enterprises has increased significantly, gradually transitioning to financial technology. Financial technology industry talent is most scarce in terms of 1-3 years working experience; companies open recruitment positions for talent demand concentrated in 1-5 years of experience, which accounting for over 70%. In terms of salary, the overall level of the financial technology enterprises is higher than traditional financial enterprises. The inflow of technical talent into the financial field is twice the outflow, and Lagou's recruitment covers over 15 million
in-demand financial technology industry talent.

![Figure 2. The distribution chart in Fin-tech industry.](image)

2. Method of curriculum reform analysis

2.1 Necessity analysis

As previously discussed, we can see that professional Fin-tech talents with data processing ability, complex algorithm implementation ability, financial modeling ability and practical thinking of solving financial problems have become the ability of college graduates that institutions are most concerned about. Particularly in the field of quantitative investment, there is a significant shortage of professionals with a combination of finance, data, and programming background to meet the demands of the industry. Moreover, the current university curriculum is heavily theoretical in nature and lacks practical applications (Wang Zhihua, 2009). This is particularly evident in the field of quantitative investment, where many theories are highly abstract and difficult to grasp without practical experience. The absence of practical case studies, text materials, and experimentation platforms also hinders the implementation of such courses. The academia-industry integration through teaching reforms can facilitate the creation of a curriculum that effectively transitions from theory to practice, aligns with the development trends in the domestic finance industry, and provides students with better opportunities for future employment.

2.2 Feasibility analysis

When doing feasibility analysis of curriculum reform and laboratory construction, the best way is to refer to existing market cases and summarize and analyze them. Typical comparative cases of national laboratories are as follows:

1) The complete financial technology laboratory built by the School of Financial Technology at the Shanghai Lixin University of Accounting and Finance contains comprehensive financial technology experiment platforms such as credit risk, international settlement practical platform, financial technology payment practical platform, database management and application systems, quantitative simulation trading training platform, modern financial services simulation training platform, financial management comprehensive training platform, etc. The laboratory construction has outstanding results in talent training, covering 95% of the training courses for the financial technology major, and is in line with the development needs of the modern financial services industry, capable of training interdisciplinary, highly qualified applied talents who meet the requirements of financial technology-related positions in the internet environment.

2) The Financial Technology Laboratory co-established by Shenzhen University's School of Financial Technology and WeBank was put into use for teaching and research in October 2020. It is one of the concrete measures taken by WeBank and Shenzhen University to jointly establish the School of Financial Technology and to build a financial technology discipline. The laboratory fully integrates WeBank's innovative advantage in financial technology,
Shenzhen University’s research advantage as a high-level comprehensive university, and the experiences of the academic and industrial communities. By closely tracking the development and application of cutting-edge technologies in the field of financial technology, the laboratory aims to accelerate the commercialization and industrialization of related technologies, and to build a deep cooperation model that links industry with profession, integrates teaching and research, and combines theory with practice. Based on the accumulated experience of WeBank's financial services, the laboratory focuses on exploring frontier technologies, jointly cultivating high-end, international financial technology talent, and promoting the rapid development of the financial industry in the Guangdong-Hong Kong-Macao region.

As demonstrated by the two cases mentioned above, the teaching method of academia-industry integration is highly suitable for the field of quantitative investment, which emphasizes practicality. Although the construction methods of the laboratories may differ in specifics, the essence remains the same, which is indeed the academia-industry integration, avoiding purely theoretical paths, and leveraging the power of the industrial sector to assist the school in carrying out profound reforms of traditional courses, keeping up with the development demands of the industry and fostering talent with practicality that can truly meet the needs of enterprises.

3. Framework of laboratory construction in quantitative investment

3.1 Construction objectives

The construction of the Quantitative Investment Laboratory aligns with the requirements of fostering financial technology professionals and plays a crucial role in talent cultivation, academic development, scientific research, and social service. The completion of the laboratory will realize the fundamental position of integrating teaching, research, and service. It will form a compound talent cultivation model that integrates innovative ability, professional technology, and occupational literacy. The data platform and technology platform can serve various universities under the Geely Education Group, promoting the integration of production and education and co-cultivating talents. This laboratory can also serve as a center for exchange in the school's financial technology industry cooperation and talent cultivation, and can be further opened to external enterprises for training and practical communication, serving the transformation of Hainan Free Trade Zone's digital economy and radiating its demonstration effect throughout the province.

3.2 Construction ideas

According to the guidelines of the outline, the laboratory in the construction process should abide by the principle of "academia-industry integration and cooperative education" and combine the resources from educational institution, research and industry, which continuously enhance practical teaching method of financial and technological talent training, and actively cultivate high-quality financial talents who are composite and practical (Wan Xi, 2006). In terms of course selection, the practical teaching content of quantitative investment should be increased, and virtual teaching experimental content should be built to improve the applied capacity under industry scenario, and train students' practical skills by increasing the experiences under actual financial scenarios. For example, for traditional abstract and theoretical knowledge, through quantitative practice and case studies, students can access the entire quantitative investment operation process, and collect and analyze data under various quantitative projects, verifying the application of financial models and financial investment theories in real scenario through data analysis.

Establishing a virtualization-style “Academia-industry Integration” platform is a necessary requirement for enhancing technical skills accumulation in the field of quantitative investment, which is an inevitable path for the academia-industry integration, and a development trend of advanced educational models both in domestic and international education institution. Through the virtualization-style “Academia-industry Integration” platform, the talent training level can be further improved, technical skills accumulation and social services capacity can be promoted.

3.3 Construction framework:

1) The framework of course module construction:

The framework of course module construction has two main features: modularization and online-based education. Firstly, online-based education is a growing trend in the future of education method, and this trend has been accelerated by the current COVID-19 pandemic. The traditional mode of teaching, where students and teachers are crowded in a classroom with the teachers' lecturing and students' listening, has become outdated. With the advancement of internet technology and information technology, the online content of educational resources has become increasingly popular. Students are not only able to view online content repeatedly, but also freely initiate online discussions without geographical or weather restrictions. When pursuing deeper learning and research, students can access a vast array of online
resources beyond the confines of their schools, greatly enriching the teaching content and practical experience. Modularization, on the other hand, is a commonly adopted training method by leading financial institutions abroad, and therefore can serve as a good reference model, especially in fields with high practical requirements, such as quantitative investment, which requires fast knowledge updates and iterations. Modularization is more efficient, convenient, and up-to-date compared to traditional teaching methods.

More precisely, the course modules in quantitative investment could be divided into following sections:

<table>
<thead>
<tr>
<th>Course Category</th>
<th>Module Name</th>
</tr>
</thead>
<tbody>
<tr>
<td>Basic Module</td>
<td>Basic concepts of quantitative investment and data pre-processing (big data analysis)</td>
</tr>
<tr>
<td>Core Modules</td>
<td>Quantitative financial practice (CTA strategy)</td>
</tr>
<tr>
<td></td>
<td>Quantitative multifactor strategy</td>
</tr>
<tr>
<td>Hands-on Modules</td>
<td>Basic Concepts in Artificial Intelligence</td>
</tr>
<tr>
<td></td>
<td>Artificial intelligence analysis in practice</td>
</tr>
</tbody>
</table>

Each module establishes an online Q&A team based on class units, incorporating three to five industry mentors in order to build a composite knowledge team comprised of university professors and industry mentors, which providing up-to-date online support. During cooperation with the industry, each module is required to meet the requirement of real-time updates and the content will be evaluated annually, keeping pace with industry developments and ensuring that the teaching content remains in line with practical application.

2) Construction of Quantitative Trading Practicum System:

Since quantitative investment is a very practical course, building a real-time trading practicum system is of utmost importance. Given the current mainstream environment of programming development, the practicum system should provide Python or Matlab interfaces for developers to construct quantitative trading strategies and perform real-time backtesting. The overall framework of the practicum system is as follows:

![Figure 3. The framework in practicum system.]

The system consists of five components: data, analysis, trading, strategy research, and toolbox interface support. The system enables students to conduct strategy research and development, data modeling, trading model design, performance backtesting, simulation validation, and tracking analysis through Python or Matlab interfaces in a simulated real-world environment, thus truly achieving the goal of combining teaching and practice.
4. Benefit analysis of curriculum reform and laboratory construction

4.1 Systematic multidimensional perspective

From the perspective of talent cultivation, the laboratory provides support for the practical training of professionals with a background in "Finance + Data + Programming" composite (Huang Rui, 2011). From the teaching perspective, the laboratory provides advanced and up-to-date data sources and teaching platform to meet the practical training requirement based on quantitative investment application scenarios, which will present more accurate and concrete results of course construction and teaching reform, helping teachers better achieve teaching goals. From the course system perspective, the online modular structure serves as a foundation for the transition from theory to practice in the course system. From the professional achievement display perspective, the platform provides a display window for professional teaching abilities, gathering teaching outputs and showcasing the practical teaching outcome. From the student competition perspective, the platform provides strong support for students to participate in domestic and foreign quantitative practices, financial modeling, financial data mining, wealth management, and other competitions. From the research perspective, the platform provides support for teachers to verify theoretical research projects with practical evidence, enhancing the diversity of scientific research results, enhancing school-enterprise cooperation, establishing the transfer of practical talents and research results from universities to enterprises, and realizing the "last mile from university to enterprise".

4.2 Sustainability perspective

In terms of the short-term development, the construction of teaching experiment platform should be aimed at cultivating students with high-quality quantitative investment practical capacity, making it a crucial venue and carrier for conducting experiments and practical teaching activities in finance-related majors (Yang Lin, 2006). The immediate objective of the project is to establish an advanced, feasible, and practically significant network environment, providing teachers and students with a comprehensive professional quantitative practical teaching center, enabling them to understand and master the connotations and practical applications of the discipline in a comprehensive and in-depth manner. By conducting case training, students’ understanding of financial knowledge will be strengthened, and their practical operational ability will be trained, providing students in quantitative investment-related majors with a theoretical and practical internship environment.

In the mid-term perspective, the university should consolidate and precipitate teaching content and results based on the laboratory platform, forming a shared platform for quantitative teaching resources. Teachers can use the laboratory platform to complete practical teaching content, especially practical teaching cases related to quantitative investment, and research resources produced by the laboratory platform, which will be displayed uniformly through the laboratory-linked internet website. The laboratory construction will not only form a demonstration base but also have a demonstration effect on professional construction in terms of teaching strength and results presentation.

Finally, in the long-term, the platform construction after the curriculum reform can become a starting point for school-enterprise cooperation, serving as a base for cultivating finance-related professional talents in enterprises, thereby promoting the rapid development of the entire financial technology major in terms of discipline construction. In scientific research, the platform can attract government and corporate participation in research projects, and in international academic exchange, it can attract well-known domestic and foreign universities, industry organizations, and centers to establish cooperation relationships.

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