



Research on the Practical Teaching of Financial Mathematics Based on the Achievement-Oriented Education

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Abstract: Practical teaching has been paid more and more attention in the process of cultivating applied undergraduate talents, but practical teaching is still an auxiliary teaching method of theoretical teaching in practical teaching. At the same time, the traditional practical teaching system lacks integrity, coherence, coordination and systematisms, and it is difficult to improve the comprehensive skills of students' employment. Therefore, it is necessary to effectively design the practical curriculum system and practical teaching level. Based on the results-oriented education (OBE), this paper follows the principle of reverse design. The practical teaching of financial mathematics includes professional skills and professional comprehensive quality. The practical teaching system of financial mathematics is divided into four ability modules according to the ability level and structure: financial perception ability, financial data ability, financial modeling ability and financial innovation ability. According to the above ability requirements, the support matrix table of the practical ability training system of financial mathematics specialty and the progressive practical teaching system of professional ability are constructed, and the corresponding ability training has the corresponding curriculum group, which can ensure the realization of the goal achievement. It provides a new idea for the teaching reform of financial mathematics practice course, and provides a scientific basis for the improvement of teaching system and evaluation mechanism.

Keywords: Financial Technology, Practice Teaching, Financial Mathematics, Outcome-Based Education, Support Matrix Table

1. Introduction

With the accelerating development of financial technology, the mismatch between the demand for financial talents and the supply of financial talents in colleges and universities is becoming more and more serious. The structural contradiction between supply and demand of financial talents is the main factor restricting the development of financial majors in colleges and universities. At the same time, with the increasing complexity of the international and domestic economic operation, the demand for risk prevention and financial innovation talents is also increasing. It is the main task of colleges and universities to train financial talents in line with financial operation. [1]. Establishing an effective practical teaching system for financial mathematics majors in a timely manner to improve students' practical ability is conducive to promoting the seamless connection between teaching and

employment, improving the efficiency of talent training, and promoting the supply-side structural reform of financial talents. In the process of training applied undergraduate talents, more and more attention has been paid to practical teaching. However, practical teaching is still an auxiliary teaching method of theoretical teaching in practical teaching. The design of practical teaching links is unreasonable and the evaluation of the achievement of teaching objectives lacks effectiveness. It is inevitable that students' application of theoretical knowledge and practical ability are weak, and the quality of talent training is difficult to meet the requirements of employers. In order to fundamentally change this situation, it is necessary to set standards for practical teaching as an independent part, strengthen process management, effectively evaluate and assess practical teaching, establish an effective quality assurance system, and expand the depth and breadth of practical teaching.

Outcome Based Education (OBE) is a learning outcome-oriented education concept. The final learning outcome obtained by students through the education process is the goal of teaching design and implementation. Learning outcomes are essentially a kind of ability structure, which is realized through curriculum teaching. Outcome-based education clearly stipulates the ability structure that students should have after graduation, and then designs the curriculum system and implements teaching activities accordingly. The setting of teaching objectives needs to promote the sustainable development of students. Under the background of the rapid development of financial technology, the cultivation of applied undergraduate talents should not only cultivate high-skilled talents, but also cultivate new people with strong adaptability, innovative spirit and sustainable development, so as to meet the requirements of the current rapidly changing environment. On the one hand, the training target system of applied talents should be in line with the society and promote the sustainable development of students. We should fully consider the current needs of employers, have the ability to predict industrial upgrading and career changes, and ensure that the ability structure of students when they graduate keeps pace with the times. On the other hand, the practical teaching system should be coupled with the law of modern talent growth. Contemporary college students grow up in the era of information explosion and rapid change. They should take the cultivation of students' professional ability as the starting point, design progressive and sustainable curriculum system and teaching objectives, and cultivate students' professional adaptability and professional migration ability.

The financial mathematics major aims to provide professionals with financial quantitative analysis capabilities for the financial industry. It focuses on the application of applied mathematics and statistics in the financial system, and will provide urgently needed financial talents for the rapid development of the financial industry. Its core content is to study the optimal portfolio selection theory and capital asset pricing theory under uncertain random environment. This emerging interdisciplinary subject is closely related to China's financial reform and development. Its development prospects in China are unlimited. It is one of the most active frontier disciplines at present, but the practical teaching research of financial mathematics is relatively scarce. Based on the results-based education (OBE) and the principle of reverse design, this paper constructs the practical ability training system of financial mathematics and the progressive practical teaching system of professional ability. It provides a new idea for the continuous reform of financial mathematics practice course, and provides a scientific basis for the continuous improvement of teaching system and evaluation mechanism.

The contribution of this paper is reflected in the following three aspects.

1. Innovatively put forward the financial mathematics progressive vocational ability: financial perception ability → financial information acquisition ability → financial modeling analysis ability → financial application ability.

2. The support matrix table of ability training system is established, and the support relationship between curriculum and training ability is refined.
3. The professional ability progressive practical teaching system of 'hierarchical teaching object and progressive teaching system' is constructed, which enriches the teaching cases.

2. Results-Oriented Education and Related Research

Outcome-based education advocates continuous improvement, relies on the design and effective implementation of precise teaching objectives to achieve learning outcomes, and helps each student achieve success. OBE determines the goal of talent training according to social needs, reverses the design based on the knowledge (ability) structure, and then determines the graduation requirements of students and constructs the corresponding curriculum system, so that the curriculum system supports the knowledge structure, the knowledge (ability) structure echoes the curriculum learning, and finally enables students to achieve the peak results. Outcome-based education focuses on students' clear learning objectives at the beginning of learning, clear learning requirements to be achieved, and requires teachers to be clear about how to guide students to complete learning tasks. It focuses on what students learn, not what teachers teach.

Outcome-based education was first proposed by American scholar Spady in 1981 and has been widely valued and applied at an alarming rate. In the United States, improving student learning outcomes has received increasing attention from policymakers, and results-based funding has become a policy priority. According to article [2], as of 2018, there were 25 states in the United States that implemented the results-based funding model. The paper shows that the outcome-based education model has a positive impact on the completion of the bachelor's degree, and has a positive impact on the smooth graduation of students and the development of the major itself [3]. Spady systematically elaborated on results-oriented education in articles [4-7]. B. Mala believed that the origin of OBE is closely related to Taylor's movement and Bloom's mastery learning theory [8]. Chandrama Acharya pointed out that there are four steps to implement the OBE education model: definition, implementation, evaluation and use of learning outcomes [9]. Kennedy et al. studied and analyzed the implementation of outcome-based education in Hong Kong, China, and concluded that practice, policy, and theory jointly affect the implementation of outcome-based education [10].

Since 2003, China has been studying results-oriented education. Jiang Bo (2003) first constructed the system of "results-based education" [11]. In the following years, there was very little research literature related to outcome-based education. Compared with Hong Kong and Taiwan, the research on outcome-based education in mainland China is relatively late. It was not until 2012 that outcome-based

education began to really enter the mainland, and the research was mostly limited to the cognition of simple curriculum reform and ideas. Paper [12-14] introduced and discussed the engineering education model of (OBE), and tried to apply it to the practice of teaching reform. Paper [15] expounds the significance and connotation of achievement orientation in financial mathematics specialty from the perspective of application-oriented talent training, and discusses the methods and ways of achievement-oriented talent training. This is one of the few papers to discuss financial mathematics education based on achievement orientation.

Focusing on the research on the achievement of talent training objectives, the paper [16, 17] put forward the evaluation method of the achievement of curriculum teaching objectives based on process, and put forward the continuous improvement of teaching quality improvement mechanism through the evaluation of the achievement of talent training objectives. The paper [18] believes that to build a curriculum system that reflects the concept of results-oriented education, it is necessary to use the correlation matrix to establish a curriculum system that supports the achievement of graduation ability. The above research is mainly studied in theory, without case analysis, and the value of operational reference is not great.

Generally speaking, foreign results-oriented education started earlier, with higher acceptance and relatively mature. Although it started late in China, it has developed rapidly in recent years. However, it is mostly limited to the cognition of simple curriculum reform and concept, and the research on the application of results-oriented education in financial mathematics is relatively lacking. Practical application is the starting point and

ultimate destination of practical courses. Therefore, practical teaching should focus on application and reasonably choose teaching content to cultivate students' application ability.

3. Financial Mathematics Professional Practice Ability Training System and Support Matrix Table

Financial mathematics is a frontier subject in the intersection of mathematics and finance. It is an applied subject that uses mathematical tools to study financial problems, through theoretical modeling, numerical calculation and other analysis, in order to find the inherent laws of finance and guide practice [19]. This part first discusses the core curriculum and practical teaching of financial mathematics, and then discusses the support matrix and practical teaching system of practical ability training system. Finally, the optimization and effectiveness of practical teaching are discussed.

3.1. Tamping Foundation Strengthening Practice

The talents trained in financial mathematics should have solid theoretical knowledge of mathematics and finance; have the ability to obtain information and analyze and process data; have the ability of mathematical modeling and using software to explain financial problems. This makes the comprehensive practical teaching become one of the core tasks of the professional curriculum in the students of financial mathematics.

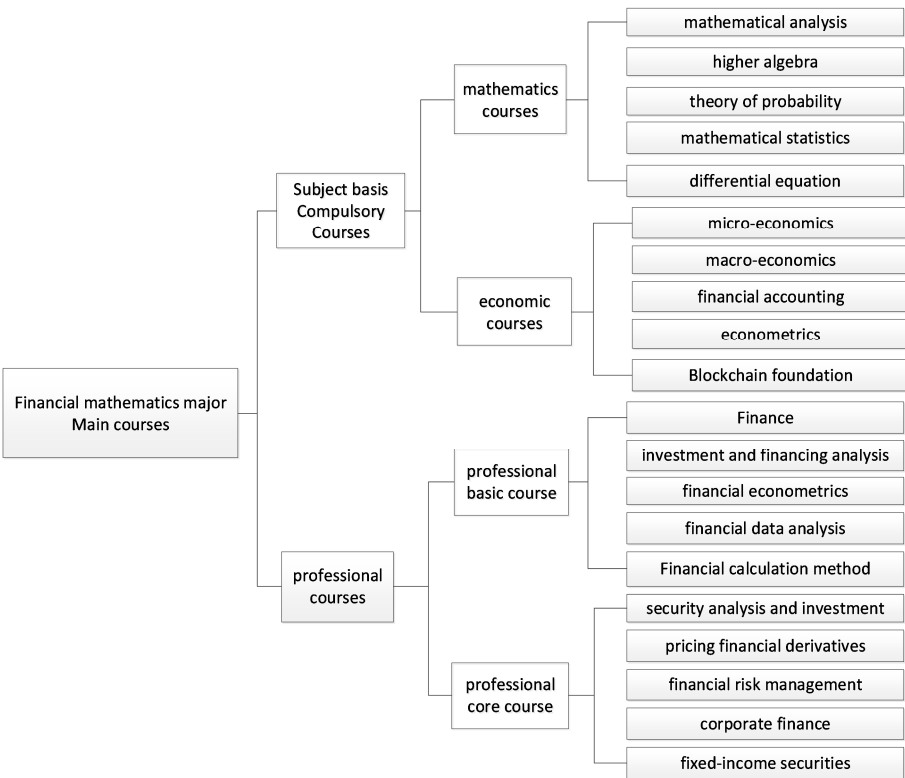


Figure 1. Core course of financial mathematics.

The main courses of this major are divided into two levels: subject basic compulsory courses and professional compulsory courses. The subject basic compulsory courses include two major courses: mathematics and economics. The professional compulsory courses are financial courses, including professional basic courses and professional compulsory courses, forming the '245' core curriculum model. The specific core courses are shown in Figure 1.

For students majoring in financial mathematics, first of all, they should have solid mathematical theoretical knowledge and basic knowledge of economic theory, and their training is reflected in the mathematics courses and economic courses in the compulsory courses of the subject; secondly, it should have solid financial theoretical knowledge, which is reflected in the professional basic courses and professional compulsory courses in the professional compulsory courses; finally, it should have the ability to combine theory with

practice. Many financial problems are solved based on the corresponding theoretical model and data processing, not only to be able to use mathematical software, but also to use data analysis software, financial analysis software, etc., which is more demanding than mathematics students. This makes practical teaching become one of the core tasks of financial mathematics teaching.

The practical teaching link includes professional skills and professional comprehensive quality. According to the ability structure, professional skills are subdivided into financial modeling ability, financial data ability (financial data acquisition, processing and analysis ability) and financial practice ability. Professional comprehensive quality is subdivided into application ability, thinking ability and comprehensive ability, and there are corresponding courses corresponding to it, so as to ensure the realization of the goal achievement, which can be seen in Figure 2.

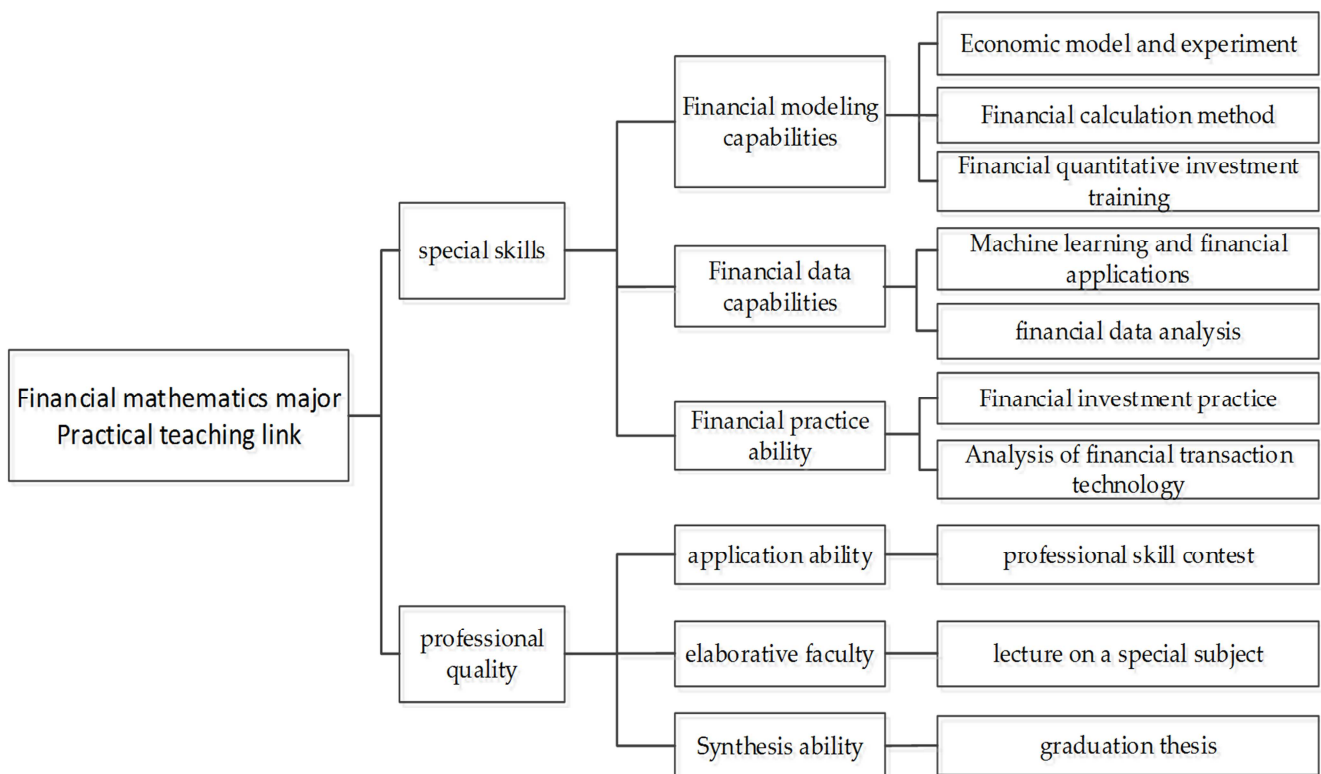


Figure 2. Practical teaching link.

In order to achieve better results, it is necessary to clearly refine the curriculum objectives, implement the curriculum teaching tasks, design reasonable assessment methods, and clarify the evaluation criteria. In the process of teaching, the starting point and destination of teaching activities are teaching objectives, which play a leading role. Teaching programs and teaching evaluation should be designed according to teaching objectives. The realization degree of teaching objectives is one of the important references to measure the teaching effect, and the achievement degree of teaching objectives is determined by the implementation degree of teaching objectives in teaching design.

3.2. Support Matrix Table and Practice Teaching System

Based on the evaluation method of the achievement degree of the course teaching goal based on the process, this paper constructs the support matrix table of the practical ability training system of financial mathematics (see Table 1). The practical teaching system is divided into four ability modules according to the ability level and structure: financial perception ability, financial data ability, financial modeling ability and financial innovation ability. Each ability is supported by specific practical activities, and the support intensity of each practical activity to different abilities is

different. At the same time, the cultivation of each ability needs different practical activities to strengthen, so that the final ability can meet the requirements of employability. In the specific teaching practice, the practice course is arranged in the first semester of the first grade, and the practice teaching of the professional course is carried out in the next semester of the first grade. For example, the cognitive practice of financial mathematics in the first semester of grade 1, the practical training of financial investment in the second semester of grade 1, the mathematical experimental training in the first semester of grade 2, and the quantitative investment strategy training in the second semester of grade 2. Grade 3 is professional practice, and grade 4 is graduation thesis writing. In addition, special lectures and professional skills competitions are held, and practical courses such as economic model and experiment, financial calculation method, machine learning and financial application, financial transaction technology analysis, financial data analysis, web crawler and data collection are offered. Then form a progressive, spiral rising and sustainable development training system from freshman to senior.

The traditional practical teaching system lacks integrity, coherence, coordination and systematisms, and it is difficult to improve the comprehensive skills and sustainable development ability of students' employment. Therefore, it is necessary to effectively design the practical curriculum system and practical teaching level. The training requirements of financial mathematics students' ability from low to high are: financial perception ability → financial information acquisition ability → financial modeling analysis ability → financial application ability. Combined with the practical teaching links and the ability training system support matrix table, the progressive practical teaching system of ability is constructed. In different grades of students to carry out different levels of practical teaching content, according to the students' knowledge to arrange lectures and choose the level of professional skills competition, deepen step by step, gradually progressive, to achieve 'hierarchical teaching object, progressive teaching system' professional ability progressive practice teaching system (Figure 3).

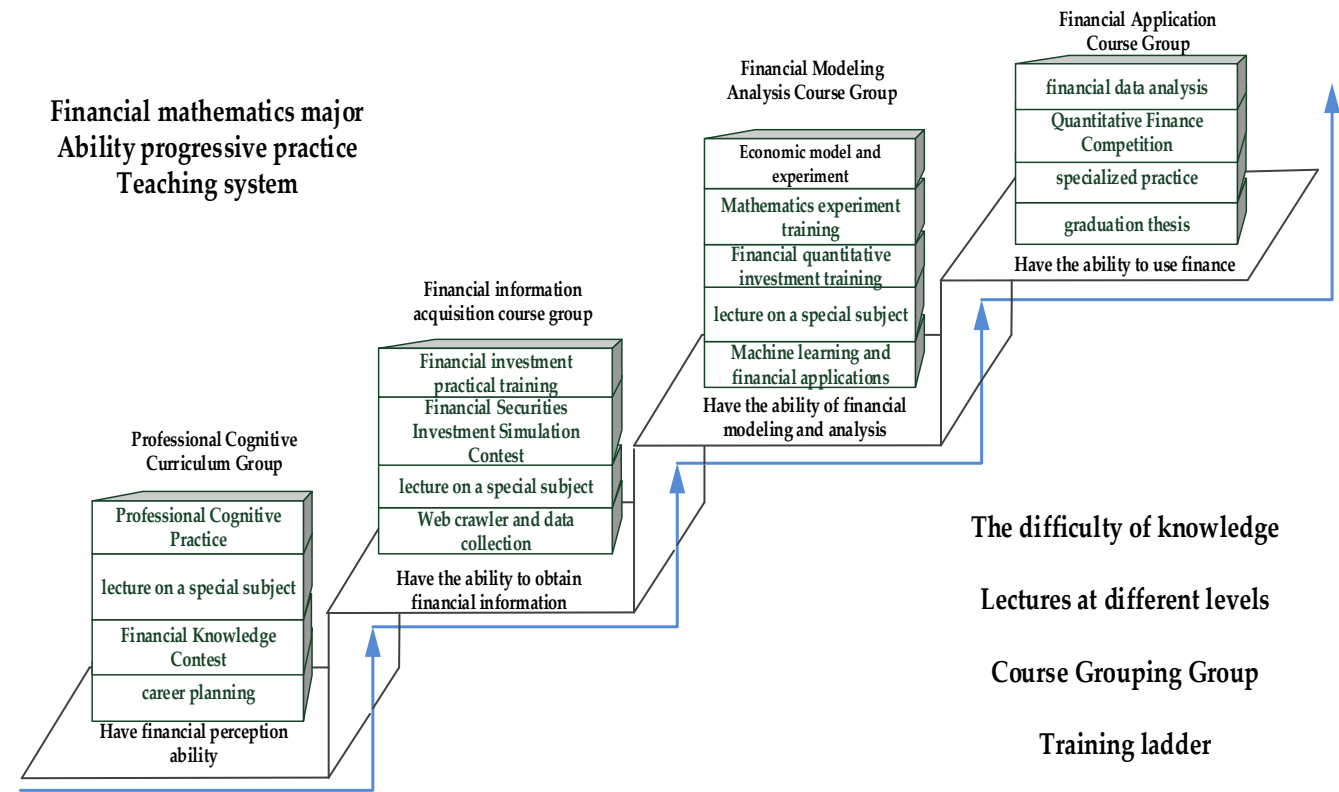


Figure 3. Practice teaching system.

Students majoring in financial mathematics should have keen financial cognition and financial perception. People with keen financial perception are more responsive to the financial information given by the outside world than ordinary people. Like all abilities, it is also necessary to cultivate and improve through learning. The professional cognitive course group cultivates students' financial perception ability through professional cognitive practice, financial mathematics professional development prospects

and career planning lectures, financial knowledge competitions, etc.

The ability to obtain information is a new requirement for the quality of talents in the information age, and it is also the primary ability of financial disciplines. Only a comprehensive understanding of financial information, it is possible to profit in investment. Therefore, the ability to obtain financial information is very important in investment. The financial information acquisition course group cultivates

financial information acquisition ability through financial investment practice, financial securities investment simulation competition, web crawler and data collection, and research seminars.

Financial modeling refers to the process of constructing financial models on computers to complete financial calculations, so as to evaluate future events or make decisions. It is an important part of asset pricing. In the data age, financial modeling has increasingly become an important consideration for top investment banks and financial institutions in recruiting talents. The financial modeling and analysis course group cultivates financial modeling and analysis capabilities through economic models and experiments, mathematical experiments, quantitative investment strategy training, machine learning and financial applications, and financial model lectures.

Financial application ability refers to the ability to comprehensively use the professional knowledge to solve practical problems, which is the ultimate goal of professional ability training. The financial application course group mainly cultivates students' financial application ability through financial data analysis, quantitative financial competition, professional practice and graduation practice. Financial application ability is a comprehensive embodiment of financial perception ability, financial data ability, financial modeling ability and financial innovation ability. Through practical level teaching, students' ability level is continuously improved, and finally the employment ability requirements are achieved.

3.3. Optimization Strategy to Improve Effectiveness

Implement the combination of school and school, go out, please come in, and establish off-campus practice base and other multi-channel, all-round practical training. In practical teaching activities, professional practical teaching is mainly reflected in practical training courses and practical activities such as "in-class experiment", "in-class computer", "series lectures", "subject competition" and "employment practice." In view of the characteristics of financial mathematics, which focuses on financial investment practice, the "golden bee" campus e-bank jointly built by Tianhua College of Shanghai Normal University and Jiading Branch of China Construction Bank. At the same time, this major has signed internship base agreements with more than ten companies. The 'Golden Bee' campus e bank and practice base ensure the smooth development of the students' probation activities to a certain extent. At the same time, we purchase quantitative investment and strategic trading training platform, carry out relevant quantitative investment training regularly every semester, and send teachers to relevant companies to carry out research projects. Through the co-sponsored 'Science and Technology Empowering Finance, Cross-disciplinary Reconstruction-2021 International Forum on the Cultivation of Interdisciplinary Talents in Colleges and Universities'. It

promotes the improvement of professional connotation, the conciseness of professional direction and the prominence of professional characteristics.

To play the role of the second classroom, improve students' financial literacy. Invite well-known experts, scholars and senior executives of the industry, set up a series of lectures on smart finance, explain the theoretical knowledge of finance, the current situation and prospects of industry development, enrich students' financial knowledge, broaden their horizons and improve their literacy. Through lectures, students are helped to make career planning, understand cutting-edge technology, deepen professional knowledge, and cultivate students' innovative thinking ability.

Practice and training have improved students' comprehensive application ability and achieved remarkable results. It is a good example that students have won 45 provincial and above awards in various disciplines and professional competitions. It won the first prize of the National College Students' Financial Innovation Cloud Competition, the first prize of the National Financial Alliance Innovation and Entrepreneurship Competition, the first prize of the National Financial and Securities Investment Simulation Training Competition, the second prize of the National College Students' Mathematical Modeling, and the third prize of the China (Hengqin) International University Quantitative Finance Competition.

4. Conclusion

In view of the requirements of school positioning and industry development for financial mathematics professionals, it is an essential means to enhance students' practical ability and improve their financial literacy to construct a practical curriculum system suitable for financial mathematics specialty in combination with the professional characteristics of quantitative investment. Based on the reverse design idea of result-oriented education, the support matrix table of practical ability training system of financial mathematics specialty and the progressive practical teaching system of professional ability are constructed, and the corresponding ability training has corresponding curriculum group to ensure the realization of goal achievement. It provides a new idea for the teaching reform of financial mathematics practice course, and provides a scientific basis for the improvement of teaching system and evaluation mechanism.

The next stage of research can be carried out from the design of teaching evaluation to evaluate the scientificity and effectiveness of the practical teaching system. With the rapid development of financial science and technology, the demand for applied and compound talents is imminent. This is not only an opportunity but also a challenge for the training of financial mathematics professionals.

Appendix

Table 1. Support matrix table of ability training system (Some courses).

Practical course	Type	16 competency standards	Professional practical ability development			
			Financial perception ability	Financial data capabilities	Financial modeling capabilities	financial innovation capability
Financial investment practice	concentrative practice	Professional knowledge, practical ability	H	M		L
mathematics experiment	concentrative practice	Professional knowledge, practical ability	L	L	M	
lecture on a special subject	lecture series	Leading edge technology, professional knowledge, innovative thinking	M	L		L
professional skill contest	discipline competition	Professional knowledge, practical ability, interpersonal communication, quality awareness, innovative thinking	H	H		M
Economic model and experiment	Machine in class	Professional knowledge, practical ability	M	M	H	H
Financial calculation method	in-class experiment	Professional knowledge, practical ability	H	L	H	M
lecture on a special subject	lecture series	Leading edge technology, professional knowledge, innovative thinking	H	L	L	M
Quantitative Investment Strategy Training	concentrative practice	Professional knowledge, practical ability	M	H	H	M
Machine learning and financial applications	in-class experiment	Professional knowledge, practical ability	M	H	H	M
financial data analysis	in-class experiment	Professional knowledge, practical ability	H	H	M	M
Analysis of financial transaction	in-class experiment	Professional knowledge, practical ability	H	M	L	L
Professional Internship	employment internship	Interpersonal communication, cultural foundation, practical ability, positive and peaceful mentality, objective and calm judgment, observance of etiquette integrity	M	H	M	H
lecture on a special subject	lecture series	Leading edge technology, professional knowledge, innovative thinking	H	L	M	H
graduation thesis	employment internship	Professional knowledge, practical ability, interpersonal communication, cultural foundation, positive and peaceful mentality, objective and calm judgment, observance of etiquette integrity	H	H	H	H

Note: H represents high support, M represents moderate support, and L represents low support.

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