

# Implementation Path and Practice of the Integration of Courses and Certificates for Computer Science Major in Application-Oriented Undergraduate Colleges under the 1+X Certificate System

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**Abstract.** The construction of computer science and technology majors in Chinese universities is gradually being optimized and improved. This study takes the integration of courses and certificates for computer science major at Guangxi Normal University of Science and Technology as the starting point. Its aim is to explore how to effectively implement the integration of courses and certificates for computer science major under the "1+X" certificate system, in order to achieve a deep alignment of educational resources with industry needs. Furthermore, this article illustrates the implementation approach by taking the example of the Intermediate and Advanced Certificates in Big Data Analysis and Application. Based on the current teaching situation of computer science major, it establishes a relevant practical curriculum system rooted in job positions. By integrating courses with certificates, this article explores the path to implementing the integration of computer science and technology courses and certificates under the "1+X" system. This approach effectively promotes the enhancement of students' practical abilities and the quality of education at application-oriented undergraduate universities.

**Keywords:** 1+X certificate system; Computer science; Integration of courses and certificates; Analytic Hierarchy Process.

## 1 Introduction

In recent years, the scale of college students has been increasing, but the employment situation facing bachelor's degree graduates has become more complex and severe, and higher requirements have been put forward for the abilities of college students in employment. To improve the employment quality of graduates and increase their income levels, it is necessary to match teaching content with new skill requirements<sup>[1]</sup>. For computer related majors, companies and industries have higher requirements for the practical operation ability, innovation ability, and problem-solving ability of computer professionals. When designing talent training programs, schools need to take into account the specific needs of the industry, and organically combine the cultivation of professional knowledge with practical skills to promote the comprehensive development of students. Since 2019, the country has also launched pilot programs for the "1+X" certificate in vocational colleges and applied

undergraduate colleges, in order to improve the quality of college students' training, enhance their compound technical skills, and develop their abilities in employment and entrepreneurship<sup>[2]</sup>. "1" refers to the academic certificate, which is the diploma obtained by learners after completing a certain stage of education tasks in the school or other educational institutions implementing academic education within the school system. "X" refers to several vocational skill level certificates. The 1+X certificate system means that students can obtain multiple vocational skill level certificates while obtaining their academic qualifications.<sup>[3][4]</sup>

As a newly established applied undergraduate college, Guangxi Science & Technology Normal University actively responds to the call of the state and implements the "1+X" certificate system. In the early practical process, the "1+X" certificate system provides good support for cultivating students' professional knowledge and skills. With the help of the "1+X" certificate system, schools can better cultivate students' composite technical skills, improve the quality of graduate training, and promote reforms in talent training programs, classroom teaching content, and other aspects to better adapt to market demand and industry standards. The "1+X" certificate system provides excellent support for cultivating students' professional knowledge and vocational skills. With the help of the "1+X" certificate system, schools can cultivate high-quality composite talents, promote the construction of computer related majors in colleges, and make greater contributions to local advancement and social development. Therefore, the implementation of the "1+X" system in applied undergraduate colleges and universities is of great significance in improving the employment ability and adaptability of college students to their positions.

## **2 The problems discovered in the pilot program of the "1+X" certificate system for computer science majors**

The "1+X" certificate system has been implemented for 4 years in our school, and many problems have been found in the process of practice.

1) In the early stage of the "1+X" certificate system pilot, the administrators, full-time teachers, and students in our school had a unclear understanding of the policies and requirements of the "1+X" certificate system. The first phase of "1+X" certificate training and exams for computer related majors was only began in the first half of 2021. Initially, teachers lacked practical experience in the enterprise, resulting in a certain degree of disconnection between teaching content and actual work requirements. They also lacked sufficient preparation for training and exams, resulting in low student participation and low pass rates in exams. The pilot work did not achieve the expected results.

2) The content of textbooks is fixed and single, and the existing curriculum system, content, and certificate exam content have a low degree of integration. The teaching content does not match the skills required by the "1+X" certificate. In the teaching process, more emphasis is placed on knowledge mastery ability, while the "1+X" certificate requires practical ability and integration with work content, reflecting the technical needs of the enterprise for the job position.

3) There are deficiencies in the practical teaching process. The "1+X" certificate requires students to conduct a large amount of practical exercises outside of class. Without teacher

guidance, students' learning difficulty increases, and their enthusiasm for learning and certification is greatly reduced.

4) The evaluation system for the pilot work assessment is not fully developed. At the beginning of the pilot implementation of the "1+X" certificate system, the college lacked a comprehensive evaluation system, making it difficult to accurately measure the effectiveness of the "1+X" certificate system.

Therefore, through the "1+X" certificate system, we can construct characteristic professional courses, professional expansion courses, and the integration of courses and certificates system, promote the construction of computer related majors, and cultivate high-quality, skilled composite talents to adapt to changes in the structure of computer talent positions, adapting to market demands and industry standards in the new era.

### **3 Ideas and optimization plans for the integration of courses and certificates.**

Taking the construction of the "Integration of Course and Certificates" course system for the majors of Data Science and Big Data Technology as an example, we can explore the construction ideas and optimization plans for the integration of courses and certificates. In-depth research should be conducted on how to organically integrate course content with vocational skill examinations, so that students can pass vocational skill examinations and obtain corresponding professional certificates through course learning, thereby improving their professional competitiveness<sup>[5]</sup>. This is a powerful means to improve the quantity and quality of high-quality talents in computer related majors under the background of the "1+X" certificate system.

#### **3.1 Give full play to the role of dual-certified teachers in the integration of courses and certificates.**

"Dual-certified" teachers also act as a bridge in the integration of courses and certificates. They have professional theoretical knowledge and rich teaching experience, as well as work experience in enterprises and rich engineering practical abilities. Under the "1+X" certificate system, these teachers can effectively combine course content with certificate examination requirements, practical experiential teaching mode<sup>[6]</sup>, guide students on how to apply theoretical knowledge learned to practical operations, increase the probability of students passing the vocational skill level certificate examinations, and achieve the goal of talent cultivation.

#### **3.2 Build the curriculum system and implement the integration of courses and certificates.**

Cultivating computer professionals who are able to adapt to the new situation of the development of the computer industry is the goal of integrating courses and certificates<sup>[7]</sup>. Firstly, in the process of building the curriculum system and implementing the integration of courses and certificates, we should collaborate with the "1+X" certificate training and evaluation organization to conduct research on the needs of computer-related industry enterprises, and understand the main job positions and job competency requirements of the technical and skilled talents required by the enterprises. Secondly, it is necessary to study the

elements and logic of professional ability and quality composition, sort out the corresponding relationship between advanced vocational skill certificate standards and teaching objectives, build structural courses according to typical work areas and tasks, and follow the tacit and gradual laws of technical skilled talents' growth<sup>[8]</sup>.

The effective connection between course content and certificate examination content is the key to implementing the integration of courses and certificates. In order to improve the pass rate of the "1+X" certificate exam and ensure that students can directly receive the certificate exam after completing the course learning, it is necessary to conduct a detailed analysis of the course teaching syllabus and clarify the corresponding relationship between each course and the corresponding certificate examination content. By refining the course content through tasks extracted from practical project work, the goal is to achieve integration of project practice and professional knowledge.

### **3.3 Carry out practical teaching on the "1+X" certificate system.**

Through the development of open experimental projects, organizing students to participate in practical training activities such as actual project development, data analysis, and other practical operations, we can improve their practical operating ability and carry out practical teaching of the "1+X" certificate system. In open experiments, not only do students exercise their hands-on ability, but they also stimulate their creativity. In large-scale comprehensive experiments, students also need to independently design experimental plans to cultivate their innovative thinking and improving their ability to discover and solve problems. Through the new business science open experimental projects, application-oriented colleges enable students to apply theoretical knowledge to practice, and also improve their scientific research and innovation capabilities<sup>[9]</sup>. In open experimental projects, the course content and certificate exam content can be organically integrated with open experiments to ensure laboratory openness and set up open experiments. Through the introduction of open experiments and combining with experimental resources provided by enterprises, it can keep up with the times and cultivate students' ability to solve practical computer professional problems using the knowledge learned in the course. At the same time, teachers can break the thinking stereotype in the teaching process and improve their professional level.

### **3.4 The construction of the pilot index system for the "1+X" certificate system.**

The management of pilot construction requires a scientific index system to guide and evaluate the implementation effect. This index system should include multiple dimensions such as the quality of education and teaching, the level of student skills, the construction of the teaching staff, and the effectiveness of school-enterprise cooperation, in order to comprehensively monitor and guide the implementation of curriculum and certificate integration. The Analytic Hierarchy Process (AHP), as a systematic method for multi-criteria and multi-alternative optimization decision-making, can be applied to the construction of the index system<sup>[10][11]</sup>.

## **4 Case analysis and practical exploration.**

In Guangxi Science & Technology Normal University, the implementation of integrated curriculum and certification may involve the adjustment of curriculum setting, the reform of

teaching methods, the integration of teaching resources and the connection with industry standards. The specific practices can include:

#### **4.1 Establish a "double-qualified" teachers team**

In the process of establishing a "double-qualified" teachers team for computer related majors, one way is to improve "double-qualified" quality of teachers through teacher training. Regular training is conducted every year, and 32 people have obtained the "1+X" teacher training certificate. Second, some senior engineers are hired from enterprises to undertake the professional courses of the college. Currently, there are 18 part-time external teachers employed by the college.

Through the establishment of "double-qualified" teachers team, a bridge can be built between professional courses and vocational skills, allowing "double-qualified" teachers to fully utilize engineering practical experience. By integrating the standards of vocational skill training levels into the teaching objectives, course content, and practical teaching process of the courses, the cultivation of vocational skills can be strengthened in the daily teaching process, and synchronized teaching assessment and vocational skill appraisal can be achieved.

#### **4.2 Integrate the relevant content of "1+X" vocational skills certificate certification into daily teaching.**

In the specific implementation process of course teaching, firstly, after research, it is found that Alibaba's big data technology is already leading the industry in China, with a strong user base and application scenarios. Therefore, the certificate chosen for application is Alibaba's big data analysis and application. Secondly, in response to the common feedback from students that the knowledge they have learned is rarely used in practical applications. We compare and analyze the differences in enterprise needs, certification content, and teaching content. By referencing and integrating the "1+X" vocational skill certificate assessment requirements of Alibaba's big data analysis and application, we determine the content that needs to be added to the talent training program. Finally, in specific course teaching, relevant courses adopt project-based and case-based teaching methods, share enterprise teaching resources, achieve curriculum alignment with big data positions, and improve students' practical abilities. In specific cases, Alibaba Cloud's big data related products are also integrated, and Alibaba Cloud services are used for practical teaching.

Beyond course teaching, in order to cultivate practical skills and promote students to combine theory with practice, multiple open experiments have been set up in combination with the "1+X" certification content and the job requirements of enterprises. The experimental content uses enterprise data and analyzes specific problems in actual work scenarios. So as to enhance students' understanding of job positions and improves their problem-solving abilities.

#### **4.3 Design of open experimental projects related to the "1+X" certificate.**

Taking the open experimental project of the "Big Data Analysis and Application (Advanced)" certificate as an example, the list of experimental projects is shown in Table 1, with a total of seven experimental projects and 28 credit hours. These open experimental projects are declared to the school by the supervising teacher, and after the approval, targeted publicity is conducted to students, so that interested students can actively join in. The implementation of

the project mainly relies on school computer labs and enterprise cloud resources, with teachers providing centralized guidance in the laboratory, and social software for online feedback and answers during the rest of the time.

**Table 1.** List of open experimental projects.

experiment project	Experiment content
E-commerce operation indicator system construction and data analysis practice	This experiment focuses on how to use Alibaba Cloud MaxCompute and DataWorks tools to implement advertising and marketing, and write SQL statements for total visits, order quantity, order conversion rate, return on investment (ROI), active user count, one-day visit conversion success rate, number of gold-level publishing houses, and other indicators, as well as the distribution of each dimension.
Practical analysis of APP operation data	The input data for this experiment is the usage data of an app. It includes detailed records of user installation and usage logs, as well as summary data of user personas. Through analyzing the data of user behavior, we can sort out the core indicators of app operation, help app operators to deeply explore user needs, clearly understand the status of the app industry.
Building enterprise data portal based on Quick BI	This experiment focuses on how to use the reporting tool (QuickBI) to build an enterprise-level reporting portal, and how to use rich charts to design and develop graphical reports for different scenarios and needs.
Building enterprise-level data analysis platform	This experiment focuses on how to use the big data computing service MaxCompute to build an enterprise-level data analysis platform, how to analyze business data, and how to display the analysis results in rich charts.
Price elasticity time series decomposition model for predicting commodity sales	This experiment predicts and analyzes the sales volume of a product from a retailer on the Alibaba Cloud PAI machine learning platform. The model is a linear regression model, which selects the promotion amplitude and promotion methods of the product to regress the actual sales volume;
Customer churn warning analysis	The experiment mainly focuses on feature selection, model training, model evaluation, and model application. Through this experiment, users can understand the basic process and implementation steps of customer churn early warning analysis.
Take-out ordering data analysis	This experiment provides a learning experience in data warehouse design, basic methods of data analysis, and the use of data visualization to present analysis results through the operation of MaxCompute and Quick BI products.

#### 4.4 Evaluation and reflection of the implementation effect

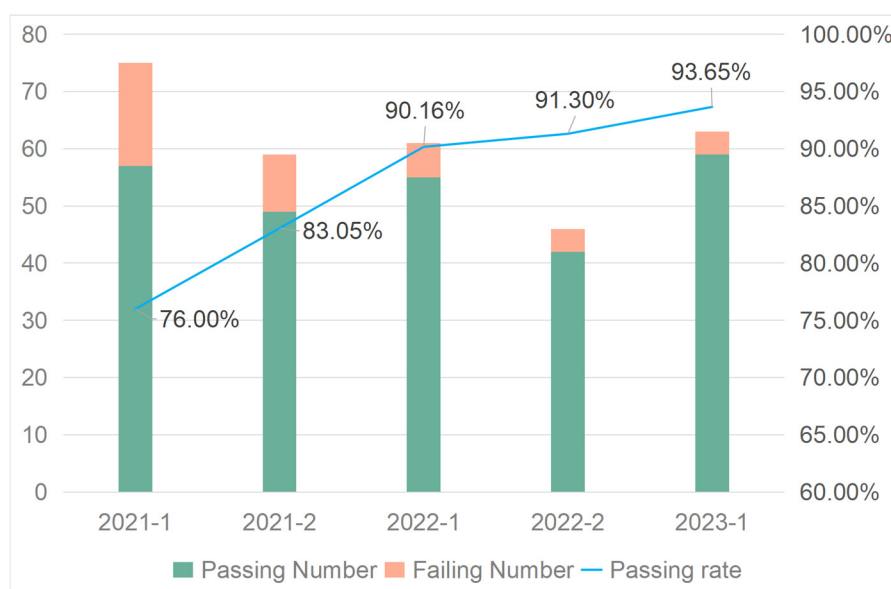
The actual constructed indicator system mainly evaluates the abilities of students, which are mainly divided into two indicators: theoretical knowledge and practical ability. Among them, theoretical knowledge includes exam scores, regular quizzes, and learning completion status, while practical ability includes experimental report scores and experimental completion status. Specific indicator data can be obtained through the Alibaba Cloud School and School Academic Affairs System.

According to the pre-determined indicator system, relevant teachers are organized to fill out a questionnaire survey, using the nine-level rating method, and the following scores and weights are obtained, shown in table 2. The consistency verification is also within the allowable range.

**Table 2** scoresweight

one-levelmetric	weight (%)	Secondary indicators	weight (%)	combination weight (%)
speculative knowledge	57.81	examination performance	58.13	33.6
		Quiz at ordinary times	10.96	6.34
		Study completion	30.91	17.87
ability of practice	42.19	Experimental report scores	35.71	15.07
		Experimental completion	64.29	27.12

Through the student data in Alibaba Cloud Middle School and the school's educational system, the student ability scores can be conveniently calculated using the scoring weights. Teachers can use the scores to understand students' learning status, encourage corresponding students to actively participate in the 1+X certificate exam, and students can also learn about their own shortcomings based on the scores, so that the integration of course certificates can achieve the desired effect. Under the guidance of the evaluation indicators, the pass rate of students who actually participate in certificate exams is constantly improving. Please see the following figure 1 for details.



**Figure. 1.** 1 + X Certificate examination Table.

## 5 Conclusion

The integration of courses and certificates has established a partnership with enterprises to achieve a connection between teaching content and vocational skills, enhancing students' vocational skills and promoting their employment. Additionally, through broader data collection and analysis, the universality and effectiveness of the integrated model are verified. Meanwhile, the reflection section needs to analyze the problems and challenges encountered during the implementation process, such as insufficient resource allocation, insufficient integration between courses and market demand, and propose corresponding improvement suggestions.

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