

# Research on the Teaching Reform of "Java Web Technology" for Engineering Education Certification

Yingying Miao, Yonghui Zi, Xichong Shen

Guangdong University of Science and Technology, Dongguan City, Guangdong Province 523668, China

---

**Abstract:** Due to the traditional teaching mode “classroom-centered, teacher-centered”, in the teaching process of course orientation, students' learning objectives are not clear, and the lack of classic case study teaching and other issues, resulting in the teaching content of the Java Web course lagging behind the development of technology, weak teaching practice, and the actual needs of the enterprise is out of touch with the engineering education to cultivate application-oriented talent needs. It is difficult to meet the demand of engineering education to cultivate application-oriented talents. This paper is oriented to the concept of engineering education, discusses the status quo of teaching reform of Java Web courses, points out the problems of teaching Java Web technology at the present stage, and then gives the reform method of teaching Java Web technology for engineering education certification. Then, it gives the reform methods and suggestions for the teaching of engineering education certification-oriented “Java Web technology” course. Through the teaching effect comparison experiment, it can be seen that the implementation of engineering education certification-oriented “Java Web technology” course effect has a significant improvement over the results of the students who did not implement it, and the number of students who scored more than 80 points is significantly higher than the number of students who did not implement it; Finally, this paper re-emphasizes the significance of the teaching reform of “Java Web Technology” for engineering education certification.

**Keywords:** Engineering Education Certification; Java Web Technology; Teaching Reform.

---

## 1. Introduction

In June 2016, China became the 18th official member of the Washington Agreement. The certification conclusions on the quality of undergraduate talent training in engineering were substantially equivalent to member states, which marked an important step in the internationalization of higher engineering education [1]. The Washington Agreement is the earliest and most parties signed, and it is also the world's most well-known international certification agreement for engineering education[2]. By joining this agreement, it not only reflects my country's emphasis on engineering education, but also marks that the quality of engineering education in our country has also been recognized by people from all walks of life in the world. The international certification agreement for engineering education is not only an important cornerstone for colleges and universities to improve the quality of engineering talent training, but also conducive to enhancing the international competitiveness of engineering education in higher education institutions. In addition, this agreement follows the core concept of what basic scientific and technological literacy and employment skills students should possess after engineering-oriented education training, that is, the focus of certification changes from the assessment of "education input" (what teachers teach) to the assessment of "education output" (what students learn) [3], and adopts ability-oriented certification standards.

This article interprets the teaching certification standards in engineering education certification, which mainly include requirements in practical project courses, teaching methods, teaching environment, learning assessment, etc.; as well as practical certification standards, which mainly include engineering practical experience requirements, safety protection requirements, skill requirements, etc., and uses the core theories and skills emphasized in engineering education certification to guide the teaching reform of the "Java Web

Technology" course. Since the "Java Web Technology" course is a course that closely combines theory and practice, it covers the basic JDBC, JavaBean and Servlet technologies, to framework technologies such as SSH and SSM, to the currently popular Spring MVC and Spring Boot technologies. Although technology continues to evolve, the core basic knowledge of Java Web development is always inseparable from HTML, Servlet, JSP, CSS, JavaScript, Ajax and other content, as well as related courses such as software engineering, databases, and data structures. Therefore, this course has the characteristics of strong comprehensiveness, high theoretical knowledge and practical requirements, and high introductory difficulty. The traditional "one-way indoctrination" teaching model is difficult to achieve ideal teaching results and cannot adapt to the actual needs of the course. Therefore, it is particularly critical to closely combine teaching, learning and practice, explore teaching models suitable for the course, and design corresponding practical links and assessment methods. By introducing engineering education certification, we can optimize the construction of curriculum resources more targetedly, enhance the practicality of the curriculum, promote curriculum reform to better serve professional development, and meet the actual needs of society for talents.

## 2. Current Situation Analysis

The "Java Web Technology" course is a core course compulsory for undergraduate and junior college majors in computer science and technology, software engineering, computer networks, etc. It is a practical course to improve students' software design capabilities and cultivate students' software programming capabilities[4]. Through this course, students will master the installation, configuration and use of development tools such as JDK, Tomcat, MyEclipse or Eclipse, focus on understanding the compilation principles of JSP, Servlet and Filter, and learn how to use the basic

knowledge of JavaBean, EL expressions and JSTL tag libraries in JSP, and master the basic skills of database access. In addition, this course aims to help students develop good programming habits, cultivate teamwork skills, and patriotism and dedication, and lay a solid foundation for subsequent learning of software development-related courses.

However, most of the current teaching of "Java Web Technology" courses still adopt the traditional teaching model, that is, first systematically explain the basic concepts and principles, and then conduct on-the-machine practice and training through examples and cases. However, the study of this course requires multiple leading courses as support, such as basic knowledge such as HTML and CSS, as well as related courses such as data structure, database, Java programming, and web design [5]. In addition, in the teaching process, teachers not only need to explain a lot of basic knowledge, concepts, theories and principles, but also involve the installation and deployment of multiple development platform software, the operation and use of multiple tools, and the writing and debugging of multiple programming languages. Therefore, the current Java Web course teaching mainly faces the following problems.

(1) The course positioning and students' learning goals are not clear, and students lack motivation to learn

The training objectives of the existing "Java Web Technology" courses usually only focus on explaining what knowledge students need to master and the specific content of the course. However, after completing the course, students often do not know what practical problems this knowledge can systematically solve, or in which practical scenarios it can be applied. Therefore, it is relatively difficult for students to proficiently use the knowledge points in the course to solve practical problems.

(2) Inadequate teaching of classic cases

In the Java Web Technology course, students' mastery of relevant theoretical knowledge is usually evaluated by the completion of experimental tasks. Although students can complete the experiment as required, due to the lack of follow-up guidance and improvement, they often lack understanding of the quality of their own code and existing problems, making it difficult to further optimize and refactor the code. Therefore, the teacher in charge of the course has sorted out classic cases and excellent student works in the experiment for students to compare and reference, and guided them to improve the code. This link is particularly important.

(3) Insufficient resources for independent learning

With the rise of flipped classrooms and self-media, students' learning methods are becoming increasingly diverse. In order to allow students to participate in classroom teaching more actively and effectively and give full play to their subjective initiative and enthusiasm for learning, introducing new teaching models has become an inevitable trend. Therefore, provide students with sufficient teaching resources to support them.

### 3. Methods for Teaching Reform of "Java Web Technology" for Engineering Education Certification

The core of engineering education certification is to evaluate students' core professional abilities, and to cultivate students' ability to use the skills, skills and tools required for software engineering in the field of software engineering, as well as the ability to use computer technology to conduct

research. It is about guiding students to master the basic knowledge of computer technology and engineering, have solid experimental skills, and cultivate talents who can adapt to the application of information technology related to computer technology or cross-fields; at the same time, it focuses on improving students' special practical ability, problem analysis and expression ability, and team collaboration ability[6]. In order to cultivate students' core abilities to meet the requirements of engineering education certification, in response to the problems existing in the course teaching of "Java Web Technology", combined with the actual situation of the software engineering major of our school and the advanced experience of similar colleges and universities at home and abroad, to achieve the goal of engineering education certification, the curriculum teaching reform should be promoted from the following aspects:

#### (1) Clarify the course goals and enhance students' motivation and enthusiasm for learning

"Java Web Technology" implements the generation of dynamic content by embedding dynamic code into static HTML pages, thereby meeting the needs of users to obtain and transmit information. From the perspective of software programming in B/S architecture, this course aims to cultivate professional programming talents with high skills in the field of B/S architecture through comprehensive application of MVC design ideas, so that they can use the knowledge and skills they have learned for practical development, and lay a solid theoretical foundation for subsequent comprehensive development training courses. The specific training goals of its course are as follows:

- 1) Cultivate students' ability to embed Java program code in static HTML;
- 2) Cultivate students to proficiently use relevant grammar knowledge involved in Java Web technology;
- 3) Cultivate students to be proficient in using built-in objects such as out, response, request, session, application, and cookies to process code;
- 4) Cultivate students to master JDBC (Java Database Connectivity) technology and focus on mastering JDBC operations;
- 5) Cultivate students' ability to use Servlets and JavaBeans to write MVC pattern code;
- 6) Cultivate students' ability to comprehensively use Java Web technology to develop projects.

Its hierarchy is shown in Figure 1:

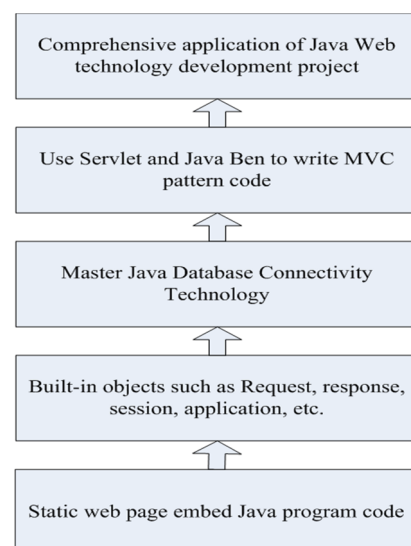


Figure 1. Java Web Hierarchy Chart

## (2) Determine classic cases and decompose and design large cases

Before applying the classic case teaching method for Java Web technology courses, it is necessary to plan and design the overall teaching process. Classic case teaching is a gradual process. First, clear and reasonable cases must be formulated based on the actual situation of the students in this class and the teaching plan. When selecting classic cases, the following content should be fully considered: based on the teaching content and teaching objectives, select the part that can reflect the characteristics of this course; the key points and difficult points should be moderate. Too difficult will dampen students' enthusiasm for learning, and too easy will find it difficult for students to achieve their goals of self-improvement. After determining the case theme during the teaching process, the corresponding case decomposition must be carried out and the large cases must be divided into small cases. On the one hand, the cases can better combine the teaching materials and

complete the explanation of teaching objectives and knowledge points; on the other hand, when proceeding step by step, students can avoid fear of difficulties. For example, taking the book sales management system as an example, it is broken down into registration and login during the teaching process. When explaining the knowledge points of registration and login, you can explain the knowledge points such as built-in objects out, response, request, session, etc., and help students review and review the knowledge points about form development. When developing functional modules such as "book management, book classification, user management, order management, new book shelves, and key recommendations", you can focus on teaching students about JDBC, Servlet, Filter, EL and JSTL. When explaining the operation steps of JDBC, you can first teach the creation of database and tables, as shown in Figure 2 on the code to create administrator tables in the database.

```
/*
Navicat Premium Data Transfer

Source Server        : a
Source Server Type   : MySQL
Source Server Version : 80035 (8.0.35)
Source Host          : localhost:3306
Source Schema        : booksales-managementsystem

Target Server Type   : MySQL
Target Server Version : 80035 (8.0.35)
File Encoding        : 65001

Date: 07/03/2025 09:57:23
*/

SET NAMES utf8mb4;
SET FOREIGN_KEY_CHECKS = 0;

-- Table structure for s_admin
-- -----
DROP TABLE IF EXISTS `s_admin`;
CREATE TABLE `s_admin` (
  `id` int NOT NULL AUTO_INCREMENT,
  `userName` varchar(255) CHARACTER SET utf8mb3 COLLATE utf8mb3_general_ci NOT NULL,
  `password` varchar(255) CHARACTER SET utf8mb3 COLLATE utf8mb3_general_ci NOT NULL,
  `name` varchar(255) CHARACTER SET utf8mb3 COLLATE utf8mb3_general_ci NOT NULL,
  `lastLoginTime` datetime NULL DEFAULT NULL,
  PRIMARY KEY (`id`) USING BTREE
) ENGINE = InnoDB AUTO_INCREMENT = 7 CHARACTER SET = utf8mb3 COLLATE = utf8mb3_general_ci ROW_FORMAT = DYNAMIC;
```

Figure 2. Administrator table creation code diagram

The decomposition and design of classic cases by teachers based on teaching objectives and teaching content not only allows students to have a holistic understanding and understanding of the cases, but also has an in-depth understanding and understanding of the submodules of the functional modules in the classic cases, thereby helping students to execute better.

## (3) Create a teaching resource library to enhance students' motivation and enthusiasm for learning

The advent of the Internet era has made digital resources increasingly abundant. However, in actual teaching, the "Java Web Technology" course does not have many personalized resources. However, integrating traditional classroom teaching with advanced teaching platforms and mobile terminal technologies and using advanced information technology means not only realizes the diversification, informatization and intelligence of classroom teaching, but also realizes intelligent and efficient classroom applications before, during and after class. In the creation of the teaching resource library, teachers can not only use the resource library resources and organize existing teaching resources, but also

reorganize or create their own courses to implement teaching, build a rich and diverse classroom teaching, and enhance students' motivation and enthusiasm for learning. The creation of a teaching resource library mainly includes functions such as courseware library, course demonstration code library, exercise library, FAQ library, excellent work library and classic project library.

Based on the existing teaching resource library, the expanded teaching resource library is created through Chaoxing Learning, as shown in Figure 3. The specific creation plan is as follows: 1) Create a teaching resource library. For example, in this course, we not only created a basic teaching resource library in Chaoxing Learning, but also created micro-videos on the homepage to explain the key points and difficult aspects of knowledge points, so that students can conduct pre-class preparation and after-class review in advance. 2) Create a course classic project library. In the "Materials" of Chaoxing Learning, some typical projects are summarized and included in the course classic project library by organizing student experiments. For example, when explaining built-in objects, we use URL to

pass values in the method in the request object, and put the function of obtaining data on the page into the project; through the login interface jump function in the project, the response object is explained; at the same time, we use the login interface to determine whether the user is logged in successfully explaining the knowledge and skills points in the session object; by connecting the database code in the project, we learn the steps of JDBC operation and basic syntax knowledge. Let students master the required knowledge and skills points through the project, and the teacher will explain and summarize the knowledge and skills points to deepen the students' impression [7]. 3) Create a common question bank. Use Chaoxing Learning to create a question bank in the "homework". This question bank is collected and organized based on the problems students often encounter during the learning process, so that the teaching teachers can share them

with students based on the student's foundation and teaching situation, so as to improve students' learning enthusiasm and learning efficiency. 4) Create a library of excellent works and classic projects. Use the "data" in the Chaoxing Learning Network platform to communicate with the employment needs of large and medium-sized enterprises, and analyze the projects of large and medium-sized enterprises. At the same time, collect and organize excellent works completed by students in the course. Based on the current teaching situation of the school's "Java Web Technology", we will improve the talent training mechanism suitable for the school's positioning, find some classic projects, and share it with the Chaoxing Learning Pass for students to browse and communicate and learn, thereby stimulating students' subjective initiative and enthusiasm for learning and improving teaching quality.

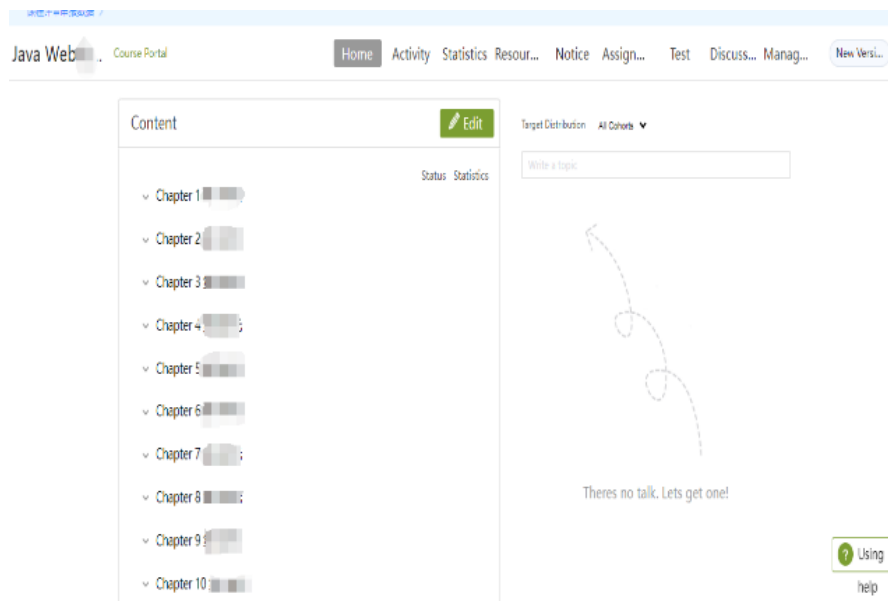


Figure 3. Chaoxing Learning Java Web Resource Library

#### 4. Implementation Effect and Analysis

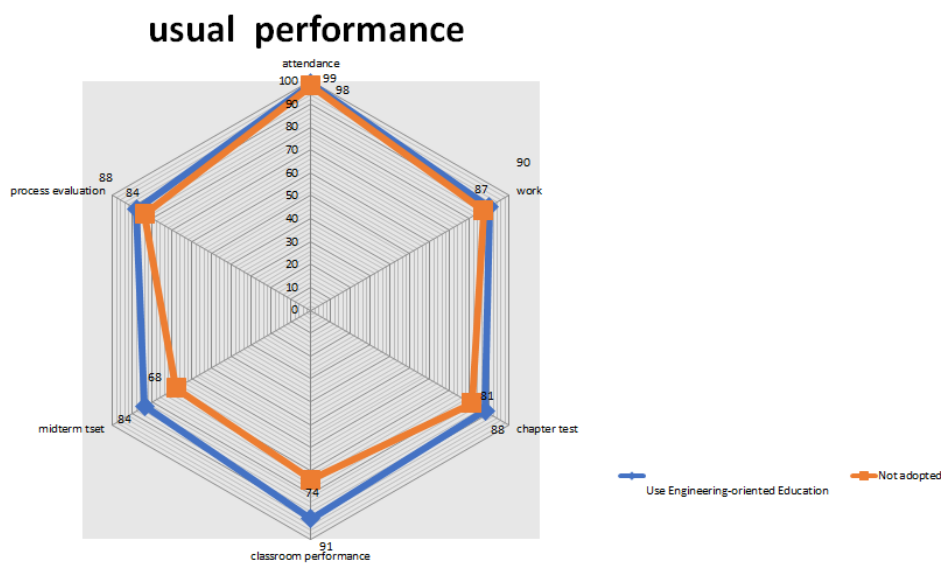


Figure 4. Comparative analysis of daily results

The "Java Web Technology" certified for engineering education is divided into two groups by 352 students in the 22-level software engineering major. One group of the "Java

Web Technology" courses adopts an engineering education-oriented method for classroom learning, and the other group adopts a traditional teaching model. At the end of the semester,

the closed-roller test will be used. During the assessment, this course consists of two parts: regular grades and final grades. Among the regular grades, process assessment accounts for 50%. The process assessment includes video learning, chapter tests, chapter learning, discussions, homework, sign-in, etc. Among them, attendance accounts for 5%, homework accounts for 8%, chapter tests accounts for 9%, classroom performance accounts for 8%, process project defense accounts for 20%, and final exams account for 50%. From the comparative experiments in Figure 4, we can see that in the reform of engineering-oriented certification teaching and the teaching reform, when attendance and homework are basically the same, differences began to occur in chapter tests, classroom performance, mid-term tests and process assessments, among which, there were 16 points in mid-term assessments and 17 points in classroom performance. From

this we can see that by adopting engineering education reform teaching, students' participation and learning ability have been improved.

The final assessment results are shown in Figure 5. The red area indicates that the reform of engineering education oriented certification has not been adopted, and the blue area adopts the overall evaluation results after the reform of engineering education oriented certification. Obviously, the teaching effect after adopting engineering education certification is obvious, with the proportion of students in the range (80-89) and (90-100) significantly increasing, the proportion of students in the range below 60 points decreased significantly, and the proportion of students with scores greater than 80 points increased by 25%. This shows that the reformed courses can stimulate students' interest in learning and improve students' ability to analyze and solve problems.

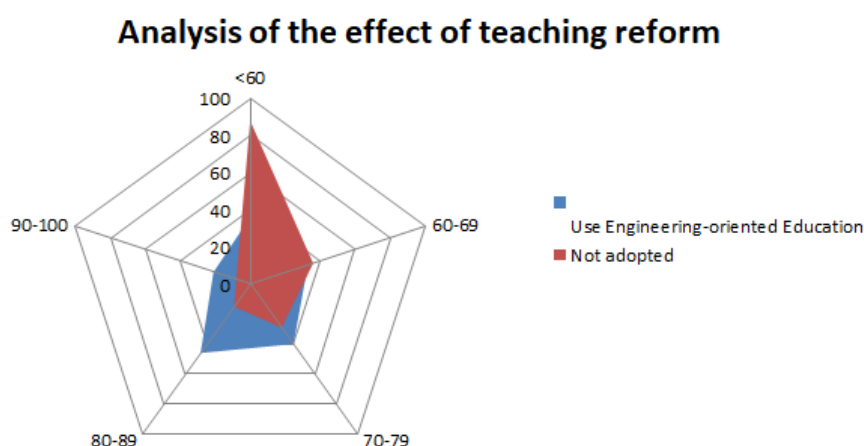


Figure 5. Comparative analysis and analysis of final assessment results

## 5. Conclusion

Implementing the "Java Web Technology" curriculum teaching reform for engineering education certification, and reforming the traditional teaching model of "classroom-centered and teacher-centered" education and teaching methods can not only promote the establishment of a "student-centered" learning method that focuses on the cultivation of students' personal abilities, but also promote teachers to guide students to decompose project functional modules, comprehensively apply the knowledge they have learned, conduct project needs analysis, design plans, and solve problems. In addition, the implementation of the "Java Web Technology" curriculum teaching reform for engineering education certification is not only conducive to supporting professional certification and improving the recognition of the professional society, but also can provide high-quality talents that meet the needs of the industry to the society, helping digital transformation, and realizing a virtuous cycle of "applying what you learn, promoting learning, and learning and applying each other".

## Acknowledgments

[Fund Project] Higher Education Teaching Reform Project (128 items in independent categories) Research and Practice for "Java Web Technology" curriculum teaching reform for engineering education certification (GKZLGC2023030).

## References

- [1] Guo Jiao, and Wang Boqing. "Analysis of the development trends of social demand in undergraduate engineering education majors—an empirical study based on employment data of college students in China." *Research on Higher Engineering Education*.05(2017):46-52+71.
- [2] Wang Sunyu, Zhao Ziqiang, Lei Huan. Construction and improvement of China's engineering education certification system—a ten-year look back on the construction of international substantive equivalent certification system [J]. *Research on Higher Engineering Education*, 2014, (05): 23-34.
- [3] Zhang Long, Miao Lei, Yang Guoshi. Teaching reform and practice of hydraulic and pneumatic transmission technology courses for engineering education professional certification [J]. *Journal of Heilongjiang Institute of Technology (Comprehensive Edition)*, 2019, 19(04):15-21.
- [4] Zhang Yongbin. *Java Web Programming Tutorial* [M]. Beijing: Tsinghua University Press, 2017.
- [5] Zhang Na. *Web Development Technology (java) Tutorial* [M]. Dalian: Neusoft Electronics Press, 2017.
- [6] Guo Xiaoyan, Li Yu, Zhang Dongna. Reform of Java web course teaching for engineering education certification [J]. *University Education*, 2020, (10): 14-16.
- [7] Zhou Wei. Project-based Java Web Development Course Teaching Reform [J]. *Guangxi Education*, 2019, (38): 63-64.