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Construction Mechanism of the Teaching and Research Section and Teaching Reform Practice for the Java Web Application Development Course

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Abstract: "Java Web Application Development" is a core course for cultivating back-end development ability in software-related majors. Aiming at problems such as the loose operation of the course teaching and research section, the separation of teaching research from teaching reform, and the mismatch between course content and industry needs, this paper proposes the approach of "mechanism guaranteeing reform and reform feeding back research", constructs a construction mechanism covering organizational structure, institutional norms, faculty development, school-enterprise collaboration and evaluation incentives, and advances the systematic reform of course content, methods, resources, practice and assessment on this basis. Practice shows that the mechanism improves course teaching quality and promotes both teacher professional development and students' practical innovation ability, providing a reference for the section construction and teaching reform of similar courses.

Keywords: Teaching and research section construction; Grass-roots teaching organization; Teaching reform; Java web application development; Course quality

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1. Introduction

1.1. Research background

"Java Web Application Development" is the core course of software engineering, which undertakes the important task of cultivating students' back-end development ability and engineering practice literacy. With the rapid iteration of the Web technology stack and the rising industry demand for versatile technical talents, the course faces continuous pressure to update its content and methods. Meanwhile, strengthening the construction of grassroots teaching organizations has become an important measure for the connotative development of universities. As the direct organizer of course construction, teaching research and teacher development,

the teaching and research section largely determines course quality and talent cultivation effectiveness. In practice, however, many sections suffer from loose operation, formalistic research activities and the separation of research from reform, and reform often remains individual spontaneous exploration without a replicable collective promotion mechanism [1].

1.2. Related work and research design

Existing studies on grass-roots teaching organizations mainly focus on organizational systems, operation modes and teacher development, emphasizing teaching-research communities and pedagogical scholarship, while studies on course reform concentrate on content reconstruction, method innovation and evaluation reform under student-centered and outcome-based concepts. Empirical research that organically combines section construction with specific course reform, and describes how the mechanism drives reform and how reform feeds back into research, however, remains insufficient [2]. This paper follows the approach of "current situation analysis — mechanism construction — practice advancement — effect verification", adopting literature research, case study, action research and experience summarization. It first defines core concepts and the theoretical basis, then analyzes the current situation, constructs the mechanism, presents the practice and construction effects, and finally gives reflection and conclusions [3].

2. Core concepts and theoretical basis

The teaching and research section is a grassroots teaching organization set up by course or course group, whose functions include organizing daily teaching, carrying out teaching research, undertaking course construction, promoting teacher cultivation, and monitoring teaching quality. It is not only an administrative management unit but also a teacher professional community with pedagogical scholarship as the core [4]. Its construction mechanism refers to the institutional arrangements and operation modes that guarantee effective operation, composed of five interrelated elements: organizational structure and division of responsibilities, institutional norms and operation, faculty team and cultivation, resource guarantee and external collaboration, and evaluation incentive and assessment orientation, which transforms occasional research activities depending on personal enthusiasm into stable organizational behaviors [5].

Teaching reform practice refers to the systematic improvement of teaching content, methods, resources, practice and assessment around the educational goal of the course, which cannot be accomplished by teachers in isolation and requires the collective efforts of the section. Theoretically, learning organization theory supports the construction of a teaching-research community and collective research; teacher professional development theory indicates that the section is an important field for teacher growth through practical reflection and peer mutual assistance; outcome-based education provides methodological support for content reconstruction and evaluation reform; and collaborative governance theory provides an analytical framework for school-enterprise multi-agent collaboration [6].

3. Analysis of the current situation

"Java Web Application Development" is positioned as a core professional course linking programming foundations with engineering practice. Its objectives include mastering the principles of Servlet, JSP and mainstream development frameworks at the knowledge level, completing requirement analysis, system design,

coding, testing and deployment at the ability level, and forming engineering standard awareness, teamwork and innovation awareness at the quality level. The section consists of full-time teachers of different titles and ages, some of whom have enterprise work experience and "dual-qualified" certification, undertaking theoretical and practical teaching, resource construction and competition guidance [7-8].

Problems still exist: first, organizational operation is loose, as section activities lack fixed arrangements and clear themes; second, teaching research is divorced from reform, staying at progress synchronization and experience exchange; third, teaching is misaligned with industry needs, with content lagging behind technological development; fourth, teachers lack development motivation because research achievements carry low weight in assessment; and fifth, the evaluation and incentive mechanism is absent [9]. The correspondence among the problems, the reform needs and the construction objectives is shown in **Figure 1**. Accordingly, the construction objective is determined: based on mechanism construction, build the section into the core platform of course construction and teaching reform, so as to achieve synchronous improvement of course teaching quality, teacher professional development and students' practical innovation ability.

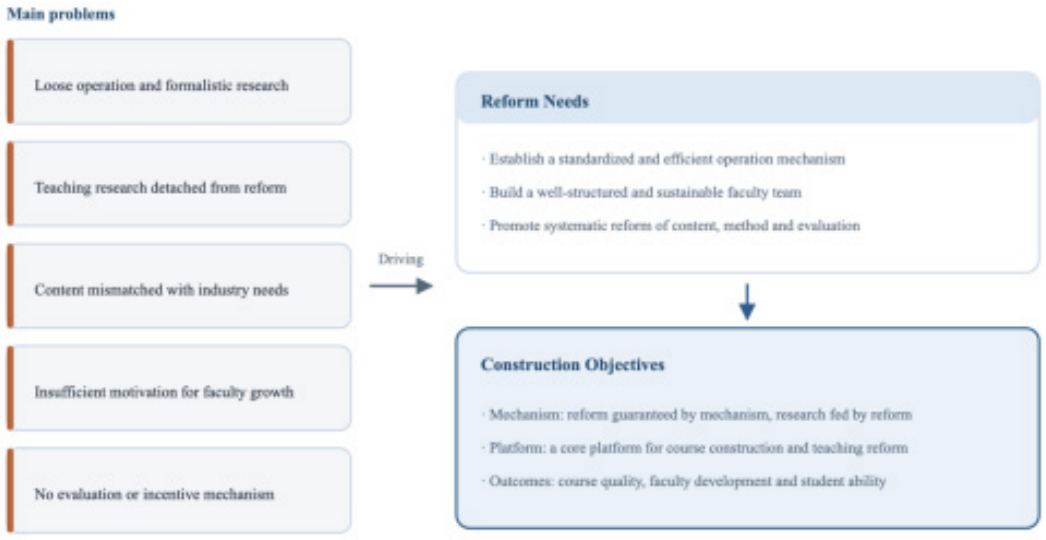

Figure 1. Correspondence among the existing problems, the reform needs and the construction objectives.

4. Construction of the mechanism for building the teaching and research section

4.1. Organizational structure and division of responsibilities

The construction follows the concept of "mechanism guaranteeing reform and reform feeding back research", combining goal orientation with problem orientation. In the organizational structure, an operational mode of overall responsibility by the section director (course leader) with group collaboration is implemented, with three groups set up under the section: the teaching implementation group responsible for course standards and classroom teaching, the resource construction group responsible for case libraries, question banks and online courses, and the competition guidance group responsible for competition selection, training and guidance [10]. Each group has a leader and a clear list of responsibilities, forming a division pattern of "director overall planning, group leader responsibility and full participation", which avoids unclear duties and task buck-passing.

4.2. Institutional norms and faculty development

Basic systems such as research regular meetings, collective lesson preparation, lesson observation and evaluation, and teaching quality monitoring are established: regular meetings are held at fixed periods with themes, records and implementation; collective lesson preparation focuses on key and difficult units to form shared lesson plans; and lesson observation involves all members in circular listening and evaluation with a closed loop of feedback and improvement, so that research activities operate "according to the system" rather than "relying on consciousness". In faculty development, a three-in-one training mechanism of "mentoring, enterprise practice and competition-driven improvement" is implemented: experienced teachers guide young teachers in teaching design and classroom organization, teachers practice in enterprises to improve "dual-qualified" quality, and teaching ability competitions and student competition guidance are used to improve teaching level in actual combat, gradually forming a rationally structured and sustainable faculty echelon [11].

4.3. School-enterprise collaboration and evaluation incentives

In school-enterprise collaboration, courses and training bases are jointly built with enterprises, real projects and development standards are introduced, and enterprise engineers are invited to participate in teaching and project guidance. Following the principle of "co-construction, sharing and mutual use", enterprises provide projects and demands while the section undertakes teaching transformation, keeping course content in sync with industry needs. In terms of evaluation and incentives, participation in research activities, reform projects, resource construction and competition guidance are incorporated into teacher assessment, and the weight of research work in professional title evaluation and performance distribution is clarified; a quality evaluation facing the whole section is conducted regularly from the dimensions of teaching operation, resource construction and reform effectiveness, with venues, funds and technical support guaranteed.

4.4. Collaborative operation of the mechanisms

The mechanisms of the above dimensions are not isolated but constitute a collaborative whole: organizational structure provides the skeleton, institutional norms the bond, faculty cultivation the core driving force, school-enterprise collaboration the external support, and evaluation incentives the sustained drive, as shown in **Figure 2**. Research is carried out based on the organization, reform is promoted through research, and the achievements of reform in turn feed back into research and teacher growth, finally forming a collaborative operation model of "organization — system — team — collaboration — evaluation" that supports and promotes each other in a cycle.



Figure 2. Collaborative operation model of the construction mechanisms of the teaching and research section.

5. Teaching reform practice based on the teaching and research section

5.1. Reconstruction of course content and teaching methods

Relying on the collective strength of the section, the course group aligns with post-ability requirements, professional standards and certificate assessment requirements, and reconstructs the content into modules such as Web fundamentals, database interaction, mainstream framework application and comprehensive project development, as shown in **Figure 3**, clarifying the knowledge, ability and quality objectives of each module and revising the course standards and syllabus accordingly, which maintains the systematicness and frontier of technology while strengthening the connection with actual development tasks. In teaching methods, project-driven and task-oriented teaching are implemented with real or simulated development tasks running through unit teaching; online-offline blended teaching moves the learning of basic knowledge before class so that class time is more used for answering questions, coding practice and project discussion; and information tools and intelligent assistance provide support for code demonstration, real-time feedback and personalized learning.

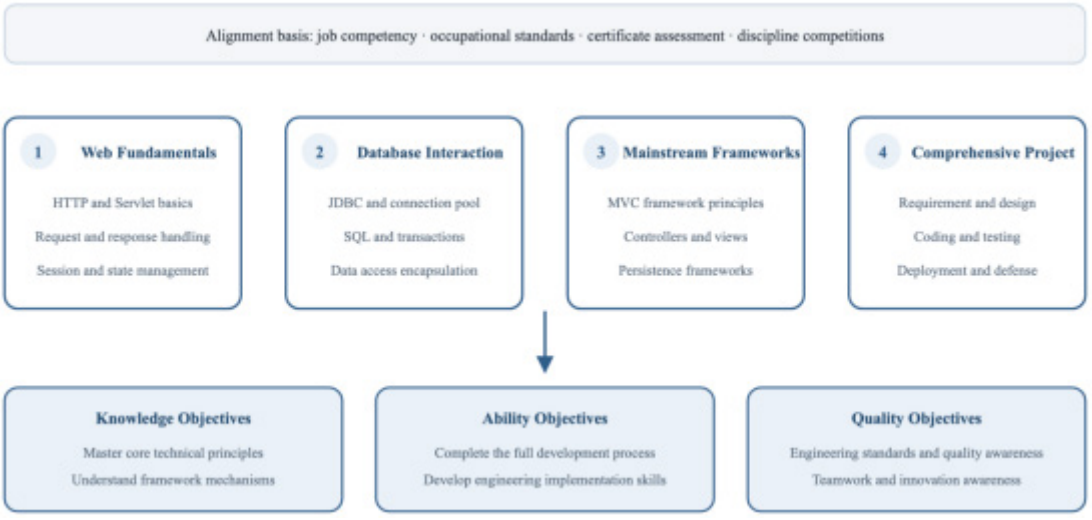

Figure 3. Modular restructuring scheme of the course content.

5.2. Resource construction and practical teaching

Led by the resource construction group, teaching case libraries, practical task sheets, exercise banks, micro-lecture resources and comprehensive project cases are systematically built; absorbing simplified versions of enterprise real projects as teaching cases, all resources are classified by module, managed by version and released and updated through the online teaching platform, forming a sustainable and shareable resource system. The course also establishes a progressive practical system of "in-class training — comprehensive projects — discipline competitions — innovation and entrepreneurship", as shown in **Figure 4**. In-class training builds foundations, comprehensive projects strengthen abilities, discipline competitions promote improvement and innovation and entrepreneurship broaden horizons. The section coordinates competition selection and training, connects competition requirements with course teaching, and transforms typical competition problems into teaching cases, forming a benign interaction among practical teaching, competitions and innovation and entrepreneurship.

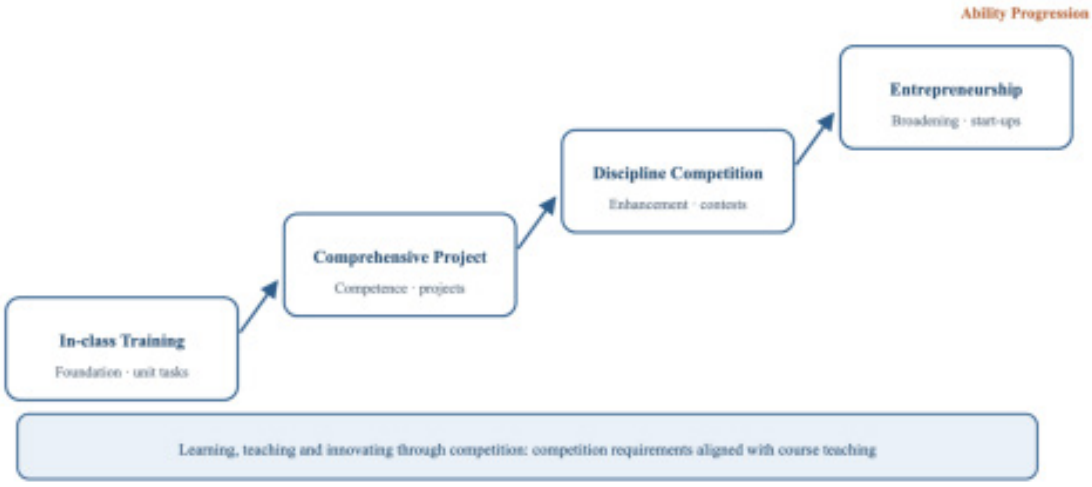

Figure 4. Progressive practical teaching system of in-class training, comprehensive projects, discipline competitions and innovation and entrepreneurship.

5.3. Assessment reform and research-teaching linkage

Aiming at a single result-oriented assessment, a course assessment system combining process evaluation with summative evaluation and involving multiple subjects is established: process evaluation focuses on classroom performance, practical tasks and project progress and combines student self-evaluation, peer evaluation and teacher evaluation; summative evaluation is based on comprehensive projects or project defense, examining abilities such as requirement analysis, design implementation and result expression, so that evaluation better serves the ability cultivation objectives. Meanwhile, the section transforms the real problems in reform into research themes and takes phased achievements such as new cases, new tasks and new evaluation schemes as research content, so that research provides collective wisdom for reform and reform continuously provides new materials for research, forming the mutually promoting two-way cycle shown in **Figure 5**.

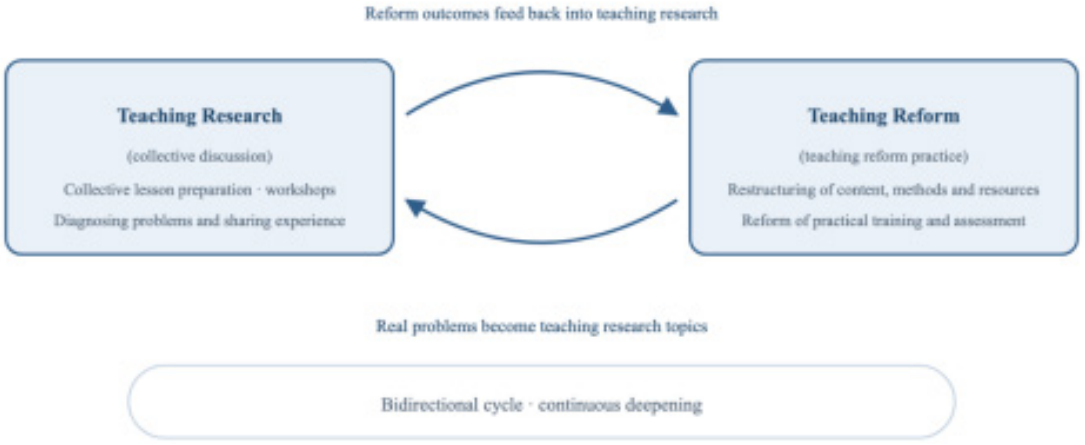

Figure 5. Bidirectional linkage mechanism between teaching research and teaching reform.

6. Construction results and empirical analysis

6.1. Course quality and faculty development

Since the mechanism was put into operation, the standardization of course teaching has been enhanced and research activities have been carried out normally. Students' evaluation of teaching and peer review results have improved compared with those before the reform, the failure rate has decreased, and classroom participation and the quality of practical task completion have improved. Teachers' enthusiasm for participating in research and reform has increased significantly: course teachers have won awards in teaching ability competitions at all levels, presided over or participated in reform projects and published teaching research papers, and the proportion of teachers with enterprise practice experience and "dual-qualified" certification has risen, moving the section from "fighting separately" to "growing collaboratively".

6.2. Student outcomes, research outputs and typical case

The integration of the course with competitions and innovation and entrepreneurship has driven the improvement of students' practical ability: awards in software development competitions have increased, high-quality course project works have emerged, the pass rate of related skill certificates has risen, and the employment quality of graduates has improved steadily. The section has also formed systematic research outputs, including revised course standards, case and resource libraries, reform projects and teaching

achievement awards, whose key indicators before and after the construction are compared in Figure 6. In the comprehensive project teaching of a semester, the section organized collective lesson preparation and thematic seminars around topic selection, task decomposition, process guidance and result defense, with enterprise mentors participating in the review, and typical problems were sorted into teaching cases for the next round, which verifies the operation logic of "organizational collaboration — teaching reform — achievement transformation".

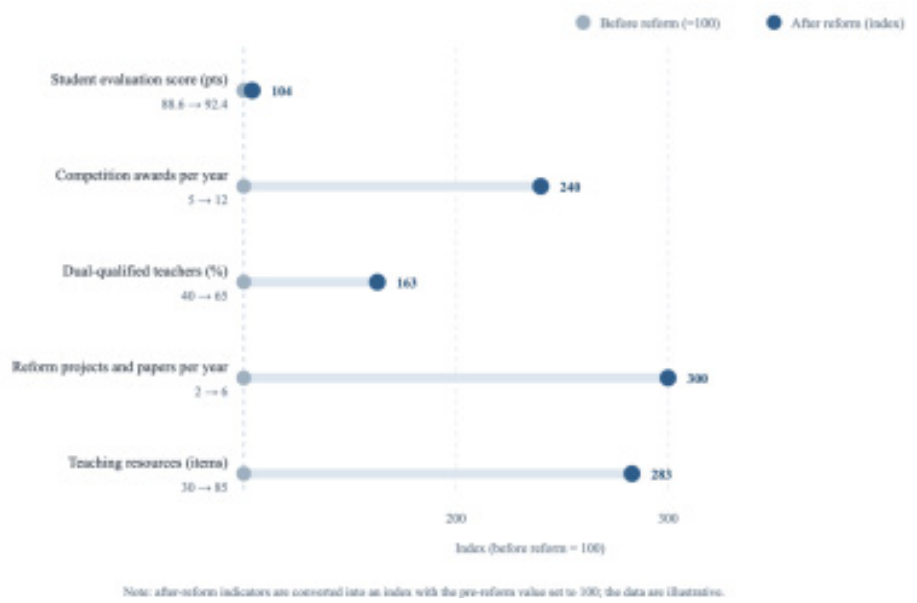

Figure 6. Comparison of key performance indicators before and after the reform (sample data).

7. Reflection and optimization strategies

Reflecting on the construction process, some deficiencies remain: the depth of research activities needs improvement, as some seminars still emphasize transactional arrangements; teachers' enthusiasm for participation varies individually; the stability of school-enterprise collaboration is affected by external conditions; and the transformation of research achievements into classroom teaching is insufficient. Therefore, subsequent optimization will deepen the connotation of research by setting special topics around the core problems of the course and guiding evidence-based teaching research; strengthen incentives by clarifying the position of research contributions in assessment and title evaluation; and stabilize school-enterprise cooperation through agreement-based and project-based ways. The transferable experience mainly includes guaranteeing normalized research with systems, replacing individual exploration with team collaboration, combining research and reform with real problems, and maintaining the long-term operation of the mechanism with evaluation incentives.

8. Conclusions and prospects

This paper takes the teaching and research section of the "Java Web Application Development" course as the object, constructs a five-dimension construction mechanism covering organizational structure, institutional norms, faculty cultivation, school-enterprise collaboration and evaluation incentives, and systematically

advances the reform of course content, methods, resources, practice and evaluation, forming a closed loop of "mechanism construction — practical reform — effect output". Practice shows that the mechanism enhances the cohesion and research capacity of the section, improves course teaching quality, and promotes teacher professional development and students' practical innovation ability. Limited to the construction experience of a single course, the universality of some practices needs to be verified in a wider range. In the future, the course group will further deepen the connotation of research and explore the integration of virtual teaching sections and artificial intelligence technology in teaching, so as to push the section construction and course reform to a higher level.

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Disclosure statement

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