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Taking the Software Technology Specialty as an Example to Construct the Professional Knowledge List with Project-Based Learning Method

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Abstract

Project-based learning is learner-led, team-oriented, and focuses on self-driven growth. It is conducive to cultivating creativity, teamwork and leadership, self-learning ability, and the ability to plan and execute projects. At present, the research of project-based learning mainly focuses on a certain course, and there is no research on the construction of project-based learning knowledge system from the perspective of professional talent training. This paper constructs the knowledge system of project-based learning based on the talent training plan, and takes the software technology specialty as an example to illustrate the construction method of the knowledge system of project-based learning. Finally, it summarizes the specific project-based learning practice. Practice has proved that project-based learning knowledge system can help students master the relevance between various courses, the relevance is intuitive, the designed projects can be realized by students themselves, which increases students' self-confidence and learning passion.

Keywords

Project-Based Learning, Software Technology, Self-Drive, Knowledge List

1. Introduction

Project-based learning is learner-led, and the goal is to achieve the project in a team, actively acquire knowledge and use the acquired knowledge to solve application problems during the completion of the project. Compared with traditional learning methods, project-based learning can effectively improve our abil-

ity to think and solve problems (Jaime, Blanco, Domínguez, & Arruabarrena, 2022; Gupta, 2022; Lopera, Gutiérrez-Velásquez, & Ballesteros, 2022; Larson, Jordan, Lande, & Weiner, 2020; Sanchez-Romero, Jimeno-Morenilla, Pertegal-Felices, & Mora-Mora, 2019). The goal of project-based learning is to enable us to master a certain knowledge and skill more efficiently through the practice method combined with real projects (Lopez-Gazpio, 2022; Herrero-de Lucas, Martínez-Rodrigo, de Pablo, Ramirez-Prieto, & Rey-Boué, 2022; Morais, Ferreira, & Veloso, 2021; Fowler & Su, 2018). Project-based learning is widely used in primary and secondary schools in the United States. In China, researchers have begun to realize that project-based learning plays a prominent role in students' ability development, but at present, project-based learning has not become the mainstream trend (Zhang & Su, 2018). In higher education, there is more research on project-based learning in a certain course (Ståhl, Sandahl, & Buffoni, 2022; Dogara, Saud, Kamin, & Nordin, 2020; Fan et al., 2023; Hernández-Mangas, & Álvarez, 2021; Clark, Wang, Splain, & Chen, 2020; Jordens, Wilmart, Garone, Kinnaert, & Catoire, 2022), but there is no research on project-based learning in the whole professional direction. Higher vocational education is to cultivate high-quality and compound technical and skilled talents. It should pay attention to cultivating the application ability required by the actual job. With the rapid development of science and technology, the technology is updated very quickly. At present, students need to learn project-oriented knowledge system by themselves. Students need to cultivate self-study ability, professional ability, team cooperation ability, innovation ability, and planning and project implementation ability. Therefore, to carry out project-based learning in the whole professional direction in higher vocational colleges, we must first provide some projects and corresponding resources. Therefore, it is very necessary to explore the construction of project-based learning knowledge system. Although our network resources are very rich, such as MOOC courses and online open courses of various universities, these resources exist in the form of a separate course, not in the form of a project. Therefore, under the condition of making full use of the existing learning resources, developing the knowledge system of project-based learning in the whole professional direction is a very worthwhile problem to explore. Let's take the software technology specialty as an example to discuss.

2. Construction of Project-Based Learning Knowledge System for the Whole Professional Direction

At present, the professional teachers will explain the talent training plan, answer the professional development path and guide the students in career planning after the vocational students enter the school but for the students who have just entered the university, after a semester, they can't remember anything. Students don't know what they need to learn until the timetable comes out every semester. When they learn a new course, they forget all the knowledge of the previous courses. Even if they can learn each course well every semester, after a period of time, the relationship between the front and back courses is completely broken.

Even if students can learn each course well every semester, they will not comprehensively apply the knowledge of the course after a period of time. That situation is very unfavorable for college students to systematically master professional knowledge and flexibly use professional knowledge. Therefore, it is proposed to construct the knowledge system of the whole major in a project-based learning way, so that students can understand what the major is learning, what can be done, and the functions of each course. Then carry out exploratory self-study according to the project and relevant knowledge in project-based learning.

2.1. The Method of Constructing Project-Based Learning Knowledge System for the Whole Professional Direction

When constructing the project-based learning knowledge system of the professional direction, the constructor needs to be very familiar with the whole professional direction, the talent training plan, the current market technology, and then design the project and knowledge system according to the characteristics of the students.

2.1.1. Extract Professional Courses Based on Talent Training Plan

Constructors need to sort out professional courses according to the talent training plan, and then carry out project design and list the knowledge system.

Let's take the talent training program for software technology specialty (Java) as an example. The professional curriculum plan of software technology (Java) talent training is simplified as shown in Figure 1.

The main courses of talent training in the software technology specialty (Java) described in Figure 1 have a sequence between these courses. In these courses, project design can be carried out according to the characteristics of "Web page production technology", "Web application technology", "Web client development" and "Framework-based application system development".
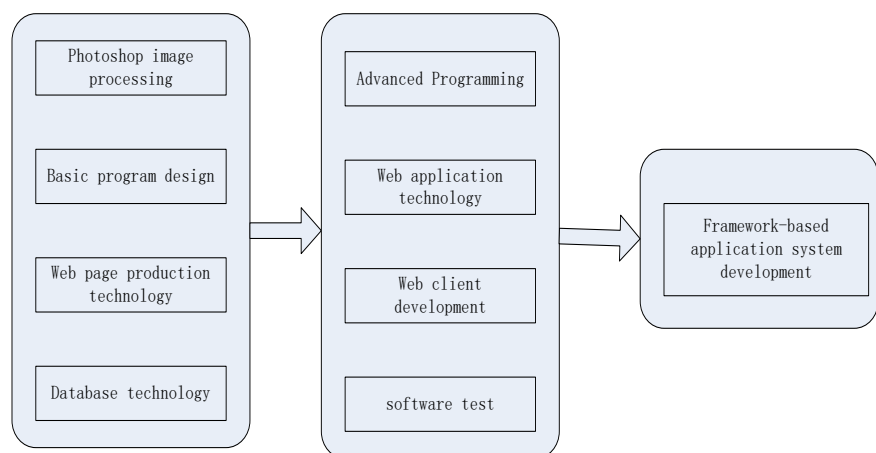

Figure 1. Main curriculum plan of software technology (Java) talent training.

2.1.2. Design Projects According to the Sequence of Courses

The principle of project design is to design the course of talent training plan into

a large project. The project is implemented in a gradual way from easy to difficult. For example, the project of the course "Web Page Making Technology" in talent training is designed as a static website about the knowledge points of the course; the course "Web Client Programming" is mainly about JavaScript and JQuery. The designed project can add the client interaction function to realize the knowledge point website of the course on the basis of the project "Web Page Making Technology"; When learning the course "Web Application Technology", the designed project is divided into two different operation interfaces: the background user is mainly to enter the course knowledge point website, and the front user is mainly to display the course knowledge point website, integrating database technology, Java Web technology, HTML, CSS3, JavaScript, JQuery, Bootstrap framework; Finally, when learning the course "Framework-based Application System Development and Training", the professional resource website project can be realized. The resource website provides three roles: administrator, teacher, and student. The front end is implemented using the vue.js framework, and the back end is implemented using the spring boot framework. The rendering of professional resources website project is shown in Figure 2.

Figure 2 is a project-based learning website for students, and it is also a project that students are required to complete. In this website, menus are automatically generated according to back-end input. Students are required to comprehensively use database and front-end and back-end frame technology.

3. Example of the Construction of Project-Based Learning Knowledge System Environment

The project-based learning knowledge system refers to the knowledge system of the whole professional direction. This knowledge system is composed of project-based learning knowledge points of a specific course. The simplest project-based learning project of Webpage Production Technology is described below. The knowledge points of each course will be flexibly applied to the comprehensive project of the course.
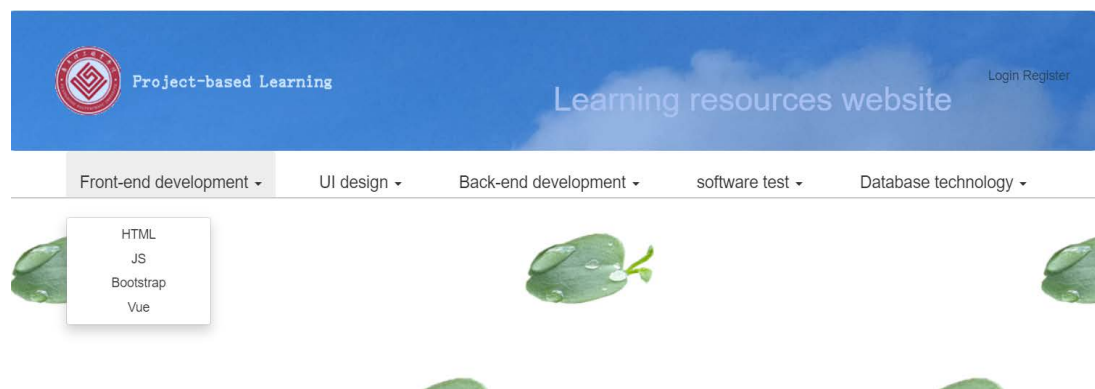

Figure 2. Professional project-based learning knowledge system.

The function of the comprehensive project is the current project-based learning knowledge site. Each course project-based learning website is designed in the module shown in Figure 3.

The comprehensive project in Figure 3 is the course website project, and the knowledge points involved in the project are in the knowledge list of the course. Take the project-based learning method website of Webpage Production Technology as an example, and its course website is shown in Figure 4 and Figure 5.

Figure 4 mainly provides learning materials for knowledge points. These knowledge points will be applied to the realization of the website. On the principle of sufficiency, online learning resources are very rich. As long as students know the knowledge points they need to master, if they don't understand it on the course website, they will search for the information themselves.

Figure 5 shows the methods and corresponding knowledge points that students need to realize the website. The project schedule is provided for students to grasp the self-learning time node. The final acceptance plan is mainly about the presentation of learning results and the training of team cooperation ability and oral expression ability.
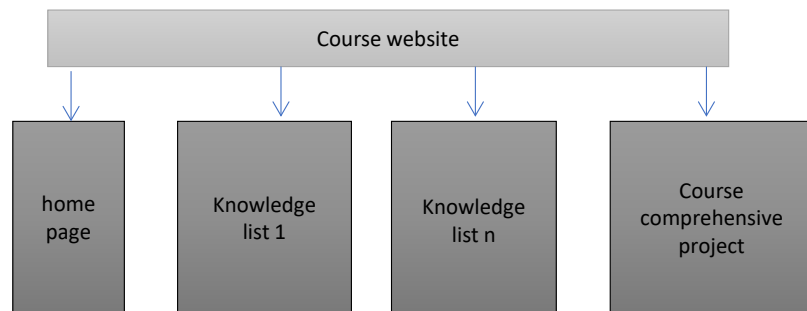

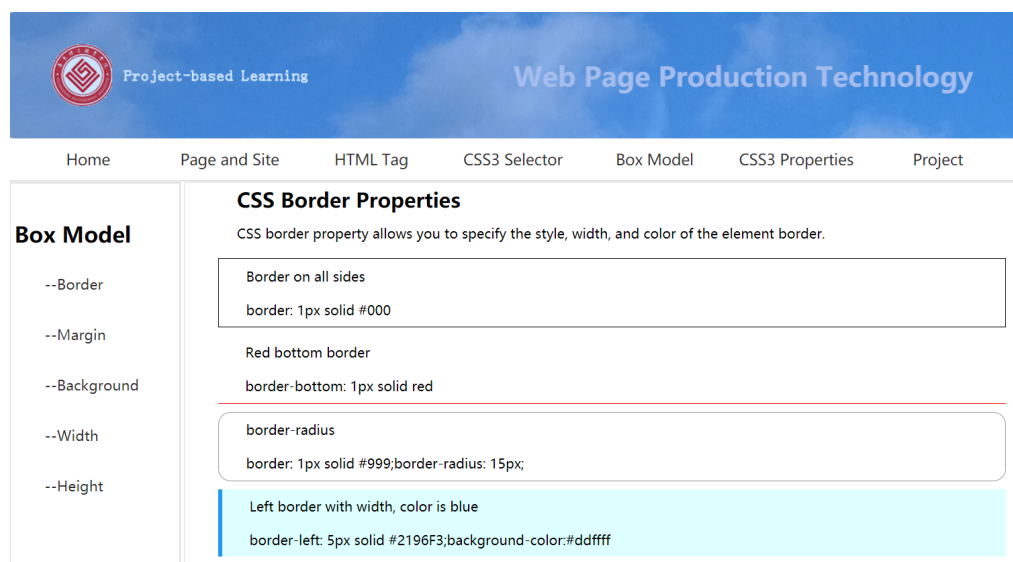**Figure 3.** Curriculum project-based learning website modules.

Figure 4. List of project-based learning knowledge of webpage production technology.
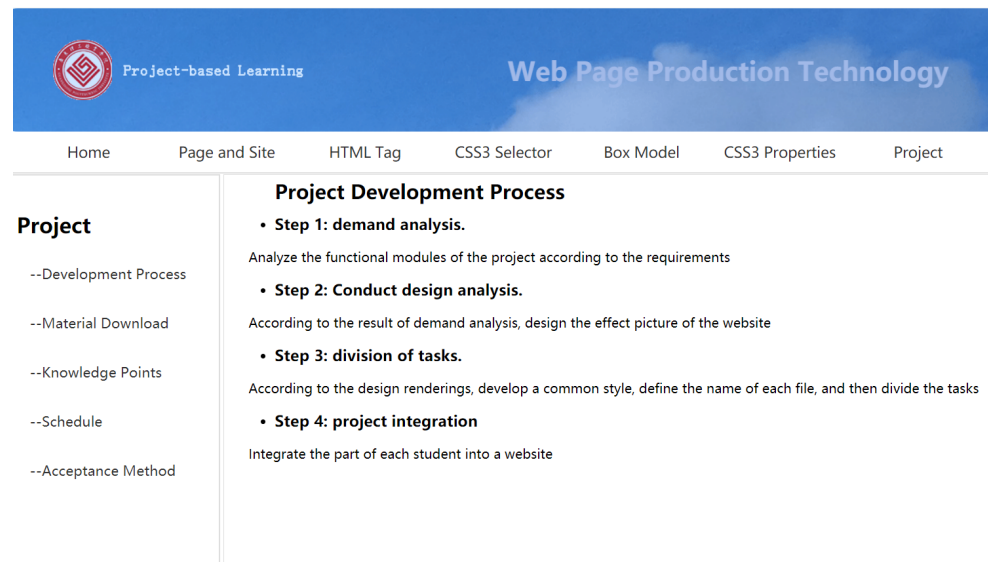
Figure 5. Integrated project of project-based learning of webpage production technology.

4. Conclusion

The advantage of project-based learning environment construction is that students can directly see the results that can be made after the study of the whole specialty, and students can intuitively feel the relationship between the courses of the whole specialty, so that the learning objectives are clearer and the learning motivation is greater.

The construction of project-based learning environment is a challenge for professional teachers. Professional teachers need to master all fields of professional knowledge, have strong organizational ability and practical ability, and also need professional teachers to have strong psychological quality. Because there are many students and a wide range of learning, they need to discuss with teachers about a wide or deep range of knowledge, so professional teachers need to constantly improve their professional skills.

Constructing the professional knowledge list with PBL applies to all majors, as long as it is in one professional direction, it has a process of knowledge accumulation and integration. It requires teachers to prepare a knowledge system, which has already been practiced among students. Students' learning enthusiasm has been improved, their learning abilities have been improved, and their performance has been even better. And there is more communication between students. Next, prepare to involve other teachers in practice.

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Conflicts of Interest

The authors declare no conflicts of interest regarding the publication of this paper.

References

Clark, R. M., Wang, M., Splain, Z. A., & Chen, K. P. (2020). Teaching a Standalone Optics and Lasers Course Using Project-Based Learning. In *IEEE Transactions on Education, 63,* 255-262. https://doi.org/10.1109/TE.2020.2976645

Dogara, G., Saud, M. S. B., Kamin, Y. B., & Nordin, M. S. B. (2020). Project-Based Learning Conceptual Framework for Integrating Soft Skills among Students of Technical Colleges. In *IEEE Access, 8,* 83718-83727.
https://doi.org/10.1109/ACCESS.2020.2992092

Fan, H. et al. (2023). Interdisciplinary Project-Based Learning: Experiences and Reflections from Teaching Electronic Engineering in China. In *IEEE Transactions on Education, 66,* 73-82. https://doi.org/10.1109/TE.2022.3186184

Fowler, R. R., & Su, M. P. (2018). Gendered Risks of Team-Based Learning: A Model of Inequitable Task Allocation in Project-Based Learning. In *IEEE Transactions on Education, 61,* 312-318. https://doi.org/10.1109/TE.2018.2816010

Gupta, C. (2022). The Impact and Measurement of Today's Learning Technologies in Teaching Software Engineering Course Using Design-Based Learning and Project-Based Learning. In *IEEE Transactions on Education, 65,* 703-712.
https://doi.org/10.1109/TE.2022.3169532

Hernández-Mangas, J. M., & Álvarez, J. A. (2021). Project-Based Learning in "Practical Development of Electronic Systems" Course, Weaknesses and Strengths in the Context Imposed by the COVID-19 Disease. In *IEEE Revista Iberoamericana de Tecnologias del Aprendizaje, 16,* 194-203. https://doi.org/10.1109/RITA.2021.3089920

Herrero-de Lucas, L. C., Martínez-Rodrigo, F., de Pablo, S., Ramirez-Prieto, D., & Rey-Boué, A. B. (2022). Procedure for the Determination of the Student Workload and the Learning Environment Created in the Power Electronics Course Taught Through Project-Based Learning. In *IEEE Transactions on Education, 65,* 428-439.
https://doi.org/10.1109/TE.2021.3126694

Jaime, A., Blanco, J. M., Domínguez, C., & Arruabarrena, R. (2022). Creation and Sharing of Lessons Learned by Blogging in the Context of Project-Based Learning. In *IEEE Access, 10,* 114346-114354. https://doi.org/10.1109/ACCESS.2022.3217473

Jordens, X., Wilmart, R., Garone, E., Kinnaert, M., & Catoire, L. (2022). A Project-Based Learning Approach for Building an Affordable Control Teaching Lab: The Centrifugal Ring Positioner. In *IEEE Access, 10,* 4907-4918.
https://doi.org/10.1109/TE.2018.2816010

Larson, J., Jordan, S. S., Lande, M., & Weiner, S. (2020). Supporting Self-Directed Learning in a Project-Based Embedded Systems Design Course. In *IEEE Transactions on Education, 63,* 88-97. https://doi.org/10.1109/TE.2020.2975358

Lopera, H. A. C., Gutiérrez-Velásquez, E., & Ballesteros, N. (2022). Bridging the Gap Between Theory and Active Learning: A Case Study of Project-Based Learning in Introduction to Materials Science and Engineering. In *IEEE Revista Iberoamericana de Tecnologias del Aprendizaje, 17,* 160-169. https://doi.org/10.1109/RITA.2022.3166862

Lopez-Gazpio, I. (2022). Gaining Student Engagement through Project-Based Learning: A Competitive 2D Game Construction Case Study. In *IEEE Access, 10,* 1881-1892.
https://doi.org/10.1109/ACCESS.2021.3139764

Morais, P., Ferreira, M. J., & Veloso, B. (2021). Improving Student Engagement with Project-Based Learning: A Case Study in Software Engineering. In *IEEE Revista Iberoamericana de Tecnologias del Aprendizaje, 16,* 21-28. https://doi.org/10.1109/RITA.2021.3052677

Sanchez-Romero, J. L., Jimeno-Morenilla, A., Pertegal-Felices, M. L., & Mora-Mora, H. (2019). Design and Application of Project-Based Learning Methodologies for Small Groups within Computer Fundamentals Subjects. In *IEEE Access, 7,* 12456-12466. https://doi.org/10.1109/ACCESS.2019.2893972

Ståhl, D., Sandahl, K., & Buffoni, L. (2022). An Eco-System Approach to Project-Based Learning in Software Engineering Education. In *IEEE Transactions on Education, 65,* 514-523. https://doi.org/10.1109/TE.2021.3137344

Zhang, W. L., & Su, R. (2018). Hotspots, Trends and Enlightenment in the Field of Overseas Project-Based Learning Research—Data Visualization Analysis Based on Cite Space. *Journal of Distance Education,* 91-102.