A Study on Project-Based Learning in a Boat Design and Building University Course

Wei-Yuan Dzan, National Kaohsiung Marine University, Kaohsiung, Taiwan
Chih-Chao Chung, National Kaohsiung First University of Science and Technology, Kaohsiung, Taiwan
Shi-Jer Lou, National Pingtung University of Science and Technology, Pingtung, Taiwan
Huei-Yin Tsai, National Kaohsiung Normal University, Kaohsiung, Taiwan

ABSTRACT

The main purpose of this study was to develop interdisciplinary project-based learning and investigate the process and effectiveness of project-based learning involving undergraduate students in the Naval Architecture and Ocean Engineering in a college in Taiwan. The theme of this research project was “boat design and building.” This study used the revised PIPER (PIPER: Preparation / Implementation / Presentation / Evaluation / Revision) model to design the project activities and integrated the learning of the following three courses: “Operation and application of 3D boat mold design software,” “Boat building,” and “Boat parts design and building practices.” In teaching and research, the students carried out via the learning by doing and experimental courses, the final completion of the boat design and construction. This study selected a total of 97 students as the subjects and conducted text analysis, a questionnaire survey to collect data. The research results showed that project-based learning in combination with hands-on learning could guide students in completing the design and building of a real boat. This learning method provided students with brand-new experiences, enabled them to experience the pleasure of boat design, and effectively elicited a positive attitude toward boat-building engineering and learning effectiveness. Moreover, this study proposed suggestions for the project process that could inform future interdisciplinary project-based learning in colleges.

Keywords: Boat Design and Building Course, FRP, Hull design, Project-Based Learning, SCRIMP

INTRODUCTION

The output of the shipbuilding industry varies with Baltic index and economic prosperity. However, the crisis of talent cultivation, especially a shortage of talent and aging issues, generally exists in shipbuilding and yacht-related industries. Therefore, there is an urgent need to cultivate boat design- and building-related professionals, and naval architecture-related colleges are responsible for educational reform that responds to this current trend. In educational

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reform for modern technological and vocational education, the famous educator John Dewey (1859-1952) applied the idea of Pragmatism, which originated in the U.S., to the field of education and further enriched the concept of Progressivism. His educational method of “Learning by Doing” has directly or indirectly affected modern education. One of Dewey’s students, William H. Kilpatrick (1871-1965), was strongly affected by Dewey’s philosophy and developed the reform of student-centered curriculum, which became the theoretical foundation of “project method.” Project method is the direct application of Dewey’s theory of knowledge. Rather than offer a direct hint to learners through knowledge and skills, this method designs courses based on the activities that learners prefer. To put each course design into practice, students are forced to learn various knowledge and skills required by the course design. Such knowledge and skills are also verified and assessed during the process and practices of course design. Therefore, how to design a curriculum to enable students to generate interest from active learning, to obtain the knowledge and skills required for boat design and manufacturing, is the most important issue.

Lou et al. suggested that PBL enables students to analyze questions, discuss their ideas with others, design projects or experiments, gather information, collect and analyze data, reach conclusions, communicate with others about their ideas and discoveries, and eventually solve problems by exploring real or meaningful questions. Students can actively engage in relevant work, complete real products, and announce their learning process within a defined period of time (Lou, Liu, Shih, & Tseng, 2011).

PBL (Project-Based Learning) is a systemic teaching method, which integrates the course contents of various subjects and enables students to ask questions and investigate various issues in real life. Because the teaching materials of various subjects are integrated, students can comprehensively learn new knowledge and skills by probing into complicated issues and carefully planned tasks (Savage, Chen, & Vanasupa, 2007). U.S. educators have always attached importance to PBL for the following reasons: 1) the findings in both brain science and psychology showed that direct instruction, which places emphasis on instruction provided by teachers and student learning, restricts the development of knowledge, thinking, and implementation among learners, and 2) the development of modern technology forces educators and schools to make adjustments. Therefore, students not only have to be good at workplace planning and familiar with the mechanism of teamwork, but they also have to develop excellent communication skills. Such abilities cannot be completely developed by traditional teaching methods (Markham, Mergendoller, Larmer, & Ravitz, 2007). Consequently, the purpose of PBL is to provide real contexts to help develop learners’ abilities to discover problems actively, communication and coordinate, and solve problems (Tzou, 2001).

Krajcik et al. suggest that the purpose of PBL is to pose to students an exploratory question that is real and meaningful. During the exploration process, students have to try to find the answer to the question, cooperate with other students, make use of technological tools, and eventually develop an artifact. The teaching involved in this process must be interdisciplinary because the contexts of real life are integrated and cannot be clearly understood from a single perspective (Krajcik, Blumenfeld, Marx, & Soloway, 1994). Therefore, in PBL courses, the final project work cannot be completed until teachers design the interdisciplinary, hands-on learning and implement the teaching of project, and students share with their peers the challenges they encounter and work in a competitive relationship. This interactive model of learning enables teachers to develop new teaching perspectives and enrich their PBL-oriented teaching concepts. The main conceptual change is that teachers’ roles are transformed from information providers to learning assistants that help students seek external organizations or resources, establish partnerships, and apply new technology to PBL. Moreover, PBL emphasizes that the questions explored by students must reflect real-life situ-
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