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APPLICATION OF PROJECT-BASED LEARNING DIDACTICS FOR A FIRST-YEAR COURSE OF ELECTRONIC ENGINEERING

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Abstract

Project-Based Learning is a powerful teaching method that transforms traditional education into an engaging, student-centered experience. The National Kaohsiung University of Science and Technology in Taiwan encourages the departments to offer the first-year students with a course of professional field exploration enabling them to gain insight into the future development of the people majoring in one's department. This paper presents the experiences of applying project-based learning didactics on the course of professional field development exploration for the first-year electronic engineering students. In the course planning, by some homework assignments, the teacher lets the students experience self-directed learning. So, students can take the initiative in planning and managing their learning. The course arrangement reveals successful result according to the questionnaire result of pre-test and post-test and final reports of many students' thoughts.

Keywords: *Professional field development exploration, project-based learning, course planning, self-directed learning.*

1. Introduction

In Taiwan, many students often rely on memorization-based learning to quickly grasp course material to perform well in entrance examinations. When choosing a major, they do not have much idea to their own interest. According to our conversation with many new students who majoring in electronic engineering, it reveals that many students opt for electronic engineering due to its perceived advantages in future employment prospects. For having an insight into the future development of the students majoring in one's department, the National Kaohsiung University of Science and Technology (NKUST) in Taiwan encourages the departments to offer the first-year students with a course of professional field exploration (楊 & 柯, 2023).

To help first-year students majoring in electronic gaining a deeper understanding of university-level learning and future career paths after graduation, we have arranged a course titled "Professional Field Development Exploration". In this course, some example course pathways and future professional career development are introduced. It's well known that Project-Based Learning (PBL) offers several key advantages for fostering better learning attitudes among students. It has been applied to this course to make good use of PBL. In this course, the teacher requires students taking the course to submit their assignments. According to the questionnaire result of pre-test (at the beginning of the course) and post-test (at the end of the course) and the final post-course reflection reports of many students, they reveal positive message about success in such a course arrangement.

2. Method

For the one-semester course of "Professional Field Development Exploration" in the electronic department, the students taking this course have been grouped into teams of three. Then the teacher announced some assignments in the beginning. Namely, students are required to submit five assignments: (1) an exploration of job requirements for a desired career, (2) a student course progression plan for professional competency development, (3) an insight report from the expert seminar, (4) post-course

reflection report, and (5) a self-directed learning report on a topic of their choice within the field of information and electronics by one group.

There are four main research directions in the Electronic Department of NKUST. These four areas are respectively: Electronic Circuits and Devices, AI technology and Communication Systems, Information and Digital IC Design, and Biomedical Electronics. As part of the 'Professional Field Development Exploration' course, we have invited professionals from the electrical and information engineering field to present their technical expertise and share their educational journeys, allowing students to develop a clearer insight into the industry.

The objective of the above first assignment is to guide students in their initial exploration of careers and the essential expertise required for targeted job positions. With this initial exploration, the students are asked for course progression plan for professional competency development during undergraduate studies by referring to the course offerings on the department's website. So, each student can have an initial deep thought about one's undergraduate learning. This is the goal of the second assignment. Since some speeches have been given by scholars and industry experts in electrical and information engineering field, students are required to choose any three lecture speeches and submit the written insight report based on the speech contents. In addition, another assignment is a self-directed learning report on a topic of information and electronics by each student group. The exact project topic is decided by the group members.

Project-Based Learning (PBL) is widely recognized as a student-centered pedagogical approach that emphasizes learning through the active exploration of real-world challenges. Thomas (2000) describes PBL as a dynamic process through which students gain deeper knowledge by engaging in meaningful projects. Rooted in Dewey's (1938) theory of experiential learning, PBL encourages students to "learn by doing," fostering not only content mastery but also the ability to apply knowledge in practical contexts. PBL supports interdisciplinary learning, allowing students to draw on diverse fields of knowledge to solve complex problems over an extended time frame (Blumenfeld et al., 1991). This approach aligns closely with the development of 21st-century skills such as critical thinking, communication, collaboration, and creativity.

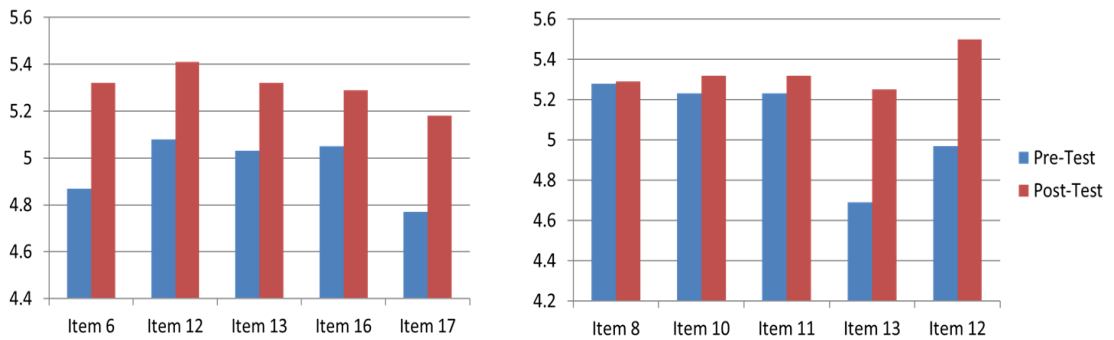
In the Electronic Department of NKUST, PBL didactics has been applied to some courses, such as Electronics and Analog Integrated Circuit Design. To help students begin to understand and engage with PBL, some core characteristics of PBL are integrated into the assignmant 5. They are: (1) the topic has real-world relevance, (2) Students have the opportunity to make decisions about the project's direction, process, or outcome, (3) learning is driven by inquiry and research, and (4) students work in teams, learning to communicate, and share responsibility. Besides, the instructor demonstrates the usage of internet resources, such as ChatGpt, Youtube course, and OpenCourseWare.

Finally, the last assignment is the post-course reflection report. It helps the instructor to collect student's feedback on the course experience.

3. Result

To know the effect of course arrangement, the questionnaire analysis of pre-test and post-test of this course was carried out. The questionnaire was designed to include both a learning effectiveness scale and a learning motivation scale, as shown in Table 1. Figs. 1 and 2 show the selected improvement in learning effectiveness and motivation, respectively. From the result of questionnaire analysis, it reveals two messages: first, this course successfully met its goal of increasing students' understanding of academic and career connections, planning abilities, and confidence in future learning; second, students reported greater curiosity, engagement, and emotional connection to the course after participation. In addition, from the post-course reflection reports of students, many students express that the course arrangement and assignments help them to find their own interest and plan their future professional development.

Figure 1. Selected Improvements in Learning Effectiveness. Figure 2. Selected Improvements in Learning Motivation.



4. Conclusion

In this article, the arrangement of a one-semester course of electronic engineering for professional field development exploration of first-year students of undergraduates is presented. By virtue of the course assignments, the core characteristics of PBL is introduced. From the investigation of questionnaire result of pre-test and post-test and post-course reflection reports of students, it reveals that the curriculum scheme has accomplished the desired effect.

Table 1. Questionnaire with both a learning effectiveness scale and a learning motivation.

#	Learning Effectiveness Scale Question	Learning Motivation Scale Question
1	I understand the purpose of attending university.	I find the course novel.
2	I understand the developmental directions of my department.	I find the content of the course attractive.
3	I understand the compatibility between my interests and department.	I am very interested in the course.
4	I understand the future course content I need to take in my department.	The course stimulated my curiosity.
5	I understand how to plan my future courses.	The course helped me understand professional knowledge and skills.
6	I understand the connection between the department's curriculum map and future career development.	The course connected to my life experience.
7	I understand the potential conflict between department choice and future career.	The course helped me plan my learning path.
8	I clearly understand the relationship between my field of study and future development.	The course is helpful for my career development.
9	I know how to manage my learning methods.	I feel proud completing course assignments
10	I understand the industrial development in my department's field.	I am happy that I chose this course.
11	I understand the qualifications required for professional jobs in my field.	I feel that the effort I put into this course is worthwhile.
12	I understand the talent demand in the professional field I am studying.	Time passed quickly during this course.
13	I understand the core professional competencies related to my field.	After this course, I feel confident in understanding other courses
14	I understand information about further studies.	After this course, I feel confident in learning new subjects I haven't studied.
15	I have the ability to work in a team.	After this course, I feel capable of planning my future studies.
16	I have experience and ability in problem solving.	After this course, I feel I can overcome setbacks during my academic journey.
17	I have communication and expression skills.	

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