Smart Media Journal / Vol.12, No.5 / ISSN:2287-1322
https://dx.doi.org/10.30693/SMJ.2023.12.5.88

A Study of the Satisfaction with the operation of design courses-Based on PJBL(Project Based Learning) - An analysis of a University of Applied Sciences in China-

WANG LEI*, Choi Wonjae**

Abstract

As the definition and role of design changes over time with the times and society, design education needs to update teaching methods to match it. The course design in this study began with an optimisation of the learning model based on previous research and analysis, followed by in-depth interviews, the application of the interview results to the final curriculum design, and finally a questionnaire to verify the positive effects of this teaching model. This teaching model has been applied to teach a pilot class in a university of applied sciences in China. The main characteristics of the course design are Project-Based Learning (PJBL) oriented, team cooperation centric, and an educational model developed based on peer assessment. In every stage of the UI design course, realistic project simulations are adopted, enhancing students' abilities through practical experience, teamwork, and peer assessment. The innovation lies in validating the effectiveness and advantages of this model at every stage of the UI design course, innovating existing teaching methods, optimizing learning models, and combining practice with evaluation. This research found that a project-oriented team course design based on PJBL has a high degree of effectiveness and relevance in each stage of the UI design course, significantly improving students' overall competence. It is expected that the results of this study can be applied in various ways to the course design of the courses that similar to design majors.

Keyword : Design Education Methodology | PJBL | Design Education in China | Peer Assessment | UI Design

I. INTRODUCTION

1. Research Background and Objectives

In the era of the Internet, with the development of information technology, the ability to solve practical problems in work has gradually become a necessary skill for 21st-century students[1]. In the context of actively conducting practical research on course design, the higher education needs to be based on work projects and take learner-centered learning mode[2]. Through the PJBL teaching model, students can practice their UI design skills and improve practical abilities by doing projects, while cultivating communication and collaboration skills, allowing them to better understand user needs and industry trends and obtain practical learning outcomes to

*Formal Member, Dankook University, PhD Student
**Formal Member, Dankook University. Professor

Manuscript : 2023. 03. 17
Revised : 2023. 04. 03, 2023. 05. 26
Confirmation of Publication: 2023. 06. 21
Corresponding Author : Choi Wonjae e-mail : wjchoi@dankook.ac.kr

prepare for future UI design work.

2. Research Scope and Methods

A course design centered by team projects based on PJBL has been piloted in a university of applied sciences in China. This study started with an analysis of the theoretical origins of PJBL and the significance of team project-based learning. Referring to the learning model of Younghee Lee (Dankook University) and Jeonghyeon Yoon (Hansong University) [3], the study optimized the learning model and then conducted in-depth interviews. Finally, questionnaires are used to verify the positive effects of this model. The purpose of teaching, the skills required by industry practitioners, and the needs of students are all understood through in-depth interviews, and the results are analyzed and reflected in the final course design. In this process, team activities are evaluated through peer evaluations between experts, mentors, and learners, emphasizing active participation and mutual guidance among learners.

II. THEORETICAL BACKGROUND

1. History and Definition of PJBL

The technological and social changes have made the world more complex, and the talents needed in these times are those who possess creativity and comprehensive problem-solving abilities. [5] PJBL literally is a project-based learning approach where educators provide real-world projects for students to solve collaboratively, exploring and addressing the various problems that arise during the project.

Table 1. History of PJBL(Project-Based Learning)

Year	Name	Progress
1950	PBL (Problem-based learning)	The origin of PBL dates back to 1950 when "Interdepartmental teaching" was implemented to prepare medical students at the Western Reserve Medical School in the United States for practical medical situations.
1950-2010	PBL (Problem-based learning+ Project-Based Learning)	During the early stages of using PBL and PJBL, the terminology PBL is used.
After 2010	PJBL (Project-Based Learning)	However, after 2010, foreign countries began to distinguish project-centered learning as PJBL. [4]

[6] Through this process, students can gradually deepen their research and ultimately complete the project, gaining knowledge and skills.

2. Learning Model of PJBL

The Project-based learning(PJBL) is designed to create tangible results through the execution of medium to long-term team projects, divided into five stages. Peer evaluation is required during the three intermediate stages, and in the fifth stage, publication and evaluation are selectively implemented[7]. The learning model is shown in Figure 1 below.

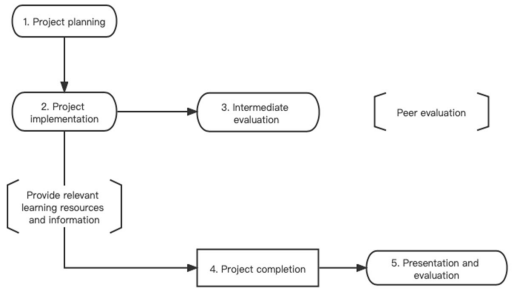

Fig. 1. Learning model

3. Team Activities

Team activities refer to team cooperation achieved through active interaction among team members, aiming at achieving common goals through enhancing teamwork and creating synergies[8]. In team-based learning, educators serve as course designers and managers of the entire teaching process, helping to remove many drawbacks of lecture-based teaching methods, such as lost educational objectives and extended learning time. Learners also participate in learning as active contributors of knowledge, taking responsibility for their previous learning and having an obligation to explain to their peers.

4. Peer Assessment

George Jardine, who served as a professor at the University of Glasgow from 1774 to 1826, described the method and usefulness of peer assessment in written form (Gaillet, 1992), and many empirical studies have been conducted since then (Oh Yearin, Kwon Oh Nam, Park Jooyong, 2018) [9]. Peer assessment is an activity in which peers become assessors and quantitatively and qualitatively evaluate their peer's learning performance or achievements[10].

As an advantage of peer assessment in team activities, it emphasizes learners' active participation and mutual guidance. It can also enhance learners' collaboration and interaction and help learners develop problem-solving and critical thinking skills.

III. COURSE DESIGN

1. Course Design and Operations

1.1 Course Design Process and Steps

The course design process, based on previous research and analysis, is divided into five steps[11], as shown in Table 2 below.

Table 2. Process and Steps of Course Design

Stage	Time	Procedures	Content
1	July 2021	Literature review	Conduct literature review on team-centered classroom and instructional design based on PJBL.
2	Early August 2021~ Mid-August 2021	Conduct in-depth interviews	Conduct in-depth interviews with Expert, industry professionals, design majors Students, and analyze the results.
3	Mid-August 2021~End of August 2021	Classroom design	Finish classroom designs that reflect the FGI analysis results.
4	Early September 2021 Course guidance	Course guidance	Establish course objectives, build teams, and provide course guidance.

5	End of December 2021	Questionnaires	Collect feedback through questionnaires to validate the final results.

The course design process is as follows: Preliminary Research and Analysis Phase (July 2021): In this stage, relevant materials regarding PJBL-based team-centeredw classroom and course design were collected and analyzed. In-depth Interview Phase (Early to Mid-August 2021): Deep interviews were conducted with experts, industry practitioners, and students from design department. The results of the interviews were compiled and analyzed. Classroom Design Phase (Mid to Late August 2021): Based on the findings from the in-depth interviews, specific classroom designs were formulated and completed. Course Guidance Phase (Early September 2021): This phase involved determining the course's positioning, team formation, and providing specific course guidance. Questionnaire Survey Phase (Late December 2021): A questionnaire survey was conducted to collect feedback that validate the final results.

1.2. Learning model of PJBL

In order to effectively implement this PJBL(Project-Based Learning) course, it is absolutely necessary to systematically plan the entire course. The learning model used in this study was modified and optimized based on the PJBL learning model proposed by Younghee Lee and Jeonghyeon Yoon. The details are shown in the table 3 below.

Table 3. Learning model of PJBL(Project-Based Learning)

Stage	Session	Teacher's activity	Students' activity	Peer evaluation	Learning mode
OT	No. 2				
Stage 1	No. 3				
Stage 2-1	No. 4				
	No. 5				
	No. 6-7				
Stage 3	No. 8				
Stage 2-2	No. 9-10				
	No. 11-12				
Stage 4	No. 13				
Stage 5	No. 14-15				

1.3. In-Depth Interviews and Results

In order to make modifications and additions to the course design in this paper and improve the completeness of the course design, in-depth interviews are conducted.

The interviews were conducted in early August 2021 to mid-August 2021, and the interviewees included six experts with master's degrees or above and the title of associate professor or above in the field of visual design, eight industry practitioners who have worked in UI design for more than five years with a bachelor's degree or above, and ten sophomore and junior majoring in visual design.

The UI design course requires experts with a professional background in visual design to provide theoretical guidance,

industry practitioners with work experience to provide practical guidance, and feedback from students to continuously improve and perfect the teaching content.

The interviews and results are summarized in table 4 below.

Table 4. In-depth interviews and results

Interviewee	Description	Number	Interviewing content(key words)	Findings
Expert	with master's degrees or above and the title of associate professor or above in the field of visual design	6	Progression of UI design course Objectives, strategies, and directions of UI design course Whether the PJBL model is suitable for UI design Whether the syllabus design is reasonable Lectures, expert feedback and guidance	Clarify the course objectives, strategies, and direction for UI design. Based on the characteristics of UI design, agree that the PJBL model is more suitable for UI design courses. Lectures, expert feedback and guidance are helpful for learners to understand UI design, as well as solving project difficulties and tracing progress. Agree that peer evaluation can provide fair and efficient grading.
Industry practitioners	have worked in UI design for more than five years with a bachelor's degree or above	8	Skills, patterns, mental states required for the job Whether the PJBL model is suitable for UI design The rationality of the syllabus setting Peer evaluation and the content of the peer evaluation Additional advice for students	Students need relevant training in practical experience, teamwork, and actual requirements for their future work. Speaking from the perspective of UI design work experience, the PJBL is more suitable for UI design courses, and can effectively connect education, learning, and work. Agree to use peer evaluation, which can evaluate the participation in project completion.
design majors Students	sophomore and junior majoring in visual design	10	Progression of UI design course The expected way to learn UI design The rationality of the syllabus setting The goals want to achieve through the learning of UI design Peer evaluation and the content of the peer evaluation	Need a combined online and offline learning mode. Want to learn about customer needs and industry trends after getting in touch with work. Need to learn practical requirements for the job. Prefer peer evaluation, which can provide transparent grading.

Based on the results analysis of in-depth interviews, experts suggest that UI design courses should clarify their objectives, strategies, and direction, and that the PJBL is suitable for UI design. Lectures and peer evaluations can help students learn and evaluate their progress. Industry practitioners suggest that students need to train in practical experience, improve teamwork, and meet actual requirements. The PJBL is suitable for APP design, and peer evaluations can be graded based on project completion. Students suggest that a combination of online and offline learning is needed, and they want to learn practical requirements for work. They prefe transparent grading.

1.4. Course Design

Teaching Syllabus:

Based on the preliminary research and analysis, this study optimized the learning model of Younghee Lee and Jeonghyeon Yoon and conducted in-depth interviews with experts, industry practitioners, and design majors. The findings from these interviews were then applied to the course design presented in Table 5. Finally, the

positive effects of this teaching model were validated through a questionnaire survey. The teaching model has already been implemented and taught in an experimental class at a university of applied sciences in China.

Table 5. Syllabus

Stage	Session	Teacher' s activity	Goals	Learner' s activities	Output	Peer review	Learning mode	Experts lectures
OT	No.2	• Introduction of UI design • Provide guidance for team formation, division of roles, team operation rule	• Understand the project • formed, division of roles for APP	• Provide guidance for team formation(division of roles)	• Report of division of roles	-		-
Phase 1 Project-APP product positioning	No.3	• Provide guidance for team project topics •Provide learning resources and information for product positioning	• Understand the goals of the project • Item division • Confirming the positioning of APP	• Select APP team project topics and develop an implementation plan • Product positioning related learning resources and information collection, exploration, analysis	• Project • plproduction positioning	-	-Real-time Q&A -offline -Team discussion	-Product analysis for UI projects Lecture 01
Phase 2-1 Project-APP interaction design	No.4	• Feedback on the implementation plan for APP interaction design • Solve problems in the project •Provide learning resources and information related to interaction design 01	•Facilitate the phased implementation of the project • Finish the interaction design	• Team Discussion • Write research methods and content	Interaction design	-	Offline + online Team discussion	Interaction design for UI projects Lecture 02
	No.5	• Feedback on research methodology and content • Solve problems in the project • Provide learning resources and information for interaction design 02		• Group discussion • Research content and discussion of results • Interaction design related learning resources and information collection, exploration, analysis • Interaction design		-	-online Team discussion	

	No.6-7	• Provide guidance for How to present interim reports and give feedback		• Summary of project progress of interaction design • Preparation, correction and supplement of interim report		-	-online Team discussion	
Step 3 Mid-term evaluation	No.8	• Give feedback on the progress of the team project in the middle of the process • Direct and implement peer reviews	•Evaluate the interim objectives of the project	•Announcement of interim report	• Interim report	Peer review - inter-team evaluation	- Live demos and Q&A -online Peer review	-
Phase 2-2 Project - APP visual design	No.9-10	• Provide learning resources and information about visual design 01 • Give feedback on project execution results • Solve problems in the project about visual design	• Facilitate the phased implementation of the project • Finish the visual design	• Visual design related learning resources and information collection, exploration and analysis • Data analysis and practice • Visual design	• visual design		-offline Team discussion	Visual design of UI projects Lecture 03
	No.11-12	• Provide learning resources and information about visual design 02 • Give feedback on project execution results • Solve problems in the project about visual design		• Summary of project progress of visual design • Group discussion • Write research findings and discussions			Offline + online Team discussion	
Step 4 Project-APP completed	No.13	• Provide guidance for how to generate the final report	• Project completion	• Group discussion • Research significance, proposal writing, references	• Report		-online Team assessment	Closing of the UI project Lecture 04
Step 5 Publication and evaluation	No.14-15	• Demonstrate team project and publish report on the APP • Direct and implements peer reviews	• Project evaluation on the APP	• A completed APP project • Form the final report	• Production of deliverables-a completed APP • Final report	Peer review - intra-team and inter-team evaluation	-offline Peer review	

The entire learning process, involved 16 weeks of team activities for the course, including orientation week and mid-term and final weeks. Weeks 2-3 are the launch phase of the APP project, during which teams are formed and the theme and division of labor for the APP project are selected. The product positioning of the APP is completed, including product analysis, requirement mining, and requirement positioning. Weeks 4-7 are the specific project planning and exploration phase for the team, collecting data based on the APP project theme, and sharing learning in team activities. The interaction design of the APP is completed, including product architecture, prototype design, and flow design. Weeks 9-12 are the stage for solving visual problems for the APP project. The visual design of the APP is completed, including interface design, design specifications, labeling, slicing, and naming. Weeks 13-15 are the final project presentation week for each team. During the process, experts provided lectures and guidance to students, offering industry insights and advice. This support helped students navigate their projects smoothly and achieve better results.

The research employs a PJBL-oriented, team cooperation-centered, and peer-assessment-based course design, which plays a significant role and offers advantages in the three stages of UI design courses.

In the Product Positioning stage, students engage in real projects to design goals and conduct user research under the framework of PJBL. This enables a deeper understanding of the project's scope and ultimate objectives. By analyzing user needs and behavioral patterns, students experience various processes involved in product positioning. This practical learning enables students to grasp project management and demands analysis skills more intuitively and apply theoretical knowledge learned in the classroom to real-world scenarios.

During the Interaction Design stage, PJBL requires students to consider factors such as user experience and interface flow, develop information architecture and wireframes, and design the structure, layout, functionality, and flow of UI elements. Collaboration with team members helps solve problems, make design decisions collectively, and share knowledge in a cooperative environment. Students provide mutual evaluation and feedback based on project progress, further enhancing their design abilities.

In the Visual Design stage, students combine the requirements and goals of real projects to create interface designs. They need to consider aspects such as colors, fonts, images, and icons, translating abstract concepts into tangible designs. At this stage, students learn how to apply design principles and standards, integrating design concepts with actual project needs.

Clear project planning and objectives, sufficient project experience and skills, and effective teamwork are crucial elements in UI project. [12] By integrating PJBL into UI design courses, students gain a more comprehensive understanding of the work involved in UI design and experience various stages of a project in a simulated work environment. Through

teamwork and peer assessment, students collaborate to solve problems, learn from each other, and receive feedback, promoting their skill development.

In the team project-oriented UI design course based on Project-Based Learning (PJBL), the content and process of each stage are intricately connected to the specific outcomes achieved by students. Compared to traditional lecture-based course designs, this course allows students to comprehensively and systematically participate in various project stages. As a result, they develop a deeper understanding of the overall system process and attain more comprehensive and systematic outcomes. The following provides a more refined explanation of the close correlation between the content, process, and specific outcomes obtained by students in each stage:

Product Positioning Stage:

Content and Process: Students actively engage in goal design and user research for real projects, fostering an in-depth comprehension of the project scope and final objectives. They analyze user needs and behavior patterns to participate in diverse processes of product positioning.

Outcomes: The target design document, user demands, analysis reports, user profile, and other outputs created by students reflect their understanding of project goals and user needs. Additionally, they demonstrate proficiency in applying practical requirement analysis and positioning processes.

Partial product positioning outcomes are exemplified in Figure 2.

Fig. 2. Exemplary product positioning outcomes

Interaction Design Stage:

Content and Process: Through collaborative teamwork, students consider factors such as user experience and interface flow in the project. They develop information architecture, wireframes, and design the structure, layout, functionality, and flow of UI elements.

Outcomes: The information architecture diagrams, wireframes, interactive prototypes, and other deliverables presented by students showcase their critical thinking skills and proficiency in operating user interface design.

Partial interaction design outcomes are depicted in Figure 3.

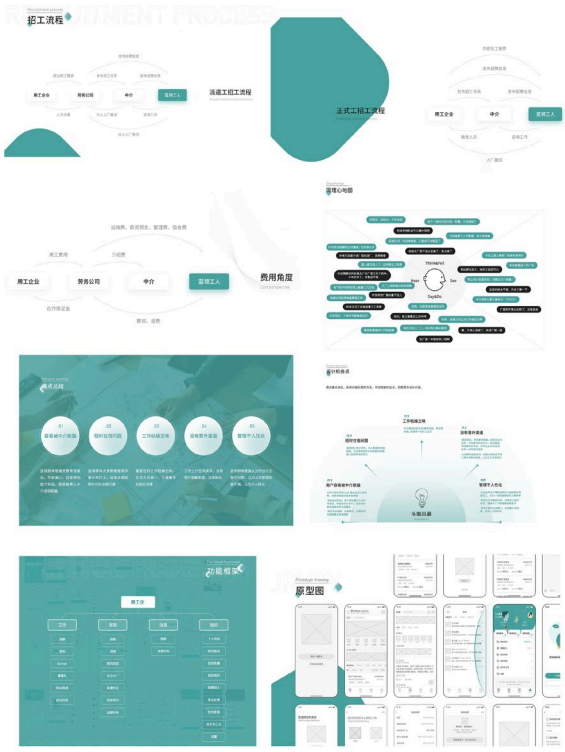

Fig. 3. Exemplary interaction design outcomes

Visual Design Stage:

Content and Process: Students integrate project requirements and objectives to execute interface design, considering aspects such as colors, fonts, images, and icons. They transform abstract concepts into tangible designs.

Outcomes: The interface design drafts, visual style guides, color schemes, and other outputs demonstrated by students exhibit their competence in creating aesthetically pleasing interfaces, effectively conveying visual messages, and expressing brand identity. Furthermore, they exemplify the students' capability to harmonize design concepts with actual project needs.

Partial visual design outcomes are illustrated in Figure 4.

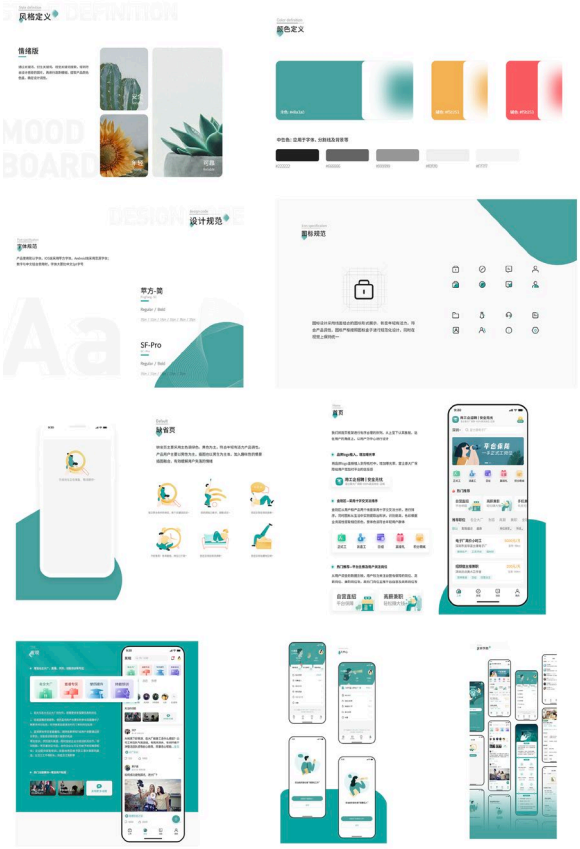

Fig. 4. Exemplary visual design outcomes

Ultimately, each group can produce a set of project deliverables that meet real-world job requirements, covering various stages from product positioning to visual design. These experiences and outcomes are primarily acquired through participation in real projects and practical activities.

Evaluation Method:

Project completion (30%), presentation and discussion (30%), attendance (10%), and peer evaluation (30%).

Peer evaluation includes work content and team role allocation, prospects and expected outcomes, actual use, commercialization, and feasibility. In discussion-based team activities, learners provides feedback each other and conducts peer evaluation at each stage.

Feedback can be given using a scale of 1 to 100 based on the level of contribution, role, creativity, and collaboration among team members. Professors and experts will participate in evaluating both stages.[13]

Peer evaluation is shown as an example in Table 6 below °

Table 6. Evaluation table

Name	Stage	Teachers' evaluation	Experts' evaluation	Peer evaluation	Score
	OT	-	-	-	
	Phase 1				
	Phase 2-1				
	Phase 3	A necessary stage	A necessary stage	A necessary stage	
	Phase 2-2				
	Phase 4				
	Phase 5	A necessary stage	A necessary stage	A necessary stage	

2. Research Methods for the Course

2.1. Research objects and tools

Research subjects: 146 students enrolled in the first semester of the third year of the Communication Design program at a university of applied science in China, divided into four classes. The composition of the research subjects is shown in Table 7 below.

Table 7. Research subjects

Features	Distinction	Frequency (number)	Proportion (%)
Gender	Female	82	56
	Male	64	43
Regular course	2020 School Year class 1	35	23.9
	School Year class 2	38	26
PJBL	School Year class 3	37	25.3
	School Year class 4	36	24.6

2.2. Measurement Tools

The measurement tool used in this study is a learning effectiveness questionnaire consisting of 20 questions. SPSS mac.25 was used to analyze the data to investigate if there are any significant differences in the impact on learning and its effects. The survey was conducted at the end of December 2021. The survey targets three categories of participants: experts, designers, and pilot students, with a total of 186 questionnaires distributed both online and offline. A total of 176 valid questionnaires were collected. The participation of respondents is shown in Table 8 below (N=186).

Table 8. Survey participants

Subjects	Description	Frequency (number)	Distinction (number)	Proportion (%)
Expert	Associate professors or above in the field of design	10	10 (valid)	5.69
			0 (invalid)	0.00
Designer	Designers in the UI design industry with at least 3 years of experience	30	24 (valid)	13.63
			6 (invalid)	3.40
Design majors	Students from four classes offered in the first semester of the third year	146	142 (valid)	80.68
			4 (invalid)	2.27

IV. ANALYSIS OF COURSE OPERATING RESULTS

Based on the collected 176 questionnaires, a comparative analysis

was conducted on the learning effectiveness of lecture-based learning and PJBL-based team collaboration, as well as the joint evaluation of learning effectiveness from four sub-factors (learning motivation, learning immersion, peer evaluation, and learning satisfaction). The results of the analysis are shown in Table 9:

Table 9. School effects (motivation, immersion, evaluation, satisfaction) Difference, M-mean, SD-standard deviation, T-text **p<.01 *p<.05

Distinction	Classes	Frequency	M	SD	T
Learning motivation	PJBL-based	176	3.92	0.93	2.504**
	Lecture-based	176	2.45	0.58	-3.057*
Immersion	PJBL-based	176	4.38	0.87	0.723*
	Lecture-based	176	3.67	0.34	-3.134
Peer evaluation	PJBL-based	176	5.07	1.01	2.405
	Lecture-based	176	2.83	0.68	-3.238
Academic effect	PJBL-based	176	4.23	0.91	0.173**
	Lecture-based	176	3.45	0.45	-1.713

Through comparative analysis on the teaching types, it is found that in terms of learning motivation, the average score for the PJBL-based class was 3.92, while the lecture-based class was 2.45. In terms of learning immersion, it is 4.38, and 3.67 respectively. In terms of peer evaluation, 5.07 and 2.83. In terms of learning satisfaction, 4.23 and 3.45.

Based on the results analysis, it is confirmed that the PJBL-based class has significant differences, with statistical significance, in four subfactors: learning motivation, learning immersion, peer evaluation, and learning satisfaction, compared to the lecture-based class. This has a positive impact on the learning effectiveness of the UI design course.

V. CONCLUSION

The research findings indicate that the PJBL-based class showed statistically significant improvements in all four aspects of the sub-factors, while no statistically significant results were found in the lecture-based class. The course design developed based on PJBL, with a focus on team cooperation and peer assessment, has been found to be highly effective in terms of applicability and relevance in each stage of the UI design course, including product positioning, interaction design, and visual design. Simulating real projects and work environments enables students to enhance their overall competence through practical experience, teamwork, and peer assessment. This study also suggests that more efficient teaching models, combined with appropriate peer assessment methods, can help alleviate the burden on instructors in terms of teaching. Therefore, this PJBL-based educational approach effectively bridges the gap between teaching, learning, and work. It is expected that the results of this study can be applied

in various ways to the course design of the courses that similar to design majors. The limitation of this study is its relatively short duration, the research sample may be subject to certain constraints, making it challenging to apply and generalize the findings to all major disciplines.

REFERENCES

[1] Yoo-Kyung Chung, "Study on Active Learning & Facilitation Convergence Education Program for Enhancing Core Competency(4C)," *Smart Media Journal*, Vol.8, No.1, pp. 67-73, 2019

[2] Li, Y. and Zhang, J., "A Study on the Development of College Students' Professional Skills in the Context of the Internet," *Journal of Higher Education Research*, 37(2), pp. 238-240, 2020

[3] Lee, Younghee, Yoon, Jeonghyeon, "A Case Analysis on Development and Operation of University Class Model using Peer Assessment Based on Collective Intelligence," *Journal of Education & Culture*, Vol.27, No.5, pp. 164-166, 2021

[4] What is the difference between problem-based learning (PBL) and project-based learning (PJBL)? (2022). https://www.sohu.com/a/614748397_120492088 (accessed Mar., 24, 2023)

[5] BongShik Yun, Sowol Yoo, "A Design of Statistical Analysis Service Model to Analyze AR-based Educational Contents," *Smart Media Journal,* Vol.9, No.4, pp. 66-72, 2020

[6] Kim, Yangsoon, "The Problem/Project-Based Learning (PBL/PjBL) at Online Classes," *International Journal of Advanced Culture Technolo,* Vol.9, No.1, pp. 162-167, 2021

[7] Lee, Young-hee, Yoon, Jeong-hyeon, Op. cit., p. 165, 2021

[8] Lee, In-Chul, Kang, Mun-Koo, Han, Seok-Hee, "The Study on the Improvement of English Proficiency through Task Force Team Activities," *Journal of Linguistic Studies*, Vol.20, No.1, pp. 79-98, 2015

[9] Oh Yaerin, Kwon Oh Nam, Park Jooyong, "The Reliability and Validity of Online Peer Assessment on Proofs in a Number Theory Course," *THE MATHEMATICAL EDUCATION,* Vol.57, No.3, pp. 216, 2018

[10] Kim, M., *Peer assessment as a learning method: the effects of the assessor and assessee's role on metacognitive awareness, performance, and attitude,* VDM, pp. 432-439, 2008

[11] Rhee Esther, "Design of Team Activity-Centric Psychological Art Engineering Class Based on PjBL in the University," *Korean Journal of Arts Education,* vol. 20, no. 2, pp. 73-92, 2022

[12] Young Kee Jung, "Development of Smart Phone App. Contents for 3D Sign Language Education," *Smart Media Journal,* Vol. 1, No. 3, pp. 8-14, 2012

[13] Rhee Esther, Op. cit., pp. 73-92, 2022

[14] J. Thomas, "A Review of Research on Project Based Learning," *International Journal of Research*, 1(1), pp. 40-46, 2000

[15] Ji Hun Oh, Dae Won Jang, Il Yong Chung, "The Effects of SW Education Using EPL and Coding robot on the Computational thinking and Problem solving," *Smart Media Journal*, Vol.10, No.3, pp. 60-67, 2021

[16] Nelson, H. G. and Stolterman, *Intentional change in an unpredictable world,* MIT Press , 2nd ed., pp. 31-54, 2012

[17] Brown, T., *How Design Thinking Transforms Organizations and Inspires Innovation,* Harper Collins, pp. 47-69, 2009

Authors

WANG LEI

She obtained a master's degree in Visual Communication Design from Konkuk University in 2014. In 2022, she is pursuing a Ph.D. in Media Studies at Dankook University with the research fields of design education methodology, UI design, UX design, branding design, and design for sustainability.

Choi Wonjae

Professor Choi Wonjae is currently working at the Department of Communication Design at Dankook University. He has been performing opera and musical stage design for many years at the Korea as well as overseas. In addition, he held four solo exhibitions in Taiwan, the United States and China. In addition, He participated in many overseas exhibitions for 28 years.