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論文の内容の要旨

Creativity is an essential skill in this increasingly complex, uncertain, and changing world. It has become increasingly prominent in education in the last few decades. Several countries emphasize developing their students' creative potentials with their education policies. Design education is crucial in preparing innovators, creators, and thinkers of the 21st century. Product design promotes student engagement in creative problem-solving. The development of problem-solving skills among students majoring in product design requires opportunities to work on real-world problems and construct tangible knowledge in authentic professional contexts. Project-based learning (PBL) is a useful tool for accomplishing this goal. Traditional product design education in China excessively emphasizes fundamental theory and skill training. Lecture-based strategies are the usual teaching method. It is rare for classroom activities and curricula to be designed to emphasize teaching strategies that develop creativity. Research on the PBL teaching method for product design in China is at a preliminary stage and lacks systematic study. Most studies outline the pedagogical steps of PBL in a course but lack validation of its effectiveness and research on the PBL teaching paradigm in product design education. Hence, designing teaching methods based on PBL to enhance creativity in product design education has become significant.

The main research objective of this dissertation was to develop a teaching method using PBL for product design education to improve students' creativity. Three studies were designed and implemented to achieve this primary research objective.

First, we conducted a survey using a questionnaire to evaluate personal creativity levels and influencing factors among college students majoring in product design in Study 1 (Chapter 3). We examined their current product design capabilities, cognition of creative thinking methods, and perceptions and preferences for teaching methods and course forms. According to the data analysis, the students' creativity was generally poor. The teaching method usually caused low creativity levels among the students. The lack of understanding of creative thinking methods, disinterest in homework assignments, and the rigid teaching environment were also factors contributing to the students' lack of creativity. The findings from Study 1 provide a reference for designing a future efficient teaching method to enhance students' creativity by considering the influencing factors.

Second, in Study 2 (Chapter 4), we conducted semi-structured interviews with eight educators of different educational backgrounds. Through the interviews, we examined the respondents' application of creative thinking methods regarding teaching effectiveness, perceptions, and teaching suggestions involved in their teaching process. The interviewees provided their insights into the specific application of other creative methods. They chose from among the several creative thinking methods we provided to them, which did not include the TRIZ (Theory of inventive problem solving) method, as it was not recommended. We conducted a thematic data analysis to reveal the eight educators' perceptions of the students' low creativity. We summarized the following reasons for the students' low creativity on the

basis of the interview analysis:

1. Their lack of life experience hampered the students in discovering their daily problems and developing innovative products.
2. The students failed to observe the objectives effectively and scientifically in their daily lives.
3. They had a poor capacity for independent thinking and excessively relied on teachers and electronic devices in the learning process.
4. The imperfect curriculum design resulted in the students' lack of training in creative thinking methods.
5. The students had poor time management and self-management skills.
6. The rigid teaching environment and unreasonable classroom layout negatively affected the students' creativity.
7. There was a lack of novelty and attractiveness toward the course assignment proposition.
8. The teaching method lacked innovation, and the teaching content was monotonous.

The teaching method designed in this dissertation was based on the results of the interviews. The respondents even suggested five ways to stimulate student creativity: sharing excellent design cases with students, recommending SWOT analysis, working and discussing in groups, random stimulation, and role-playing. In the next stage of the instructional design, we used the methods suggested by the respondents in the interviews as a platform for the students. The respondents' suggested methods for generating creative ideas at various product design stages were summarized. In future teaching experiments, these data will support students as a scaffold. The educators, who had excellent teaching experiences, were asked to suggest and advise on teaching methods to improve student creativity. The respondents proposed teaching methods to enhance student creativity in the following dimensions: assignment proposition, teaching methods, teaching activities, student learning behaviors, and teaching content. The analysis of each interview question informed the design of the teaching method proposed in this dissertation.

Third, in Study 3 (Chapter 5), we combined the findings from studies 1 and 2 with PBL to develop our instructional design, which we call "PIEPR." The teaching process was organized into the following phases: preparation, impartation, exploration and implementation, presentation and evaluation, and reflection and improvement. The teaching experiment conducted a pretest and posttest to determine students' creative thinking levels using the Torrance Test of Creative Thinking-Figural. We also investigated the teaching effect after the experiment to determine the effects of the teaching method on the students' creative thinking levels. We drew our conclusions from the analysis of the interview data, the pretest and posttest results of the experimental and control groups, and the observations of the course conduction. According to the above-mentioned processes, both the experimental and control groups exhibited improvements in all four criteria of creative thinking abilities. A comparative analysis of the creative thinking levels of the students in the experimental group between the pretest and posttest revealed that the students' flexibility, fluency, originality, and elaboration were significantly improved with the experimental activities in our PIEPR teaching method. However, these were also slightly increased in the control group, but the improvements were not statistically significant. Thus, this indicates that the improvements of the creative thinking skills in each evaluation criterion in the experimental group were more effective than those in the control group. This implies that the PIEPR teaching method, which is based on PBL, is implementable and valuable in cultivating creative thinking skills among product design students.

The main contribution of this study is the teaching method we designed, PIEPR, which is an innovative teaching method based on PBL that enhances the creativity of product design students. Specific creative teaching methods and teaching processes were proposed: preparation, impartation, exploration and implementation, presentation and evaluation, and reflection and improvement. This research provides a reference for future product design education by designing the PIEPR teaching method. We hope that the teaching method proposed herein could be popularized and utilized in future product design education courses. This study also provides educators with preferable teaching strategies to cultivate more innovative talents to drive product development in the new era.

Keywords: Creativity; Creative thinking methods; Project-based learning; Product design education; PIEPR.

論文審査の結果の要旨

Importance of creativity become more and more prominent in design education field for fostering next generation leaders. In product design education, we promote creative problem-solving skills based on project-based learning (PBL). However, research on the PBL teaching method for product design in China is still at a preliminary stage and lacks systematic and empirical study.

This research developed and implemented a teaching method using PBL for product design education to enhance students' creativity through various methods including 1) questionnaire survey to evaluate personal creativity levels and identify influencing factors. 2) semi-structured interviews with educators to describe the application of creative thinking methods regarding teaching effectiveness, perceptions in their teaching process; 3) educational experiment with PIEPR (preparation, impartation, exploration - implementation, presentation - evaluation, reflection - improvement) process based on PBL.

She found that the students' flexibility, fluency, originality, and elaboration were significantly improved after the educational activities in the PIEPR teaching method.

This developed a PIEPR teaching method based on PBL that enhances the creativity of product design students, and it provides a reference for future product design education by adopting the PIEPR teaching method. Thus, we approve awarding a doctoral degree to Ms. SUN, Xiaolei in September 2022. All the committee members approved it on her final defense on Aug 2nd 2022.