THE EFFECTS OF PROBLEM-BASED LEARNING PROGRAM ON CHINESE HIGHER VOCATIONAL STUDENTS' CREATIVE SELF-EFFICACY

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ผลของโปรแกรมการเรียนรู้โดยใช้ปัญหาเป็นฐานที่มีต่อประสิทธิภาพภายในตนเองเชิงสร้างสรรค์ของนักเรียนอาชีวศึกษาระดับสูงของจีน

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This study aims to develop a problem-based learning program (PBLP) to enhance Chinese higher vocational students' creative self-efficacy and investigate the effectiveness of using the PBLP to enhance students' creative self-efficacy in terms of three components: Ideageneration, Uncertainty, and Focus. This test of Creative Self-efficacy was adapted from Alan Hill's test of Creativity Self-efficacy. The sample consisted of 108 students with the lowest level of creative self-efficacy, selected from a total of 326 students. They were randomized equally into the experimental and control groups, with 54 in each group. The experimental group was taught by the PBLP mode, while the control group was not. The researcher first recorded the students' pre-test scores and had the students participate in a PBLP course, then administered a post-test at the end of the PBLP course. Finally, data were collected and analyzed. The results show that the PBLP can enhance Chinese higher vocational students' creative self-efficacy. There is a significant difference in students' creative self-efficacy before and after the experiment in all components at the .001 level. Students are very satisfied with the problem-based learning program.

Keyword : Problem-based Learning program, Creative Self-Efficacy, Chinese higher vocational students

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CHAPTER 1

INTRODUCTION

1.1 Background

Against the backdrop of today's increasingly globalized economy, science and technology are advancing at an astonishing rate (Northcut, 2010). The survival of human beings also relies on creativity, and an individual's growth is closely related to it (Csikszentmihalyi, 1997). As Albert Einstein said, "Creativity is more important than knowledge, because knowledge is limited, while creativity encompasses almost everything in the universe. It drives the evolution of technology and is even the source of knowledge. A world without creativity is doomed to be monotonous and lifeless(Kozbelt et al., 2010). The study of creativity can be traced back to the mid-19th century. Gulford and Torrance's explorations in the psychology of creativity are regarded as the starting point of research in this field(Comfort & Wukich, 2013).

Therefore, in today's rapidly changing society, the traditional education model is gradually failing to meet the market demand for innovative talents (Ulger, 2018). Since then, scholars from various countries have increasingly recognized the importance of creativity and have begun to study it extensively (Runco, 2007). In the 1980s, the Japanese government pointed out that cultivating creativity is the key to the future and emphasized the need to cultivate "globally competitive creative human resources(Aspinall & McLaughlin)."At the same time, an educational debate on "what kind of talent to cultivate" began in the U.S. In 1983, the National Commission on Excellence in Education warned the public: "We are in a crisis, and the growing number of mediocrities is threatening our nation's and our people's future (Snooks, 2020). " Wolfe, chairman of the Federal Commission on Human Resources and Advanced Talent Development, stated, "For a nation like the United States, we have no choice but to rely on the best minds for invention, discovery, and application. The intelligence of our citizens is the nation's most valuable asset(Mulgan, 2017)." In Germany, on the other hand, the Minister of Research Riesenhuber explicitly warned the public, "We can only

gain a foothold in international competition if we are a scientific and technological powerhouse, and our survival depends on the quality of our brains, not on any other factor(Fry, 2009)." It can be seen that behind the competition in science and technology is the competition in creativity. Similar to China, in recent years, China's innovation capacity has been rapidly improving, and it has become a significant force in global scientific and technological innovation, with considerable potential for future development (Wei et al., 2017). However, at the same time, there are many problems, and sustained efforts are needed to overcome the current challenges and achieve a higher level of innovation, especially in today's increasingly competitive global market; it is particularly urgent to strengthen the construction of innovation capacity. To cope with the rapidly changing global economy, China urgently needs to invest more in several key areas, including science and technology, education, and culture, to cultivate talents with an international outlook and a sense of innovation.

However, many believe that innovation is limited to the exclusive domain of prestigious universities, doctoral and postgraduate students, and that tertiary students do not need to be involved. Higher vocational students are not only an important group of Chinese youth for creativity development but also the main force behind the country's future development, and they need to possess a stronger innovative ability to adapt to the needs of the times (Fang et al., 2018). In China's higher vocational education system, Creative Self-efficacy has been increasingly emphasized as an important psychological trait for students in learning and practice. Creative Self-efficacy influences students' motivation, learning strategies, and final academic performance(Puozzo & Audrin, 2021). Cultivating the creative self-efficacy of higher vocational students can enhance their comprehensive quality, increase social competitiveness, and meet the needs of the national development strategy.

Apparently, among students with high creative self-efficacy, their self-expectations of creative behavior correlate more with creative work engagement than those with low creative self-efficacy. Moreover, students with higher self-efficacy perform exceptionally well in creative tasks. When they face challenges and setbacks, they will

be more courageous to challenge the difficulties, pay more attention to and create a more suitable environment, which can further stimulate their perseverance and perseverance, seek for easier paths, and give full play to their maximum ability to seek to try different ways to overcome difficulties; the stronger the students' creative self-efficacy, the more confident and the more inclined they are to choose a more appropriate way to overcome the difficulties; the more students' creative self-efficacy, the more they will be able to choose a more suitable environment for their creative work. The stronger the students' innovative self-efficacy, the more confident they are, the more inclined they are to choose relatively challenging tasks, and they will be emotionally invested in the activities, actively trying new methods and paths to improve efficiency and complete the task(Wood et al., 2000).

However, existing research suggests that higher vocational education has focused more on teaching specialized knowledge in the curriculum, while relatively neglecting the development of creative self-efficacy among higher vocational students (Xie et al., 2023). Although some schools have started introducing innovation and entrepreneurship programs, systematic creative self-efficacy training still needs improvement. Due to weak creative self-efficacy, which often leads higher vocational students to feel helpless when facing creative challenges in the real world, many of them lack sufficient self-confidence in the learning process, especially when confronted with complex practical problems (Puozzo & Audrin, 2021). The survey showed that most higher education students reported feeling unconfident in performing creative tasks and believed they were not creative enough to cope with some creative tasks. They often feel uncomfortable in the face of uncertainties in creative tasks, which leads to avoidance to the extent that they cannot concentrate on creative tasks and come up with creative solutions. Some studies have highlighted the need to develop and practice creative self-efficacy through regular practice (Álvarez-Huerta et al., 2021). Due to the limitations of internships and practical training opportunities in higher education institutions, students need more environments and opportunities to develop their creative self-efficacy.

Therefore, as an important form of education for cultivating high-quality vocational talents, China's higher vocational education faces the double challenges of reform and development. Against this background, enhancing the Creative Self-efficacy of higher vocational students has become a core issue of concern for educators. Higher vocational students face unprecedented challenges and opportunities as an essential group of Chinese youth in developing creativity(Zhou et al., 2024). Therefore, higher vocational colleges and universities must adjust their teaching concepts to emphasize the cultivation of students' creativity. If a person wants to improve their creativity, Creative Self-efficacy is a crucial factor that cannot be ignored, as it has a close relationship with creativity.

Creative Self-efficacy refers to an individual's confidence and belief in his or her ability to succeed in creative tasks. The concept is derived from psychologist Albert Bandura's self-efficacy theory, which emphasizes how people's perceptions of their abilities influence their motivation, emotions, and behavioral performance (Bandura, 1977). Since Bandura proposed the concept of self-efficacy, this idea has been widely applied in various aspects of the educational field, encompassing the learning processes of students of different grade levels and abilities. Regarding research on creative self-efficacy in the field of education, many scholars have explored the impact of creative self-efficacy on students. According to Beghetto, students with high creative self-efficacy are more inclined to choose challenging tasks they believe they can complete and succeed at. This positive attitude motivates them to keep exploring new areas and trying new things. Conversely, students with low creative self-efficacy may avoid choosing tasks they believe they cannot perform, limiting their opportunities to learn and grow. In addition, students with high creative self-efficacy are more likely to exhibit high psychological resilience and cope positively with life's stresses and setbacks, thereby maintaining their psychological well-being. Students with low creative self-efficacy may have increased psychological distress, such as anxiety and depression, due to a lack of confidence and coping skills(Beghetto, 2006). Puozzo's study notes that students with high creative self-efficacy are more likely to persevere

and exert effort when faced with difficulties and setbacks. They believe in their ability to overcome difficulties and are therefore more willing to invest time and energy in solving problems. Students with low creative self-efficacy, on the other hand, may lack persistence and perseverance, and are prone to give up when they encounter difficulties, resulting in poor learning outcomes. Students with high creative self-efficacy are confident that they can effectively master knowledge and skills; therefore, they can focus their attention, utilize learning strategies appropriately, achieve optimal learning outcomes, and efficiently complete a variety of learning tasks. Students with low creative self-efficacy, on the other hand, may constantly worry about failure and dwell on their inadequacies, making it difficult for them to perform well in learning tasks (Puozzo & Audrin, 2021). Karwowski stated that creative self-efficacy is a crucial prerequisite for engaging in creative endeavors and achieving creative performance. Students with high creative self-efficacy are more likely to generate novel and original ideas and solutions, thus demonstrating higher levels of creativity. Students with low creative self-efficacy, on the other hand, may inhibit their creative behavior and shy away from trying out new ideas and approaches due to a lack of self-confidence(Karwowski et al., 2018). Yu's research shows that students with high creative self-efficacy are more likely to succeed in their academic and professional careers. They possess a high level of self-motivation and adaptability, enabling them to learn and grow in response to challenges. Students with low creative self-efficacy may lack confidence and motivation, which limits their potential to excel in a competitive society (Yu, 2013). Creative self-efficacy has a multifaceted impact on students, affecting not only their academic performance and creativity but also their psychological health and career development. Therefore, educators should emphasize the development of students' creative self-efficacy and improve their self-confidence and creativity through effective interventions.

Creative Self-efficacy is not innate; it is socially constructed through the experience of interaction between people and their environment. Research has revealed that teachers' supportive behaviors and recognition of students' creativity can significantly enhance students' Creative Self-efficacy (Spencer & Lucas, 2018).

Additionally, it is emphasized that creating a classroom environment that is open and encourages exploration is key to stimulating students' Creative Self-efficacy (Karwowski, 2011). According to Puccio's research, problem-based learning programs can stimulate students' idea generation, thus indirectly enhancing their creative self-efficacy (Wang et al., 2024). While Hermelo Silver's research found that problem-based pedagogy emphasizes guiding students' thinking and learning by posing problems, and the posing and solving of problems are often accompanied by uncertainty, which provides students with the space and opportunity to think freely and helps stimulate their creativity and imagination. At the same time, by responding to the challenges posed by uncertainty, students can develop their resilience and adaptability, which helps cultivate their creative self-efficacy (Hmelo-Silver, 2004). By implementing the problem-based teaching method, teachers can effectively enhance students' concentration and promote their development(Cohen & Cohen, 2014). It is an effective pedagogical method for developing students' creative self-efficacy. According to the PBLP learning program, teachers should be good at asking questions, inspiring students to think independently, encouraging creativity, and solving problems with innovative thinking and methods. This process requires students to utilize their Creative Self-efficacy and solve problems effectively based on their new ideas and thoughts (Hmelo-Silver, 2004). In addition, Teachers facilitate discussions that encourage students to articulate their ideas, challenge each other's assumptions, and build upon one another's insights. This collaborative dynamic enhances students' communication skills and nurtures a sense of teamwork and mutual respect, essential for navigating complex real-world problems. Teachers guide students through problem identification, information gathering, hypothesis formulation, experimentation or research, analysis, and conclusion drawing and presentation as part of this process. Each stage enables students to develop creative self-efficacy skills by evaluating sources, synthesizing information, and making informed decisions (Hmelo-Silver, 2004).

In China's higher vocational education system, creative self-efficacy has been increasingly emphasized as an important psychological trait in students' learning and

practice(Zeng et al., 2022). The specificity of vocational education necessitates that vocational school students require more creative self-efficacy to acquire a range of skills and knowledge. However, multiple factors contribute to the generally low creative self-efficacy of Chinese vocational school students. First, students often face more frustrating experiences, which can lead them to question their learning abilities. Although some students possess a wide range of specialties and hobbies, they may lower their self-requirements in the more relaxed environment of vocational schools, thereby missing the opportunity to showcase their talents and experience success, and lose motivation to take the initiative to innovate(Graesser & D'Mello, 2012). In addition, society's over-emphasis on academic qualifications and a certain degree of discrimination against students in vocational schools puts even students with excellent grades and outstanding abilities at a disadvantage in the competition. This status quo tends to give them the illusion that their efforts are futile, severely undermining their self-confidence and, in turn, weakening their willingness to foster innovation(Gorard, 2010). Poor social expectations cannot be ignored, as they significantly impact the innovation self-efficacy of vocational school students. Parents, teachers, and even society may underestimate the intellectual level and innovation ability of vocational school students due to inherent prejudices, and such stereotypes inadvertently convey negative messages, which constitute a serious obstacle to students' innovation self-efficacy. Additionally, some vocational school students have developed bad habits, such as dissipation and poor discipline, during their secondary school years. After entering vocational schools, the relatively relaxed environment and low management pressure, coupled with insufficient attention to students' learning and growth, lead to a weak learning atmosphere. In addition, the clustering of similar students further exacerbates the spread of bad habits, making it difficult for students to focus on developing their creative self-efficacy(Gorard, 2010).

Based on the above study, this research aims to investigate the effects of the Problem-based Learning Program on the creative self-efficacy of Chinese higher vocational students, verify its effectiveness in developing students' Creative Self-

efficacy, and provide new insights for teaching curriculum in higher vocational schools. In terms of age, Chinese higher vocational students are at the stage of personality development characterized by "identity and role confusion," according to Erikson's developmental stage theory (Xing & Rojewski, 2018). At this stage, individuals search for and confirm their values, beliefs, and career goals through learning, socialization, and practical experiences. In this process, creativity enables them to express themselves uniquely. Through art, writing, design, and other forms, they explore and display their inner world, thus gaining a clearer understanding of their interests and values. When faced with various academic and life challenges, they believe their creativity will help them find novel solutions, enabling them to cope with complex problems more effectively and enhancing their adaptability and self-confidence. Suppose higher vocational students fail to pass through this stage in good health. In that case, it not only hinders the development of their ability but also impacts the development of higher vocational education and, by extension, the country. Especially for higher vocational students in e-commerce, the core courses include UI design, AI design, Image processing, and Art design, all of which require software to design works. Therefore, students should exercise their independent innovation ability in the learning process and design excellent works through independent innovation. E-commerce design positions require skilled talents with innovative abilities and the ability to learn independently. Improving the creative self-efficacy of e-commerce students can promote the development of their creativity, which is very helpful for their future learning and career development.

1.2 Significance of the study

Based on the current development status of creative self-efficacy among Chinese vocational college students, this study will construct a problem-based learning program for higher vocational students and conduct experimental research on the program, which is of great significance for student growth, teacher education, teaching, and social development.

For students, Creative Self-efficacy enhances their learning motivation(Puozzo & Audrin, 2021). Students who believe they can successfully solve problems and complete projects are more actively engaged in their studies. Second, Creative Self-efficacy helps students cope with challenges and setbacks. Many students become frustrated and give up their efforts due to difficulties in the learning program. However, students with high Creative Self-efficacy tend to deal with frustration more effectively. In addition, Creative Self-efficacy contributes to the overall development of students. Creativity does not just exist in academia; It also plays an important role in art, sports, and social interaction.

For teachers, cultivating students' Creative Self-efficacy is conducive to students' all-around development and can improve teachers' teaching effectiveness and professional achievements (Xie et al., 2023). In cultivating students' sense of Creative Self-efficacy, teachers can continually reflect on their teaching practices to achieve personal growth. At the same time, teachers should be mindful of the individual differences of each student and provide personalized guidance and support. Good interaction between teachers and students will be more frequent in this process. Listen to students' ideas, respect their creative expression, and encourage them to experiment and explore in a safe environment.

On the social front, there is a growing demand for innovative talents nationwide. Students develop Creative Self-efficacy through various school projects and activities, stimulating their imagination and creativity(Puozzo & Audrin, 2021). In addition, developing students' Creative Self-efficacy also contributes to society's overall competitiveness. By emphasizing students' sense of innovative self-efficacy in the education system, more talents with an innovative spirit and practical ability can be cultivated, providing a steady stream of power for the country's scientific and technological progress and economic development.

1.3 Objectives of the study

The primary purposes of this study are as follows:

1. Design the Problem-based Learning Program to enhance Chinese higher vocational students' Creative Self-efficacy.

2. Study the effects of the Problem-based Learning Program on Chinese higher vocational students' Creative Self-efficacy.

For the study, the following assumptions were used:

1. After attending the learning program, students who participated in the Problem-based Learning Program had significantly higher levels of Creative Self-efficacy than before attending the Problem-based Learning Program.

2. After attending the learning program, students who participated in the Problem-based Learning Program had significantly higher levels of Creative Self-efficacy than students who did not participate in this program.

1.4 Research Question

1. What is the Problem-based Learning Program to enhance Chinese higher vocational students' Creative Self-efficacy look like?

2.what is the effects of the Problem-based Learning Program on Chinese higher vocational students' Creative Self-efficacy.

1.5 Scope of the Study

Population

The subjects of this study were 326 first-year higher vocational students in e-commerce from Guangdong NanFang Institute of Technology in Guangdong Province, China, who had normal development and no other physical or mental obstacles.

Sample

The population of this study consisted of first-year students at the Guangdong NanFang Institute of Technology in Guangdong Province, China. The sample for this study consisted of 108 students with the lowest level of creative self-efficacy, selected from a larger group of 326 freshman e-commerce students. Next, make 108 paper labels, each with a student's name on it. Place these labels in a box

and mix thoroughly. The teacher randomly pulls labels from the box until each group has 54 labels. Lastly, 108 students were randomly assigned to the experimental and control groups, with 54 students in each group. None of the experimental subjects had received the problem-based learning program course. The experimental group participated in the Problem-based Learning Program, whereas the control group did not.

Variable

The variables in this study are as follows:

1. The independent variable is the Problem-based Learning Program.

2. The dependent variable is the Creative Self-efficacy of Chinese higher vocational students.

1.6 Definitions of terms

1.6.1 Creative Self-efficacy

Creative Self-efficacy refers to an individual's confidence and self-assessment of their ability in creative activities. It is an individual's confidence in their ability to generate novel and valuable ideas and solutions when faced with a creative task. Creative self-efficacy in this study comprises three components as follows(Hill et al., 2008):

Idea generation refers to the ability to create, develop, and communicate new ideas where fresh concepts and solutions are needed to address challenges, improve products, or enhance services.

Uncertainty refers to the ability to make choices that lead to challenges in planning and decision-making from having limited knowledge or a lack of definite information about an outcome, event, or situation. Uncertainty can arise from doubt and ambiguity, presenting opportunities for growth and innovation that encourage adaptability and creative problem-solving.

Focus refers to concentrating attention or effort on a particular task, subject, or objective. It involves filtering out distractions and honing in on what is most important, enabling individuals to achieve their desired outcomes more efficiently.

1.6.2 Problem-based Learning Program (PBLP)

The Problem-based Learning Program (PBLP) is a learning program that uses a student-centered teaching strategy that emphasizes teaching methods that promote learning and knowledge acquisition through solving specific problems. The teaching and learning process of the PBLP is divided into five main areas: group organization, Questioning, Discussion, Debriefing, and Reflection (Barrows, 1996).

In this study, the Problem-based Learning Program consists of five steps as follows:

Step 1: Group organization refers to organizing students into small groups, where they can collaborate and work together to solve the problem. It fosters teamwork, communication, and the ability to work in diverse groups.

Step 2: Questioning that refers to a real-world or authentic problem and is presented to students, often in the form of a case study or scenario. This problem is the foundation for the learning process, encouraging students to engage meaningfully with the material.

Step 3: Discussion refers to students working together to develop and test potential solutions to the problem. This process involves critical thinking, creative problem-solving, and the application of knowledge and skills learned in class.

Step 4: Debriefing refers to students presenting their solutions to the problem to the class or a larger audience. This presentation enables students to demonstrate their understanding of the material and apply it in a real-world context.

Step 5: Reflection refers to the presentation, typically followed by an evaluation process in which the facilitator and peers provide feedback on the student's work.

1.6.3 Chinese higher vocational students

Chinese higher vocational students refer to first-year students who enrolled in the e-commerce program of Guangdong NanFang Institute of Technology in Guangdong Province, China. These institutions focus on providing practical and technical skills training that prepares students for specific careers in various industries.

The programs typically emphasize hands-on experience, internships, and applied learning, allowing students to gain relevant competencies for the job market. Higher vocational education is a crucial component of China's educational system, designed to meet the growing demand for skilled workers in the economy.

1.7 Conceptual Framework of the Study

In this study, the problem-based learning program is the independent variable, and the Creative Self-efficacy of Chinese higher vocational students is the dependent variable.

The variable relationship is shown in Figure 1 below:

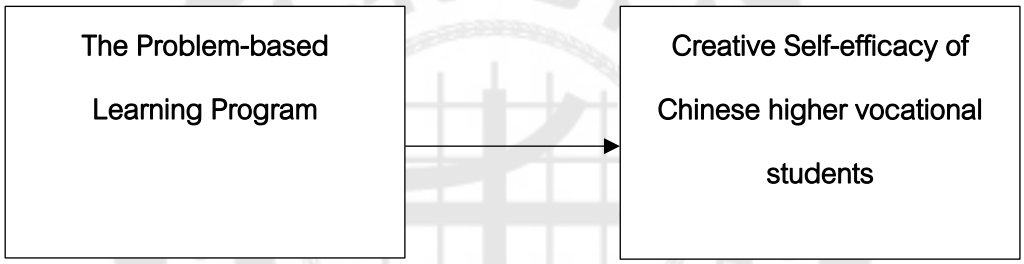

Figure 1 Conceptual framework of the study

1.8 Hypothesis of the study

For the study, the following assumptions were used:

1. After attending the learning program, students who participated in the Problem-based Learning Program had significantly higher levels of Creative Self-efficacy than before attending the Problem-based Learning Program.

2. After attending the learning program, students who participated in the Problem-based Learning Program had significantly higher levels of Creative Self-efficacy than students who did not participate in this program.

CHAPTER 2

REVIEW OF LITERATURE

This chapter is a review of the available literature dealing specifically with:

2.1 Creative Self-efficacy

2.1.1 Definition of Creative Self-efficacy

2.1.2 The Components of Creative Self-efficacy

2.1.3 Measurement Tool of Creative Self-efficacy

2.1.4 Related Research on Creative Self-efficacy

2.2 Problem-based Learning Program (PBLP)

2.2.1 Definition of PBLP

2.2.2 Characteristics of PBLP

2.2.3 Process of PBLP

2.2.4 Theoretical Foundations of PBLP

2.2.5 Key pedagogical issues addressed by PBLP

2.3 The Relationship between PBLP and Creative Self-efficacy

2.1 Creative Self-efficacy

2.1.1 Definition of Creative Self-efficacy

Bandura (1977) put forward the triadic interactive determinism, namely "environment - person - behavior," which emphasizes the important role of the subject in the relationship between behavior and environment. He introduced the concept of "self-efficacy" for the first time and gradually established the theoretical system of self-efficacy based on the summarization of research on individuals and others(Bandura, 1999). According to Bandura, self-efficacy refers to an individual's belief or confidence in their ability to achieve behavioral goals within a particular domain. In other words, self-efficacy reflects a person's judgment of their ability to accomplish a specific task or goal, and this pre-evaluation and judgment will directly affect the individual's subsequent behavior. Individuals with high self-efficacy tend to be more confident in accomplishing tasks. Conversely, if they have low self-efficacy, they may need more

confidence and choose not to take action or give up halfway when encountering difficulties(Bandura, 1999). In addition, the strength of self-efficacy also influences how people choose to behave, how they cope with setbacks, the effort they put into achieving their goals, and the feelings and emotions they experience during the process (Schunk, 1991).

Since the concept of self-efficacy was first introduced, scholars have begun to study it in depth in specific domains or areas of interest. Ford notes that creativity is domain-specific and that individuals with high self-efficacy can stimulate novel and practical ideas through intrinsic motivation(Ford, 1996). Mumford and Gustafson emphasize that self-efficacy positively influences creativity by enhancing individuals' confidence in their ability to generate novel and valuable ideas. The positive effect of self-efficacy on creativity was further confirmed by Mumford and Gustafson(Mumford & Gustafson, 1988), based on the potential link between self-efficacy and creativity. Tierney and Farmer proposed the concept of "creative self-efficacy," which draws on Bandura's self-efficacy theory and Amabile's theory of creativity. According to them, Creative Self-efficacy is an individual's assessment of their ability and confidence to produce creative work in a given task. It forms part of the individual's self-concept. Although Creative Self-efficacy falls under the umbrella of creative personal image, it is distinct from broader concepts of competence, such as self-esteem and self-confidence(Tierney & Farmer, 2011). Creative self-efficacy refers explicitly to an individual's self-efficacy in the creative domain and is distinguished from general self-efficacy, which reflects an individual's overall beliefs about their competence across various domains. Specifically, individuals who engage in creative activities tend to be more willing to engage in creative work if they have high competence beliefs. However, if individuals have low expectations for the outcome of the final creative product, they may be reluctant to engage in creative behavior, which can result in poor performance.

Drawing on Tierney and Farmer's definition of Creative Self-efficacy, this study will define the Creative Self-efficacy of Chinese higher vocational students as a

self-assessment of their ability and confidence to produce particular creative behaviors or works during their studies and lives.

2.1.2 Components of Creative Self-efficacy

Creative Self-efficacy refers to an individual's confidence in his or her ability to generate novel and valuable ideas and solutions when faced with a creative task. Creative Self-efficacy comprises three main components: Idea generation, Uncertainty, and Focus(Hill et al., 2008).

First, idea generation refers to the ability to create, develop, and communicate new ideas, where fresh concepts and solutions are needed to address challenges, improve products, or enhance services.

Second, uncertainty refers to the ability to make choices. It can lead to challenges in planning and decision-making due to having limited knowledge or a lack of definite information about an outcome, event, or situation. Uncertainty can arise from doubt and ambiguity. It can also present opportunities for growth and innovation, encouraging adaptability and creative problem-solving.

Third, focus refers to concentrating attention or effort on a particular task, subject, or objective. It involves filtering out distractions and honing in on what is most important, enabling individuals to achieve their desired outcomes more efficiently.

2.1.3 Creative Self-efficacy Measurement Tool

The Creative Self-Efficacy Measure is an instrument that assesses an individual's self-confidence and sense of competence when faced with creative tasks. With the growing importance of innovation and creativity in all fields, it is increasingly critical to understand and assess how individuals perform in creative activities. Measures of creative self-efficacy can be a combination of quantitative and qualitative methods (Tierney & Farmer, 2011).

Quantitative research is usually implemented through self-report questionnaires, and there are two primary forms of questionnaire design. The first is the Likert-type total plus scale method. This method is designed to have a clear structure characterizing the content and rating of the scale. Participants are required to answer

each question individually, and their self-efficacy strength and level of each factor are measured by the sum of the scores of all the questions.

Based on research into creativity and self-efficacy, Tierney and Farmer developed the Creative Self-efficacy Scale, designed to measure an individual's beliefs about their ability to solve creative problems in the work environment(Farmer & Tierney, 2017). In this area, Taiwanese scholar Lin Bifang developed the Creative Teaching Self-efficacy Scale, specifically for teachers, within the theoretical framework of Tierney and Farmer. The scale consists of three dimensions: teachers' positive and negative creative self-efficacy beliefs and coping beliefs about the external environment(Lin & Qiu, 2008). Meanwhile, Hong Suping and Lin Shanru in Taiwan developed the Student Creative Self-efficacy Scale using a Likert-type measure. The scale encompasses three dimensions: creative thinking strategy beliefs, creative finished product beliefs, and the ability to resist negative evaluations. The study demonstrated that it performed well in terms of reliability and validity (Weng & Zhang, 2024). Alan Hill, a famous scholar in Singapore, also designed a self-efficacy scale for student groups. It contains three parts: Idea generation, Uncertainty, Focus, and its reliability, which have been verified in China (Hill et al., 2008).

2.1.4 Related Research on Creative Self-efficacy

As a special area of self-efficacy, creative Self-efficacy has been emphasized by scholars in creativity research. Redmond et al. suggested that when faced with a sales task, salespeople with strong creative self-efficacy could generate sales ideas and be able to accomplish the task better(Redmond et al., 2015); Tiernery's study found that there was a significant positive correlation between employee Creative Self-efficacy and their creative performance Tiernery's study found a significant positive correlation between employees' Creative Self-efficacy and their creative performance(Tierney & Farmer, 2011). Tiernery and Farmer's study showed that Creative Self-efficacy moderated employees' perceptions of creative behavior and supervisors' expectations and supervisory behaviors toward their employees. Their study found that increasing employees' creative role identity and perceived supervisors'

creative expectations over a six-month period increased employees' sense of competence in creative work. This result further suggests that increases in creative self-efficacy are consistent with increases in creative performance.

Research on Creative Self-efficacy is also closely tied to studies on teachers and students. Beghetto conducted a study on the relationship between Creative Self-efficacy and related variables, using 324 secondary school students as subjects. The study found that students with high levels of Creative Self-efficacy were more willing to attend college, complete after-school assignments, and participate in extracurricular activities than those with low levels of Creative Self-efficacy (Beghetto, 2006). Puozzo and Audrin investigated the creative self-efficacy of vocational school students and found that their overall level of creative self-efficacy was low(Puozzo & Audrin, 2021) . Alan Hill, a Singaporean scholar, revised the Creative Self-efficacy Scale for High School Students and examined the relationship between Creative Self-efficacy and emotions and achievement goals of high school students. The results showed that creative self-efficacy was positively related to students' positive emotions(Hill et al., 2008). Tang's studied Creative Self-efficacy in cross-cultural domains and concluded that Creative Self-efficacy is an individual's belief that he or she can generate novel and appropriate ideas, works, and products. She developed a five-item Creative Self-efficacy questionnaire and found no significant difference in the Creative Self-efficacy of Chinese and German students (Tang et al., 2017).

2.2 Problem-based Learning program (PBLP)

2.2.1 Definition of PBLP

The Problem-based learning program originates from an ancient Western teaching method, which dates back to the midwifery of Socrates in ancient Greece and is also known as the "Socratic method" (Barrows, 1996). When using this teaching method, the teacher not only imparts knowledge to the students but also guides them to discover the dilemmas in their knowledge on their own through discussion, questioning, answering, and debating, thereby helping them find the correct answers. In this process, teachers and students collaborate to solve problems,

stimulating students' enthusiasm for learning and enhancing their motivation to learn (Hmelo-Silver, 2004). In the late 1960s, Prof. Howard Barrows, who taught at the Canadian Medical College, observed the overemphasis on students' academic performance in traditional teaching methods and concluded that such methods needed improvement in developing doctors' professional competence. He pointed out that doctors needed more competencies, such as communication, critical thinking, and decision-making, to pass exams rather than relying on rote memorization of concepts. Therefore, he advocated that teaching should be based on clinical problems and simulate real medical scenarios. For this purpose, he introduced the Problem-based learning program and applied it to the neurophysiology course. In this new teaching environment, students were divided into small groups and gained new knowledge by solving real medical problems through discussion (Barrows & Tamblyn, 1980). In 1971, the Problem-based learning program began to emerge in continental Europe, with the first attempts occurring in countries such as Sweden, the Netherlands, and Belgium (Schmidt, 1983). In the 1980s, the Problem-based learning program gained popularity in North America, and many colleges and universities began adopting this teaching method to train their students. With time, Problem-based learning programs gradually evolved and became more scientific and perfect (Albanese & Mitchell, 1993). As of 1991, over 100 colleges and universities in the United States had introduced PBL and reaped significant teaching results. Among these colleges and universities, Harvard University, as we know it, has also adopted the Problem-based learning program to train students in its medical school.

The medical field initially adopted the Problem-based learning program and has subsequently been widely utilized in education across various disciplines, including architecture, management, economics, engineering, geology, psychology, law, and sociology (Barrows & Tamblyn, 1980). The method has been applied to various educational fields, including primary and secondary schools, undergraduate education, graduate education, vocational training, and adult education. Research on Problem-based learning programs by foreign scholars has primarily focused on the factors

affecting problem-based learning programs, the implementation strategies of problem-based learning programs, and the application effects of problem-based learning programs.

2.2.2 Characteristics of the PBLP

In a novel way, the Problem-based learning program encourages students to engage in a learning process that requires them to address real-world situations of poorly structured learning processes as a way to develop their cognitive and metacognitive skills so that they become self-directed learners, which is characterized by the following five key features (Barrows & Tamblyn, 1980):

1) Problem-centered.

A learning activity's starting point and core is an authentic and challenging problem or situation, usually a real-life problem that stimulates students' curiosity and desire to learn. The problem-solving process requires students to actively inquire, gather information, analyze data, formulate hypotheses, develop solutions, and evaluate the effectiveness of the solutions (Yeo, 2008). Problems are usually open-ended, with no single correct answer, encouraging students to think critically, explore multiple solutions, and develop critical and creative thinking skills. Problems serve as a vehicle for learning content and a guide to the learning process, prompting students to participate actively, think critically, and learn through problem-solving (Permatasari, 2019). By placing problems at the center of learning, the PBLP approach stimulates students' interest in learning, develops their problem-solving skills, and fosters a deeper understanding and more comprehensive learning outcomes.

2) Student-centered.

The problem-based learning program method emphasizes the full play of student autonomy and teacher guidance. The teaching method has shifted from teacher-led to student-led, with students at the core of teaching activities to stimulate their motivation and enthusiasm (Bate et al., 2014). Students adopt the group learning method in teaching, which involves 6-10 people forming a learning group to explore

methods and approaches to solve problems together, promoting mutual learning and cultivating the spirit of teamwork.

3) Teamwork.

The problem-based learning program encourages students to build learning teams to solve problems through communication and cooperation within the team. Team members assign work according to task requirements and individual skills, complete their tasks independently, and then use brainstorming to discuss and compare, fully understanding the problem and finding a practical solution (Braßler, 2016).

4) Autonomous learning.

Learners can independently plan their learning progress, arrange their learning time, and effectively organize their learning tasks and resources. Learners can self-motivate, maintain motivation and enthusiasm for learning, and persistently pursue learning goals. Learners can independently choose learning contents, modes, and resources that suit them and learn according to their needs and interests (Ertmer & Glazewski, 2015). Learners can self-evaluate and self-reflect, objectively evaluate the learning process and learning outcomes, and promptly adjust their learning strategies and methods.

5) Feedback and Assessment.

Teachers and peers will provide feedback to help students improve their solutions, and assessments will focus on students' understanding of the problem and their ability to solve it (Wells, 2009).

2.2.3 Process of PBLP

Barrows summarized the teaching and learning process of the problem-based learning program into five main areas: Group organization, Questioning, Discussion, Debriefing, and Reflection (Barrows, 1986). The main processes are described below:

Step 1: Group organization. Students are grouped according to their school numbers; however, a more effective method is to group them reasonably based

on their personality, knowledge structure, and other characteristics. Each group usually consists of 6 to 10 members. To solve problems and complete learning tasks efficiently, members can divide the work according to their strengths, interests, and abilities, and assign their respective responsibilities. Each group should have a leader, a recorder, and a presenter responsible for arranging the learning plan, recording the work, organizing the learning results, and presenting the group's learning to the teacher and the class.

Step 2 Questioning: To guide students in learning through problem-solving, teachers need to carefully design questions that stimulate students' thinking, prompting them to actively search for information, engage in in-depth thinking, discuss, and research. Problems should be set appropriately and challenging, but within students' abilities. Students should consider contextual analysis and their knowledge base when posing questions to ensure that they clearly understand the difficulty level of the questions in the course of study.

Step 3 Discussion: Group members will discuss internally, consolidate information, and share it, complementing each other, while groups will discuss among themselves, presenting their problems, asking questions, and making points. During the exchange, students will individually analyze the problem and develop a plan of action for the future, including developing an independent learning task. Students may encounter new or more interesting problems at this stage and become more motivated to find relevant information to solve them.

Step 4 Debriefing: At the end of the group discussion, the teacher asks students to present the entire problem-solving process in a written narrative or as a PowerPoint presentation. This debriefing must include prior preparation, a detailed problem-solving plan, strategies for addressing the problem, and an evaluation of the solution's effectiveness. The teacher and the rest of the class can then express their doubts and questions about the presentation through interactive exchanges and questions.

Step 5 Reflection: At the end of the discussion, the teacher evaluates the students' communication, reporting, and presentation, recognizing and commending the groups for their excellent thinking and practice. In summary, special emphasis is placed on what students should know and the thinking they need to develop.

2.2.4 Theoretical foundations of PBLP

A problem-based learning program emphasizes problem-solving. Its theoretical foundation is rooted in Cognitive-Discovery Learning Theory, Constructivist Learning Theory, Humanistic Learning Philosophy, and other related theories. The theory of Cognitive-Discovery Learning advocates discovery learning by providing students with learning materials to explore and think independently (Cheng, 2019).

Cognitive-Discovery Learning Theory advocates discovery learning, in which students are provided with learning materials and can explore and think independently to discover, understand, and ultimately master knowledge. In this process, learning is an active experience, as students construct knowledge structures through critical thinking, inquiry, and problem-solving. The problem formulation in Problem-based Learning is the problem identified by students in the teaching process. Then, students can solve real-world problems based on the problem through independent inquiry and cooperative learning, promoting their cognitive development and learning effectiveness (Xu et al., 2023). Cognitivist learning theory emphasizes the autonomy and participation of students. It encourages students to think and reflect continuously throughout the learning process, deepening their understanding and enhancing their ability to apply knowledge. By applying cognitivist learning theory to Problem-Based Learning, teachers can stimulate students' motivation to learn, cultivate their critical thinking and problem-solving abilities, and thereby promote the development of students' positive and healthy self-identity(Yilmaz, 2011).

Constructivist learning theory posits that people co-construct knowledge and understanding of the world through interaction and experience with the external world, as well as through personal reflection and introspection. Emphasizing the individual's active processing and interpretation of information, knowledge is believed to

be constructed based on the individual's experience and background, and it develops and evolves through experiences(Kim, 2014). In the constructivist view, knowledge does not exist objectively but is constructed subjectively by the individual. Learning is a process constructed through the interaction between the individual and the environment, where the individual continuously constructs their knowledge and understanding through interaction and experience with the surrounding environment. The PBLP pedagogy first needs to create a situation that prompts students to think about the situation, similar to the constructivist theory, emphasizing the importance of students' thinking. This is similar to the situation that the constructivist theory emphasizes(Suhendi, 2018). Secondly, students are asked to explore the problem in the situation, discuss it, and then apply their knowledge to address it, ultimately combining the actual situation with their understanding to achieve an in-depth understanding of the situation. When faced with a problem, Problem-based Learning divides students into small groups for discussion and negotiation, allowing them to collaborate and communicate to address the problems they have uncovered or those raised by the teacher (Kelson & Distlehorst, 2000). In the discussion process, students will independently synthesize their past knowledge and experience to solve the problems that have arisen. Both constructivist theory and Problem-based Learning emphasize learner initiative, authentic Problem-based Learning, social interaction, and cooperation, so they are often combined in teaching practice to promote students' deep learning and knowledge construction (Almulla, 2020).

The primary viewpoints of humanistic learning theory include respecting the dignity of the individual, safeguarding individual freedom, and promoting self-actualization. In the teaching and learning process, the teacher's primary task is to promote students' self-directed growth and provide appropriate teaching and learning resources and environments to support this purpose(Adi & Kamilia, 2023). The humanistic learning theory encourages meaningful and autonomous learning, involving students in a holistic approach that encompasses affective, attitudinal, and cognitive aspects. There are three primary forms of humanistic teaching and learning: problem-

centered discussion, free learning, and the open classroom. Problem-centered discussion is primarily used in schools, enabling students to promote one another and fully participate in the discussion process, where each student highlights their strengths and encourages others to showcase their extraordinary aspects (Dewi et al., 2023). Student-centeredness is a core concept of the Problem-based learning program, meaning students play a proactive role (Iloka, 2023). They ask questions and solve problems through in-depth discussions, leading to self-directed learning. The teachers' role in this process is that of a facilitator, whose task is to help students identify problems, organize discussions, and provide advice or support when necessary to ensure that teaching and learning proceed smoothly (Barrett & Naughton, 2014). At the same time, teachers should also pay attention to students' affective attitudes and values, respecting and caring for them. At the end of the discussion, teachers must integrate students' perspectives and provide timely feedback to them. According to the Humanistic Learning Theory, the teaching and learning process should be dedicated to arousing students' inner potential, guiding them to explore their learning domains, inspiring them to express their individuality, and motivating them to develop an upbeat personality (Kumari, 2024). This concept helps students build their self-identity and stimulates their initiative to improve their learning skills.

2.2.5 Key pedagogical issues addressed by PBLP

In the traditional teaching mode, students often find themselves in a state of passive acceptance of knowledge, lacking initiative and interest in the learning process. The PBLP teaching method stimulates students' intrinsic motivation to learn by designing problems and projects closely related to their interests and real-life experiences, allowing them to actively participate in the learning process (Hung, 2016). In this process, students need to plan their learning paths independently, collect information, analyze problems, propose solutions, and continuously adjust and optimize their solutions during the implementation process, a process that significantly improves students' concentration and learning initiative. In the PBLP program, students typically work together in groups to complete projects, learning how to communicate effectively

with others, divide tasks, cooperate, and resolve conflicts, all of which are crucial for their future development. Through teamwork, students can not only brainstorm and improve the efficiency and quality of problem-solving but also cultivate team spirit and self-confidence through mutual learning and support (Almulla, 2020). PBLP pedagogy encourages students to think about the problem from multiple perspectives and come up with innovative solutions. During the implementation of the project, students need to try, explore, reflect, and improve continuously, and this process helps develop their idea generation and problem-solving abilities (Affandy et al., 2024). The PBLP teaching method provides strong support for the overall development of students by addressing key teaching challenges, including poor concentration, a lack of teamwork and communication skills, and limited development of idea generation and problem-solving skills.

2.3 The Relationship research of PBLP and Creative Self-efficacy

The problem-based learning program indirectly positively affects creative self-efficacy by stimulating students' idea generation, cultivating their ability to adapt to uncertainty, and focusing on problem solving(Tan et al., 2009). This teaching method helps cultivate students' concentration, stimulates idea generation, and enhances their ability to cope with uncertainty in life and learning, thereby improving their creative self-efficacy and laying a solid foundation for future learning and work.

Affandy's study suggests that the problem-based learning program stimulates students' desire for inquiry and curiosity by posing challenging and engaging problems. This desire for inquiry prompts students to think actively and seek ways to solve problems, thereby stimulating their creative thinking (Affandy et al., 2024). A problem-based learning program emphasizes that students continue to ask questions, analyze problems, and solve them in a problem-solving context. Cultivating awareness of this problem helps students develop critical thinking and creative thinking, enabling them to view the problem from a different perspective and devise novel solutions. The problem-based learning program encourages cooperation and communication among students. Marashi once said that in cooperative learning, students can inspire each other and

discuss together, to broaden their thinking and stimulate creativity. Through teamwork, students can brainstorm and form more innovative solutions. The problem-based learning program focuses on combining theoretical knowledge with practice, and by solving practical problems, students can apply what they have learned in practice, thus enhancing their practical ability and sense of innovation(Marashi & Khatami, 2017), and the cultivation of this practical ability helps to develop students' creative self-efficacy.

Hmelo's study showed that problems in problem-based learning programs are often open-ended, with no fixed answers or solution paths. Students need to think and explore on their own, and this process is full of uncertainty. Each student is unique, with distinct knowledge backgrounds, thought processes, and learning interests. Therefore, in problem-solving, students may generate various ideas, methods, and solutions, thereby increasing the uncertainty of the teaching and learning process (Hmelo-Silver, 2004). Heng also mentioned in his study that the relationship between uncertainty and the problem-based learning program is positive for students. This uncertainty provides students with the space and opportunity to think freely, which helps stimulate their creativity and imagination (Heng, 2013). At the same time, by dealing with the challenges posed by uncertainty, students can develop their creative self-efficacy.

Andriani et al. suggest that the problem-based learning program helps to improve student concentration. The problem-based learning program stimulates students' curiosity and inquisitiveness by posing a series of questions related to the content. Students will actively concentrate and focus on exploring and thinking about the questions to find the answers. Under the guidance of the problem-based learning program, students clarify the problems they need to solve and the goals they need to achieve. This clear goal orientation enables students to focus their attention and avoid distractions during the learning process (Andriani et al., 2024). Anazifa and Djukri have also stated that the problem-based learning program encourages students to think actively and explore independently, requiring them to constantly think, analyze, and synthesize information while solving problems. This active thinking process helps improve students' concentration(Anazifa & Djukri, 2017). The problem-based teaching

method can effectively enhance students' concentration and promote their creative self-efficacy.

Problem-based learning program is a student-centered teaching method, which stimulates students' interest in learning and desire for inquiry by posing authentic problems, and then promotes students' ideageneration, cultivates students' ability to concentrate and adapt to uncertainty, and then indirectly affects students' creative self-efficacy. This teaching method has a positive impact on students' creative self-efficacy. This teaching method not only helps students to achieve better learning results in the classroom, but also helps them to better utilize their creativity and potential in their future life and work.

CHAPTER 3

METHODOLOGY

In this chapter, the researcher provides the research method design, including the research design, research participants, sample selection, research tools, data collection, and analysis. This chapter also describes the methodology used for conducting the research.

The research method design is as follows:

1. Research Design
2. Context of the study
3. Populations and sample selection
4. Research instruments
5. Procedures of the Study
6. Data Collection
7. Data Analysis

3.1 Research design

This study employed a quasi-experimental research design, in which two parallel classes were selected as the experimental and control groups. The Problem-based Learning program was taught to the experimental class. In contrast, the control class did not, and the Creative Self-Efficacy Scale was used to test the students' creative self-efficacy before and after the experiment to obtain the data. Then, the data were analyzed by SPSS to explore the changes in their Creative Self-efficacy before and after the Problem-based Learning program and verify the effect of the Problem-based Learning program on the creative self-efficacy of Chinese higher vocational students.

Then, the data were analyzed to explore the changes in their Creative Self-efficacy before and after the Problem-based Learning program and verify the effect of the Problem-based Learning program on the creative self-efficacy of Chinese higher vocational students. The flow of the experiment is showed in figure 2.

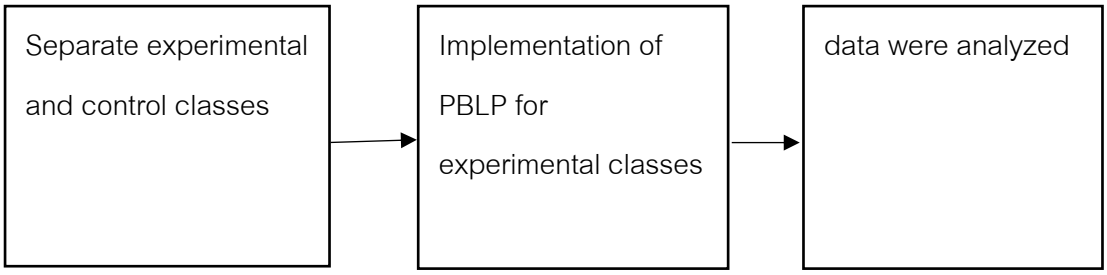

Figure 2 The flow of the experiment

3.2 Context of the study

This study was conducted with the participation of 326 first-year students in e-commerce from Guangdong NanFang Institute of Technology, a general background school located at No. 683, Wuyi Road, Jianghai District, Jiangmen City, Guangdong Province, China, which is a full-time general higher education college approved by the People's Government of Guangdong Province and filed with the Ministry of Education of the People's Republic of China (MOE) and covers the disciplines of Engineering, Economics, Management, and Literature. Guangdong NanFang Institute of Technology was founded in 2009. The school's area is approximately 70,000 square meters. There are more than 30,000 students in the 2024 academic year.

In this study, the subjects were higher vocational students in e-commerce. The core courses of e-commerce included User Interface (UI) design, AI design, and Art design, all of which require software to design works. User Interface (UI) design is a field that focuses on creating the visual and interactive elements of digital products such as websites, mobile applications, and software applications. The main goal of user interface design is to enhance the user experience (UX) by creating interfaces that are aesthetically pleasing, interesting, and easy to navigate. User interface (UI) design is an important part of the digital product development process. It aims to create visually appealing, functional, and accessible interfaces that promote a positive user experience. AI design is the subject of Artificial Intelligence design, which refers to the ways and means applied to create AI systems and applications that effectively solve problems and enhance the user experience. It encompasses a variety of disciplines,

including machine learning, natural language processing, computer vision, and human-computer interaction. Artificial Intelligence design is an interdisciplinary field that focuses on developing user-friendly, ethical, and practical intelligent systems that solve complex problems. It involves a thoughtful approach to technology development that prioritizes user needs and responsible AI practices. Art design is a field that encompasses all aspects of the creative process in the visual arts and design disciplines. It focuses on the conceptualization, creation, and communication of ideas through artistic expression and design principles. Art and design is a dynamic and multifaceted field that combines creativity, technical skills, and an understanding of aesthetics to communicate ideas and emotions. It plays a crucial role in a wide range of industries and has a profound impact on visual culture and society as a whole. Whether through traditional art practices or modern design techniques, art and design continually evolve to adapt to shifting cultural and technological environments. Students need to increase their creative self-efficacy when taking these courses because Students who believe in their creative abilities are more likely to maintain a positive attitude toward learning. This self-efficacy motivates them to participate in course activities, overcome difficulties, and explore new design ideas and techniques. Moreover, these courses require students to have an open mind and the ability to think creatively and innovate. Creative self-efficacy can help students overcome their fear of failure and encourage them to try different methods and ideas, thereby promoting their design innovation. Additionally, complex user requirements and technical challenges often arise during the learning process. Self-confidence can help students remain calm when encountering problems and actively seek solutions, rather than giving up easily. Students with high creative self-efficacy are more willing to accept feedback from others and turn the input into motivation to improve their self-design ability. This is essential for continually improving their work and enhancing their skills during the design process. Creative self-efficacy is crucial in User Interface (UI) course learning, as it affects students' learning outcomes, innovation, and career development. Therefore, educators should help

students improve their creative self-efficacy by providing a safe learning environment, encouraging exploration and innovation, and giving positive feedback.

3.3 Populations and samples

Populations

The subjects of this population were a total of 326 first-year higher vocational students in e-commerce from Guangdong NanFang Institute of Technology in Guangdong Province, China, who had normal development and no other physical or mental disabilities, and were willing to participate in this experiment.

Samples

The population of this study consisted of first-year students at Guangdong NanFang Institute of Technology in Guangdong Province, China. The sample of this study was made by selecting 108 students with the lowest level of sexual self-efficacy from 326 students of freshman e-commerce majors. Then, the 108 students were randomly and equally assigned to experimental and control groups, with 54 students in each group. None of the experimental subjects had yet received the Problem-based Learning program course. The experimental group participated in the Problem-based Learning program, whereas the control group did not. All the students investigated were developing typically, had no other obstacles, and were willing to participate in this experiment.

3.4 Research instruments

The measurement instruments used in this study were the Problem-based Learning program and the Creative Self-efficacy Scale. Three experts in the field were invited to validate all the instruments to test their validity and appropriateness.

1. Problem-based learning program.

The problem-based learning program is an educational approach that promotes active learning, critical thinking, and problem-solving by placing students in situations to solve real-world problems. In this learning mode, problems serve as the starting point and driving force of learning, and students need to explore problems, find

solutions through teamwork, data collection, discussion, and analysis, thereby acquiring knowledge and skills in the process (Barrows, 1996).

In this study, the problem-based learning program consists of five steps:

Step 1: Group organization refers to students being organized into small groups, where they can collaborate and work together to solve the problem. This fosters teamwork, communication, and the ability to work in diverse groups.

Step 2: Questioning: Students are presented with a real-world or authentic problem, often in the form of a case study or scenario. This problem is the foundation for the learning process, encouraging students to engage meaningfully with the material.

Step 3: Discussion refers to students working together to develop and test potential solutions to the problem. This process involves critical thinking, creative problem-solving, and the application of knowledge and skills learned in class.

Step 4: Debriefing refers to students presenting their solutions to the problem to the class or a larger audience. This presentation enables students to demonstrate their understanding of the material and apply it in a real-world context.

Step 5: Reflection refers to the presentation typically followed by an evaluation process, during which the facilitator and/or peers provide feedback on the students' work.

The Problem-based Learning program consists of 12 activities, each with five stages. Improving the Problem-based Learning program based on three experts' opinions and selecting the content approved by the experts for implementation. A pilot study was conducted to determine whether the students understood the content.

There were a total of twelve lesson contents in this study:

Lesson 1: Understanding user interface (UI) design. It’s design refers to understanding the definitions, principles, processes, and elements of user interface design.

Lesson 2: Eco-friendly icon design mainly refers to designing an Eco-friendly icon that raises people's awareness of environmental protection, enhances their self-awareness of their behavior, and reduces environmental pollution.

Lesson 3: Exercise for All icon design involves creating an icon that enhances awareness of exercise and promotes the health of all people.

Lesson 4: Medical app interface design involves creating a medical app interface that helps users manage their health effectively. Features such as dietary advice, exercise programs, and medication reminders can help patients better control their health.

Lesson 5: Food app interface design involves creating a food app interface that provides a convenient online shopping service, allowing people to purchase food and daily necessities from home using their cell phones.

Lesson 6: Furniture e-commerce website interface design is designing a Furniture e-commerce website that helps consumers with disabilities.

Lesson 7: Book e-commerce website interface design involves creating a Book e-commerce website interface that helps readers solve the problems they encounter when accessing, selecting, and purchasing books.

Lesson 8: Music player software interface design is designing a Music player software interface that helps users solve problems.

Lesson 9: Taxi-hailing software interface design involves creating a Taxi-hailing software interface that helps people solve inconvenient travel problems.

Lesson 10: Puzzle Game Interface Design involves creating a Puzzle game interface that aids colorblind players in solving problems.

Lesson 11: Adventure game interface design involves creating an Adventure game interface that seamlessly integrates educational content with gameplay.

Lesson 12: End of Course Summary. A summary was given at the end. Additionally, a post-test for the creative self-efficacy experiment was prepared for the students.

Table 1 shows the design of the problem-based Learning program course, and Figure 2 shows the specific teaching links.

Table 1 Problem-based Learning program course

Lesson	Content	Problem	objectives
1	Introduction	How to make UI design favor practical applications?	Basics of user interface design
2	Eco-friendly icon design	How to design an Eco-friendly icon?	Designing an icon with the theme Eco-friendly
3	Exercise for All icon design	How do you design the Exercise for All icon?	Designing an Exercise for All icon
4	Medical app interface design	How to design a Medical app interface?	Designing a Medical App Interface
5	Food app interface design	How to design a Food app interface?	Designing a Food app interface
6	Furniture e-commerce website interface design	How do you design a furniture e-commerce website interface?	Designing a Furniture e-commerce website interface

Table 1 (Continue)

Lesson	Content	Problem	objectives
7	Book e-commerce website interface design	How do you design a book e-commerce website interface?	Designing a Book e-commerce website interface
8	Music player software interface	How do you design a music player software interface?	Designing Music player software interface
9	Taxi-hailing software interface	How to design a Taxi-hailing software interface?	Designing a Taxi-hailing software interface
10	Puzzle game interface design	How to design a Puzzle game interface?	Designing a Puzzle game interface
11	Adventure game interface design	How to design an Adventure game interface?	Designing an Adventure game interface
12	End of Course Summary	After learning UI design, what problems in life do you think you can help you or people around you solve?	A summary was given at the end. In addition, a creative self-efficacy experiment post-test was prepared.

The flow of problem-based learning program

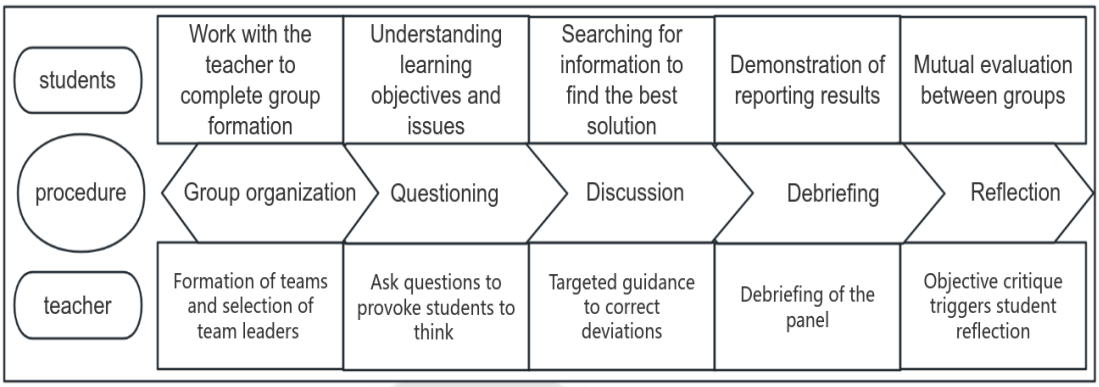

Figure 3 The flow of problem-based learning program

The specific teaching session consisted of five steps: Group organization, Questioning, Discussion, Debriefing, and Reflection.

Step 1 Group Organization: Before starting the first Problem-based Learning lesson, the teacher will divide the students into groups of 6 members based on the students' situations and the characteristics of the lesson. Students will be divided into groups of 6 members. Each group will elect a group leader, who will be responsible for recording and summarizing the hypotheses proposed by each member of the group for the problem and the optimal solution discussed by the group in the classroom and will make an oral report and a presentation to the teacher and other members of the group in the group reporting session.

Step 2 Questioning: Teachers should design questions in advance based on their teaching objectives, the content, and the students' actual situations. PBLP questions should focus on students' points of interest and should effectively stimulate students' interest in learning. After the study group is formed, teachers will gradually ask students about PBLP teaching problems related to the lesson's teaching content and guide them in thinking.

Step 3 Discussion: After receiving the questions raised by the teacher, the group members, under the guidance and supervision of the group leader, will carry

out a reasonable division of labor to address the questions. Each group member makes full use of their strengths, expresses their views, and actively discusses and collaborates. Each group member gives full play to his or her advantage, expresses his or her views, actively discusses, collaborates, and learns, or actively searches for solutions to problems by consulting books and network materials and combining his or her existing knowledge. In the group discussion process, the group leader will record the ideas and assumptions of each member promptly and summarize the generalizations, forming a unified best solution. Teachers make roving observations at this stage to help students correct their deviations and guide them in establishing a consistent direction for their solutions, promoting in-depth thinking.

Step 4 Debriefing: At the end of the group discussion, the teacher will randomly assign all groups to report back, and the group leader will present the group's final and best solution to the audience through oral reports and PPT presentations.

Step 5 Reflection: Upon completing the group report, the group conducted in-depth reflection and discussion on problem-solving under the instructor's guidance. It explored and summarized the understanding and application of the new knowledge. After the discussion, everyone understood the knowledge point deeply and summarized the new knowledge. After the discussion, they gained a deeper understanding of the knowledge and learned to apply it more effectively to solve practical problems. The teacher provided objective comments on the students' reports, recognized and praised the outstanding groups, and the students reflected on and summarized their performance. Through evaluation and reflection, students can gain a deeper understanding of their strengths and weaknesses, thereby improving their overall quality.

2. Creative Self-efficacy Scale.

This research developed the measurement scale from the Creative Self-Efficacy Scale developed by Singaporean scholar Alan Hill (Hill et al., 2008). Alan Hill revised the Creative Self-efficacy Scale for high school Students and examined the relationship between creative self-efficacy and the emotional and achievement goals of high school

students. The scale consists of the following three components: idea generation, Uncertainty, and Focus, and measures creative self-efficacy based on these components. Creative self-efficacy was measured based on these three components. The creative self-efficacy scale in this study was based on a 5-point Likert scale, which includes five levels of evaluation, namely, “Very Conformity,” “Substantial Conformity,” “Neutral or Uncertainty,” “Substantial Non-Conformity,” and “Very Non-Conformity”.

In this study, The Creative Self-efficacy Scale has good reliability and validity; the internal consistency reliability of the scale is 0.902, and the CITC ranges from 0.374 to 0.606, the Cronbach's alpha coefficient of this scale for the Ideageneration dimension is 0.857, and for the Uncertainty dimension, the Cronbach's alpha coefficient is 0.816. Cronbach's alpha coefficient for the Focus dimension was 0.795. Details of the various items are in Appendix 1.

Components of the scale.

1) Idea generation is the ability to create, develop, and communicate new ideas where fresh concepts and solutions are needed to address challenges, improve products, or enhance services. It corresponds to "I am good at coming up with new ideas", "I have a lot of good ideas", "I have a good imagination", "I can quickly come up with several different solutions during course projects", "hen creativity is needed, I specialize in brainstorming unique ideas ", "I can often come up with original ideas for my classmates or teachers", "Even when faced with conventional problems, I can try to solve them with non-traditional methods".

2) Uncertainty is the ability to make choices that lead to challenges in planning and decision-making. It can arise from limited knowledge or a lack of definite information about an outcome, event, or situation. Uncertainty can arise from doubt and ambiguity and present opportunities for growth and innovation, encouraging adaptability and creative problem-solving. It corresponds to "I can delay judgment (not making any evaluation) when coming up with ideas", "I can tolerate ambiguity", "I can wait patiently for good ideas to emerge", "Even if the mission's goals are not clear, I am confident that I can move forward through creative approaches", "When faced with unexpected

problems, I can flexibly adjust my strategy and come up with innovative solutions", "With incomplete information, I am still willing to try risky ideas ", "The skepticism of others will not shake my confidence in my creativity ".

3) Focus is the ability to concentrate attention or effort on a particular task, subject, or objective. It involves filtering out distractions and honing in on what is most important, enabling individuals to achieve their desired outcomes more efficiently. It corresponds to "I have a strong will to master knowledge ", "I constantly check to see how well I am doing ", "I continue doing my task and never give up even if I face difficulty ", "I have a strong will to improve skills and techniques", "I can stay focused for long periods on complex creative tasks ", "I will polish my idea over and over again until it achieves the desired result ", " When inspiration runs low, I still manage to keep trying different approaches to solving problems", These items on the Creative self-efficacy scale.

The above three components of creative self-efficacy were combined based on the opinions of three experts. The item objectivity-consistency (IOC) scale was used to assess the program's effectiveness. The content validity was tested by combining the above three dimensions of creative self-efficacy and adopting the item objectivity and consistency (IOC) index based on the views of three experts. Items with gain index values of 0.67-1.00 were selected to form a credible, valid, and comprehensively monitored and assessed scale.

Then, it was verified whether the scale accurately assessed the creative self-efficacy of Chinese higher vocational students. Cronbach's alpha Coefficient is used to evaluate an assessment's internal consistency or reliability. The scale's feasibility was determined through attempts and testing among higher vocational students.

3.5 Research process

This study adopts the experimental research method, divided into three stages: pre-test, Problem-based learning program intervention, and post-test. The specific process is as follows:

Step1: pre-test

Before the experiment began, the students took a pre-test to assess their creative self-efficacy.

Step 2: Problem-based learning program intervention

Students are divided into several groups, and members of each group assume different roles. Teachers set a challenging and realistic problem situation that aligns with the teaching objectives and students' backgrounds. Students analyze the problem together in the group, identify the key elements and constraints of the problem, and collect relevant information and materials by consulting books, Internet resources, etc. Group members discussed the collected information and materials, shared their views and ideas, and jointly formulated strategies and plans to solve the problem. After determining the strategy to solve the problem, the student group began to implement their plans. Next, students need to show and share their learning results. Finally, students need to reflect and summarize their learning process, and teachers can also take this opportunity to evaluate students' learning outcomes and understand the effect of the Problem-based Learning program intervention to carry out subsequent improvement and optimization.

Step 3: post-test

At the end of the two-week experiment, the students took a post-test to determine their Creative Self-efficacy.

3.6 Data collection

The experiment and data collection procedures were as follows: First, the researcher reviewed the curriculum, course objectives, and course descriptions. Second, the researcher developed the instruments used in the study, including a lesson plan based on the Problem-based Learning program and a Creative Self-efficacy scale designed to enhance executive functioning.

During the experiment, the sample was pretested. First, the researcher recorded the students' pretest scores. Second, the students were given a two-week course through the Problem-Based Learning program. Third, at the end of the experiment, the students were post-tested upon completion of the Problem-based

Learning program. Finally, data were obtained and analyzed to answer the research questions.

3.7 Data analysis

Descriptive statistics were analyzed for pretest and posttest scores, including means and standard deviations. The mean scores and standard deviations were then calculated, and independent samples t-tests were used to determine if there was a significant difference between the mean scores of the pretest and post-test in order to compare the creative self-efficacy of the experimental and control group students before and after their course of study through the Problem-based Learning program.

CHAPTER 4

RESEARCH RESULTS

This chapter presents the research results in the following order:

4.1. Results from developing the PBLP to enhance creative self-efficacy in higher vocational students.

4.2. Results from the study on the effect of the PBLP.

1. Compare the difference in creative self-efficacy level between the experimental group before and after attending the PBLP.

2. Compare the difference in creative self-efficacy level between the control and experimental groups after attending the PBLP.

4.1 Results from developing the PBLP to enhance creative self-efficacy in higher vocational students.

In this study, the researcher designed a program using PBLP principles to enhance the creative self-efficacy of high vocational students. Prior research has noted that the problem-based learning program can enhance students' creative self-efficacy. Problem-based learning program, as a student-centered instructional method, emphasizes

the development of students' creative self-efficacy through solving real-world problems, where students become explorers, discoverers, and master problem solvers in a classroom where each student is asked to document and demonstrate their thinking, attempts, failures, and successes in solving problems. Through this series of activities based on the principles of PBLP, the creative self-efficacy of higher vocational students was stimulated and enhanced.

The study designed 12 teaching programs, each program includes a theme thematic activities, 12 thematic activities were set up: Introduction, Eco-friendly icon design, Exercise for All icon design, Medical app interface design, Food app interface design, Furniture e-commerce website interface design, Book e-commerce website interface design, Music player software interface, Taxi-hailing software interface, Puzzle

game interface design, Adventure game interface design, End of Course Summary. in each activity, the teacher will carefully design the problem, Separately, students were guided to use the role-playing, brainstorming,Six Thinking Hats,“SCAMPER” method,“observation and imitation” method,“user experience map”,analogical thinking,“combination of imitation and innovation” methodology,“reverse thinking”,“reverse thinking”, and the students need to group, each group of six people, a total of nine groups, each group should be around the teacher's questions for discussion, using different methods to explore the answer to the problem, in the process of student discussion, the teacher should also give students some guidance, has corrected the students wrong direction. During the students' discussion, the teacher should also provide guidance to correct their incorrect direction. Finally, the students present their results, and the teacher evaluates the results of each group.

The lesson plans include a Teacher's Guide and a Student's Guide. The Teacher's Guide provides the necessary information for the Problem-Based Learning Program, including content, objectives, required instructional materials and tools, and detailed descriptions of the program's steps. This helps teachers to effectively prepare and organize classroom instruction to ensure that the teaching and learning process runs smoothly and maximizes student learning outcomes and development.

The Student Guide is designed to provide students participating in the program with the necessary information about the problem-based learning program, including subject matter content, requirements, and the number of participants per session. The teaching process consists of five steps, including Group organization, Questioning, Discussion, Debriefing, and Reflection (Barrows, 1986). Furthermore, the detailed information for each step is as follows:

Step 1: Group Organization. Before the first problem-based learning program class begins, the teacher will divide the students into groups of 5 to 6 people based on their situations and the characteristics of the course. Each group will select a group leader who is responsible for recording and summarizing the hypotheses proposed by group members, as well as the best solutions discussed in class. The group leader will

then deliver an oral report and a presentation to the teacher and other group members during the group presentation session.

Step 2 Questioning: Teachers design questions in advance based on the teaching objectives, teaching content, and students' actual situations. Problems should focus on students' interests, effectively stimulate their interest in learning, and guide them to think.

Step 3 Discussion: After receiving the questions raised by the teacher, the group members will, under the direction of the group leader and the teacher's supervision, divide the work reasonably around the questions. Each group member fully utilizes their strengths, expresses their opinions, and actively participates in discussions and cooperation. Each group member makes full use of their strengths, expresses their opinions, actively discusses, and collaboratively learns. By consulting books and online materials and combining their existing knowledge, they actively seek solutions to problems. During the group discussion, the team leader will promptly record the ideas and assumptions of each member, summarize and generalize them, and form a unified best solution. At the same time, the teacher incorporates a variety of instructional techniques into the problem-based program, such as “role-playing”, “the brainstorming” method, the“Six Thinking Hats“method, “the ‘SCAMPER’ method “, the “observation and imitation” method, etc. When these techniques are effectively combined and applied in teaching and learning, they can work together to build a robust learning framework that helps students develop critical skills, such as critical thinking, creative problem-solving, teamwork, and communication (Seechaliao, 2017). At the same time, these techniques encourage students to think outside the traditional learning paradigm and engage in the learning process more actively and innovatively. In this way, teachers impart knowledge and develop students' abilities to become lifelong learners who can succeed in an ever-changing world(Hooper & Rieber, 1995).

Step 4 Debriefing: At the end of the group discussion, the teacher will randomly assign all groups to report back, and the group leader will present the group's final and best solution to the audience through oral reports and presentations.

Step 5 Reflection: After completing the group report, the instructor guided the group in conducting an in-depth reflection and discussion, exploring solutions to the problems. They explored and summarized their understanding and application of new knowledge.

The table below shows the descriptive conclusions of the five steps. For more details, please refer to Appendix 2.

Table 2 problem-based learning program Model Description

Step	Teacher behavior	Student behavior
Step1 Group organization	The teacher groups 54 students into nine groups of 6.	Students get to know and familiarize themselves with each other and their group members.
Step2 Questioning	The teacher gives the learners some designed questions and asks each group to complete their part individually.	The students examine the pictures, listen attentively to the teacher, and consider the questions she poses.
Step3 Discussion	Teachers can guide students to utilize different methods, look at problems from different perspectives and correction.	Students look at problems from different angles and explore to discover new perspectives and solutions based on teacher guidance.

Table 2 (Continue)

Step	Teacher behavior	Student behavior
Step4 Debriefing	The teacher will sort the nine groups, then have them take turns showing their answers.	The students present the results that they have integrated.
Step5 Reflection	The teacher provided a comprehensive evaluation of each group's presentation, offered suggestions for improvement, and included a final summary.	students integrate the information again and review what they have learned in this lesson.

4.2 Results from the study on the effect of the PBLP

The data is collected from three evaluation indicators of creative self-efficacy: Idea generation, Uncertainty, and Focus.

Analyze the data to test the following research hypotheses:

Assumption 1: After attending the learning program, students who participated in the problem-based Learning program had significantly higher levels of Creative Self-efficacy than before attending the problem-based Learning program.

Assumption 2: After attending the learning program, students who participated in the problem-based Learning program had significantly higher levels of Creative Self-efficacy than students who did not participate in this program.

The researchers' first step in data organization was to collect creative self-efficacy scores from 326 students and select the 108 students with the lowest scores. These 108 students were then randomly divided into experimental and control groups of

54 students. The experimental group participated in the problem-based learning program while the control group did not. Finally, at the end of the program, creative self-efficacy scores were again collected from these 108 students, and data were analyzed to test the hypotheses. The results of the implementation are analyzed below.

Table 3 The t-test score of creative self-efficacy between the experimental group and the control group before using the problem-based learning program

creative self-efficacy	Experimental group pretest (N=54)		Control group pretest(N=54)		t	p
	$\bar{x}$	S.D	$\bar{x}$	S.D		
Ideagenration	20.59	4.47	20.95	4.86	1.139	0.260
Uncertainty	20.02	3.70	20.24	3.64	0.650	0.519
Focus	20.33	2.42	20.56	2.74	0.812	0.420
Total	60.94	9.67	61.75	9.03	1.225	0.226

The data showed that the total creative self-efficacy scores of the experimental and control groups on all dimensions were $p>0.05$, indicating that there was no difference between the two groups of students in creative self-efficacy at the developmental level before the implementation of the problem-based learning program. Therefore, learners in the experimental group could be organized to participate in the problem-based learning program.

Research question 1: Is the average score of creative self-efficacy in the experimental group higher than before participating in the program?

Table 4 The t-test score of pre-test and post-test of creative self-efficacy in the experimental group

creative self-efficacy	Experimental group pretest (N=54)		Experimental group posttest(N=54)		t	p
	$\bar{x}$	S.D	$\bar{x}$	S.D		
Ideagenration	20.59	4.47	25.43	4.58	-9.249***	<0.001
Uncertainty	20.02	3.70	25.13	4.98	-11.603***	<0.001
Focus	20.33	2.42	24.78	3.90	-10.354***	<0.001
Total	60.94	9.67	75.33	11.47	-12.603***	<0.001

***p < .001

The paired samples t-test of the experimental data showed that the mean score of the pre-test of the experimental group was 160.94 with a standard deviation of 9.67, while the mean score of the post-test was 75.33 with a standard deviation of 11.47. There was a significant difference between the two groups of data (p<.001), both in terms of mean ($\bar{x}$) and standard deviation (S.D). From the data, it can be seen that after participating in the problem-based learning program, the students in the experimental

group performed very significantly on the creative self-efficacy dimensions in terms of Ideagenration (25.43), Uncertainty (25.13), and Focus (24.78). In terms of creative self-efficacy dimensions.

The data in the table show a statistically significant difference in the level of creative self-efficacy among students in the experimental group on all three dimensions at the 0.01 level after participating in the problem-based learning program. (Ideagenration $\bar{x}$=25.43 S.D=4.58, Uncertainty $\bar{x}$=25.13 S.D=0.31, and Focus $\bar{x}$=24.78 S.D=3.90).

The experimental results are consistent with research hypothesis 1. That is, the level of creative self-efficacy of the experimental group is higher than that of the pre-experimental group after participating in the problem-based learning program. The experimental results demonstrate that the problem-based learning program is effective in enhancing students' creative self-efficacy, and the study's findings support the first research hypothesis.

Table 5 The t-test score of pretest and posttest of creative self-efficacy in the control group

creative self-efficacy	Control group pretest (N=54)		Control group posttest(N=54)		t	p
	$\bar{x}$	S.D	$\bar{x}$	S.D		
Ideagenration	21.31	5.24	21.22	4.58	-1.000	0.332
Uncertainty	20.46	3.59	20.67	4.98	-1.228	0.225

Table 5 (Continue)

creative self-efficacy	Control group pretest (N=54)		Control group posttest(N=54)		t	p
	$\bar{x}$	S.D	$\bar{x}$	S.D		
Focus	20.78	3.03	20.80	3.90	-0.500	0.960
Total	62.56	9.53	62.96	12.15	-0.262	0.794

The pre- and post-test data for the control group of students were tested using a paired-samples t-test. The total pre-test score was 62.56, and the post-test score was 62.96. The data showed that the control group's overall creative self-efficacy scores on all dimensions in the post-experiment were $p>0.05$. The pre- and post-test data showed no significant difference in the total scores of the control group. ($p=0.794$)

Research question 2: After participating in the program, is the average score of creative self-efficacy in the experimental group higher than that in the control group?

Table 6 The t-test score of the posttest of creative self-efficacy between the experimental group and the control group

creative self-efficacy	Experimental group posttest (N=54)	Control group posttest(N=54)	t	p

Table 6 (Continue)

creative self-efficacy	$\bar{x}$	S.D	$\bar{x}$	S.D		
Ideagenration	25.43	5.31	21.22	4.58	5.056***	<0.001
Uncertainty	25.13	4.33	20.67	4.98	6.446***	<0.001
Focus	24.78	4.38	20.80	3.90	7.088***	<0.001
Total	75.33	11.41	62.69	12.15	7.762***	<0.001

**p < .001

Table 6 demonstrates the results of comparing the posttest scores of the experimental group with those of the control group through an independent samples t-test. Students in the experimental group, who participated in the problem-based learning program, had significantly higher creative self-efficacy scores on all components than students in the control group, who did not participate in the program, with a statistically significant p-value of <.001. The statistical significance of the dimensions of the experimental group of students who participated in the problem-based learning program reached the 0.01 level. (Ideagenration $\bar{x}$ =25.43 S.D=5.31, Uncertainty $\bar{x}$ =25.13 S.D=4.33, Focus $\bar{x}$ =24,78 S.D=4.38).

The experiment's results showed that at the end of the experiment, the experimental group had a higher level of creative self-efficacy than the control group.

This finding verified Research Hypothesis 2: After participating in the problem-based learning program, the experimental group exhibited a higher level of creative self-efficacy than the control group. These experimental results suggest that the problem-based learning program can enhance creative self-efficacy.

CHAPTER 5

CONCLUSION AND DISCUSSION

5.1 Objectives of the Study

The research was conducted for the purpose as follows:

5.1.1. Design the Problem-based Learning Program to enhance Chinese higher vocational students' Creative Self-efficacy.

5.1.2. Study the effects of the Problem-based Learning Program on Chinese higher vocational students' Creative Self-efficacy.

5.2 Research Hypothesis

For the study, the following assumptions were used:

1. After attending the learning program, students who participated in the problem-based learning program had significantly higher levels of creative self-efficacy than before attending the Problem-based Learning Program.

2. After attending the learning program, students who participated in the problem-based learning program had significantly higher levels of creative self-efficacy than students who did not participate in this program.

5.3 Research Method

This study employed a quasi-experimental research design, in which two parallel classes were selected as the experimental and control groups. The problem-based learning program was taught to the experimental class. In contrast, the control class did not, and the Creative Self-Efficacy Scale was used to test the students' creative self-efficacy before and after the experiment to obtain the data. Then, the data were analyzed to explore the changes in their Creative Self-efficacy before and after the problem-based learning program and to verify the effect of the program on the creative self-efficacy of Chinese higher vocational students.

5.4 Conclusion and Discussion

5.4.1 Conclusion

1. To develop problem-based learning program (PBLP) to enhance creative self-efficacy of higher vocational students.

This course adopts the problem-based learning program and designs 12 activities to cultivate students' creative self-efficacy. The PBLP model consists of five steps: Group organization, Questioning, Discussion, Debriefing, and Reflection(Barrows, 1996).In each activity, students gather inspiration from various resources such as picture books and the internet, then proceed to design and create, and finally present and evaluate their work. There are 12 themes in total, each with problems designed to encourage students to work in teams, be creative, and solve real-world problems. The instructional steps for each theme follow a problem-based learning program.

The specific process is as follows:

Step 1 Group Organization: Prior to the start of the first problem-based learning session, the teacher will divide the students into small groups of 6 students each, based on their profiles and the characteristics of the course. Each group will elect a leader responsible for recording and summarizing the hypotheses presented by group members and the best solutions discussed in class.

Step 2 Questioning: The teacher pre-designs questions based on the theme of the activity, teaching objectives, and students' actual situations to effectively stimulate students' interest in learning and guide them to think critically.

Step 3 Discussion: Based on understanding the teacher's questions, group members will rationally divide the work around the questions under the guidance of the group leader and the teacher's supervision. They will actively seek ways to solve the problem by consulting books and online materials and combining their existing knowledge.

Step 4 Debriefing: At the end of the group discussion, the teacher will randomly assign all groups to report back, and the group leader will present the group's final and best solution to the audience through oral reports and presentations.

Step 5 Reflection: After completing the group report, the instructor guided the group in conducting an in-depth reflection and discussion, exploring solutions to the problems. They explored and summarized their understanding and application of new knowledge.

The problem-based learning program is a teaching method that guides students' thinking and exploration by asking questions. Providing an open-ended problem or situation that encourages students to think from multiple perspectives stimulates students' imagination and helps them generate new ideas. Students can be encouraged to share their thoughts and ideas, no matter how unique or absurd they may be, and encouraged to conduct preliminary experiments to verify them. Students can be guided to recognize that uncertainty is part of the creative process, not a problem to be avoided, even if the results may not be as expected. By encouraging students to develop a “trial and error” mentality, they can gain experience and lessons learned through trial and error, which can help them cope better with uncertainty. In the process, teachers provide appropriate feedback and incentives to motivate students to stay focused and complete the task. Overall, teachers' PBLP programs can effectively promote students' creative self-efficacy in the three areas of idea generation, uncertainty, and focus.

2. To study the effect of PBLP.

1) For assumption 1, the analysis of the results of the average score of the experimental group before and after participating in the program is as follows:

The study shows that, after participating in the problem-based learning program, the level of creative self-efficacy among students in the experimental group increased significantly compared to their level before participation. The difference in the dimensions' scores was statistically significant at the 0.01 level. The difference in the scores of the students' creative self-efficacy levels in the experimental group before and after the test indicates that the level of creative self-efficacy increased after completing the problem-based learning program. The study's results support the first research hypothesis.

2) For assumption 2, the comparison results of the average creative self-efficacy scores of the experimental group participating in the program and the control group not participating in the program are as follows:

The study shows that students in the experimental group achieved higher grades after participating in the problem-based learning program compared to students in the control group who did not participate in the program. These differences were statistically significant in all three dimensions, with a significance level of 0.01.

On all dimensions of creative self-efficacy levels, students who participated in the problem-based learning program scored higher on the creative self-efficacy test than those who did not. This indicates that the problem-based learning program effectively enhances students' creative self-efficacy. The findings support the second research hypothesis.

5.4.2 Discussion

1. From Research Objective 1, design the problem-based learning program (PBLP).

The problem-based learning program is a student-centered instructional strategy. In this study, the program activities focused on creating an environment in which students actively participate in solving real-world problems, thereby facilitating learning and knowledge acquisition through the process of solving specific problems. Students need to learn to work in teams, understand problems, think deeply, and solve them throughout the learning process. Problem-based learning programs are divided into five steps: Group organization, Questioning, Discussion, Debriefing, and Reflection (Barrows, 1986).

Barrows (1986) states that a problem-based learning program is a student-centered instructional approach that motivates students' curiosity and inquisitiveness by posing authentic and meaningful problems, and encourages active learning in the exploration of problem solving. In problem-based teaching, students must take the initiative to find solutions to problems, which stimulates their creativity and innovative thinking. Through continuous experimentation and exploration, students can gradually

build confidence in their ability to succeed in creative activities. the problem-based teaching program usually uses real problems or cases. These situations can help students better understand and apply what they have learned, thus improving their practical skills and problem-solving abilities. In practice, students can gradually develop their creative and problem-solving abilities, thereby increasing their creative self-efficacy. In problem-based teaching, students work collaboratively with others to solve problems. Through teamwork, students can learn to communicate, negotiate, and share ideas with others, thereby developing their social and cooperative skills. At the same time, teamwork can help students better utilize their creativity and imagination, further improving creative self-efficacy.

In this study, the aim was to create a problem-solving environment for students through problem-oriented learning, placing them in complex and near-realistic problem situations, and to enhance their self-confidence by engaging them in problem solving and experiencing a sense of accomplishment through success, which will further motivate them to be brave enough to try new things and not be afraid of failing in their studies and lives. In the problem-based learning program, students must take the initiative to find information, analyze the problem, put forward a hypothesis, and verify the solution. This process can develop their independent learning ability and enable them to learn how to acquire information and utilize resources effectively. In problem solving, students must cooperate with their peers to accomplish tasks. This helps them learn how to communicate, negotiate, and compromise effectively with others, thus enhancing their cooperative skills. Students may encounter setbacks and failures in the process. However, by reflecting and fixing their mistakes, they can learn how to face difficulties and persevere. This experience helps enhance students' creative self-efficacy in all aspects, including self-confidence, independent learning, problem-solving, cooperation and communication, creative thinking, adaptability, and resilience. Enhancing these abilities will lay a solid foundation for students' future studies and careers.

2. From Research objectives 2, Study the effect of using a problem-based learning program on the creative self-efficacy of higher vocational students.

(1) Hypothesis 1: After participating in the problem-based learning program, the experimental group has a higher level of creative self-efficacy than before.

The pre- and post-intervention scores of the students in the experimental group were analyzed by comparing the differences in their levels of creative self-efficacy before and after their participation in the experiment. The study's data showed that students in the experimental group increased their creative self-efficacy after completing the problem-based learning program, as indicated by their post-test scores, confirming that the program effectively enhances students' creative self-efficacy. The study's results supported the first research hypothesis.

This study assessed students' creative self-efficacy along three dimensions.

1) PBLP promotes the development of students' Ideageneration.

Ideageneration refers to the reflection in students' ability to create new things and solve problems, including coming up with innovative ideas and solutions(Puozzo & Audrin, 2021).

In this study, problem-based learning breaks the traditional stereotypical teaching model by introducing real-life complex problems and using daily life as a context to help students relate what they learn to real life and their future careers, and encouraging them to learn and explore actively, where students need to do hands-on practical investigations and design solutions around real problems(Savin-Baden, 2007), which requires them to apply what they have learned to This requires them to think and come up with innovative solutions and use software within a specified time frame to create an innovative piece of artwork. In psychology, idea generation refers to the process by which an individual or team generates new and unique ideas or creativity through a specific method or process(Puccio & Cabra, 2012).

The experimental data showed a significant difference between the experimental group of students in terms of ideageneration at the pre-test and post-test. The degree of ideageneration is reflected in students' ability to create new things and

solve problems, including the use of diverse learning strategies, the ability to apply what they have learned flexibly, and to come up with new and unique learning methods and solutions(Puccio & Cabra, 2012). In practice, continually explore new and effective learning methods and skills, and be able to use new tools, techniques, or methods and apply them to learning and daily life to improve efficiency and quality. Perform well in teamwork, present creative insights and solutions, and communicate and collaborate effectively with team members(Sapp, 1992).In the creative self-efficacy activity, the ideageneration score not only takes into account the basic stimulus-response, but also assesses whether the individual can generate a large number of ideas with a certain degree of variability and diversity among them, and whether the generated ideas are practical and can be applied in real life. For example, in the second theme, “environmental icon design”, the researcher guided the students to focus on the environmental theme and encouraged them to effectively communicate and collaborate with their team members in teamwork, to come up with creative insights and solutions, and to add elements to their creations by using new tools, techniques, or methods. The process of creativity is ongoing and is usually accompanied by frustration, revision, and continuous improvement. Students completed the main parts of their work based on their understanding and then added details incrementally, continually solving problems encountered and refining their work as needed.

2) PBLP promotes the development of students' Uncertainty.

Uncertainty means students may encounter various unknown situations and outcomes during the creative process. In the ideageneration stage, creators may face numerous uncertain ideas and inspirations, which can appear and disappear at any time. Creators need to learn to accept this uncertainty and try to transform these uncertain ideas into actual creations(Beghetto, 2019). In the creative process stage, creators may face many unexpected problems and challenges, such as bottlenecks in creative thinking, technical difficulties, etc.; in the completion stage of the work, even if creators have completed their works, they face the uncertainty of market feedback and audience acceptance, and creators need to accept the fact that their

works may not be accepted and understood by everyone, and learn to learn and grow from it. These uncertainties may complicate and make the creative process difficult, but they may also stimulate creators to think creatively and enable them to find new solutions (Beghetto, 2019).

In this study, uncertainty refers to the feeling that students experience when they feel confused and unsure of how to act or generate practical ideas in response to a creative task or challenge. Students are unsure how to begin or move forward with the creative process because they lack the knowledge and skills to accomplish a given task. Over-reliance on traditional ways of thinking, difficulty thinking outside the box to generate novel ideas, and fear that their creativity will be judged as not good enough or not up to standard lead students to shy away from trying new ideas. Students have limited resources available to them, thus restricting their creative endeavors. In the absence of clear goals or guidance, students may feel uncertain about which direction to take.

For example, in the tenth activity of the Creative Self-Efficacy Test, students were asked to design a themed game interface for colorblind players. First, students needed to identify the factors that limit colorblind players, and team members needed to work consistently to try new ideas and strategies to finalize the solution. At the beginning of the creation process, team members used brainstorming methods to develop various novel solutions based on the theme of the activity. After continuous negotiations and refinements, the students entered the implementation phase, based on the identified solutions. In this phase, they needed to design components suitable for colorblind players and utilize software or new tools and methods to bring their novel ideas to life. Once completed, their work will be challenged by the teacher and their classmates, and they will seek opportunities and inspiration in the challenge to refine their work further. All of these performances demonstrated the students' creative self-efficacy. The students' changes in the uncertainty dimension also differed before and after the experiment. Before the test, Prior to the test, students lacked the knowledge and skills needed to complete specific tasks, leading them to be unsure of how to begin

or move forward with the creative process Lack of confidence in their level of creativity and fear that their ideas would be judged as not good enough or unpopular.

The key to increasing students' uncertainty is providing them with a supportive environment and adequate resources, including learning materials, tools, and equipment(Kraft et al., 2015). According to Peter Drucker, teachers can help students broaden their thinking and encourage experimentation with different ways of thinking and problem solving through practical educational activities. Set clear and measurable targets for students and provide timely feedback to help them understand their progress and areas for improvement. Educate students on how to deal positively with the uncertainties and challenges of the creative process. This includes accepting failures and setbacks as opportunities to learn and grow, learning from mistakes, and developing problem-solving skills. Students are encouraged to take risks, try new ideas, and be creative, even when they may not be perfect or risky (Drucker, 1998). Students can gradually increase their creative self-efficacy by accepting failure and trying new possibilities. Help students develop positive mental attitudes, including self-confidence, optimism, and resilience. These qualities can help students better cope with the challenges and uncertainties of the creative process, thereby enhancing their creative self-efficacy (Puozzo & Audrin, 2021). For example, in the third thematic activity, teachers provided students with the necessary tools and resources for exploration based on the activity's theme, set clear and measurable goals for them, and offered timely guidance as the activity progressed to help students understand their progress and areas for improvement. Please encourage students to take risks in trying new ideas and being creative, and help them develop positive attitudes of confidence, optimism, and resilience when their attempts fail. After students engaged in several meetings of the minds, each group finalized its solutions. One group finally decided to create a model of the Earth with a gas mask. The color of the Earth is green, symbolizing the need to take care of the planet and prevent air pollution.

Teachers can help students overcome uncertainty in the classroom by teaching decision-making skills, developing problem-solving skills, providing support

and guidance, fostering resilience, and emphasizing teamwork(Comfort & Wukich, 2013).

3) PBLP promotes the development of students' Focus

Focus refers to focusing attention or energy on a particular task, topic, or goal. It involves filtering out distractions and focusing on what is most important, enabling an individual to achieve desired results more efficiently(Cohen & Cohen, 2014).In this study, the researchers found that one of the key issues facing students was their lack of focus on problem-solving, which led to difficulties in responding effectively to the challenges they encountered in their creative endeavors. In this study, the researchers found that one of the key issues facing students was their lack of focus on problem-solving, which led to difficulties in responding effectively to the challenges they encountered in their creative endeavors. Therefore, the role of the teacher in guiding students through the learning process is crucial, starting with a clear plan and goals at the idea generation stage. This helps students know what to focus on and avoid being distracted by irrelevant matters. Creating a conducive learning environment during the creative process, teaching students methods such as breaking down large tasks into smaller, more specific subtasks can help them manage and complete them more easily. Setting clear time limits for each task ensures that learning progress is controlled. Relaxation techniques, such as meditation and deep breathing, can help reduce stress and anxiety, as well as improve concentration when faced with complex problems (Santos et al., 2023).

In the study, the key to improving students' focus is to begin the lesson by clearly stating the learning objectives and expected outcomes, so that students understand the questions the teacher is asking and what they are going to achieve (Hino & Funahashi, 2022). Students are taught how to manage their time effectively, set both short-term and long-term design goals, avoid procrastination, and increase their productivity. Moreover, teachers should encourage students to participate in discussions, design challenges, and collaborative projects to deepen their understanding and find solutions through hands-on exercises and feedback loops.

Specific and constructive feedback is given to students promptly, highlighting the strengths of their designs and areas for improvement.

The pre- and post-experimental results showed that the students' creative self-efficacy level in the experimental group was significantly higher, indicating that the problem-based learning program can help students improve their concentration. Dolmans also noted in his study that the PBLP can stimulate students' interest in learning and make them more focused on problem-solving (Dolmans et al., 2016).

The study results showed that the level of creative self-efficacy of higher vocational students increased in all dimensions after the experiment.

Changes in the students' creative self-efficacy in the experiment depended primarily on a sound pedagogical design based on a problem-based learning program. The program developed 12 thematic activities tailored to the interests and specializations of 108 students, which defined the purpose and methodology. The themes are relevant to life, primarily allowing students to solve real-world problems, and align with their existing experiences, enabling students to develop a strong sense of identity and a desire to explore the themes presented. In all theme activities, teachers help students get started by showing the basic form of the theme and explaining key points. Teachers encourage students to create independently through imitation, building their self-confidence and developing their creativity and problem-solving skills. This instructional strategy is designed to enable students to continue their self-development through progressively increasing challenges, thereby gaining experience in learning and collaboration. The problem-based learning program is an educational process that begins when a student is confronted with a real-world problem or challenge that needs to be solved and ends when the student demonstrates an understanding and application of what they have learned, as well as problem-solving skills. In this process, students must actively explore, research, discuss, and practice to find solutions to their problems. In this study, 12 thematic activities were set up: Introduction, Eco-friendly icon design, Exercise for All icon design, Medical app interface design, Food app interface design, Furniture e-commerce website interface design, Book e-commerce website

interface design, Music player software interface, Taxi-hailing software interface, Puzzle game interface design, Adventure game interface design, End of Course Summary. Each activity inspires unlimited creativity as students work in teams and explore through the web. The Problem-based learning program is a student-centered approach to teaching and learning. The core of this approach is to promote active learning and knowledge application by solving real or simulated complex problems. In PBLP, students are placed in a situation that requires them to solve a problem, thus stimulating their ability to explore knowledge, apply theory, think critically, and work in teams.

The results are consistent with the research of Masek and Yamin (2021), who explored the impact of the problem-based learning approach on teaching and learning in high school classrooms through an empirical study(Masek & Yamin, 2011). The problem-based teaching method can significantly enhance students' creativity and idea-generating abilities by posing problems and guiding them to explore and solve these problems independently. The application of problem-based teaching method can effectively change students' learning behavior, drive the individual thinking of continuous exploration and thinking, and in the form of changing the state of passive learning, creating a good learning atmosphere, which can help to improve the learning efficiency, improve the confidence of students to deal with uncertainty, and change the learning behavior of the students so that the students are more focused on learning(Masek & Yamin, 2011). Creative self-efficacy comprises three parts: idea generation, uncertainty, and concentration (Hill et al., 2008); therefore, the problem-based teaching method can indirectly improve students' creative self-efficacy.

(2) Hypothesis 2: After participating in the problem-based learning program, the experimental group had a higher level of creative self-efficacy than the control group.

The results revealed a significant difference between the experimental group and the control group, with the experimental group achieving higher scores than the control group. The results also support the second hypothesis.

The primary reason for this is that the students in the experimental group gained experience with a teaching method based on problem-based learning, whereas the students in the control group did not. The teaching and learning process was divided into five stages. Among these, Group organization, Discussion, and Debriefing were three tasks assigned to students before class, allowing them more time to explore, discover, and create. Explanation, Questioning, and Reflection were done in class(Wijnia et al., 2019). The topic setting of the whole problem-based learning program was relatively innovative, engaging, and challenging. Students in the experimental group may encounter some obstacles and difficulties in practicing. However, this process is more conducive to improving students' creativity and problem-solving ability. When students see the results of their efforts to solve the problem, they will feel proud and satisfied, and this sense of achievement will build their self-confidence and motivate them to study and explore harder in the future (Baumeister et al., 2003).

The results of this study have important implications for the Chinese higher vocational students. Firstly, problem-based learning program facilitates students' Ideagenration, which is consistent with the findings of Ulger (2018). The reason is that, first of all, in the problem-based program, teachers typically pose challenging and open-ended questions, which stimulate students' curiosity and prompt them to take the initiative in exploring unknown areas and finding new ways to solve problems. The problem-based learning program encourages students to examine problems from multiple perspectives, challenge traditional ideas, and offer new insights. This way of thinking helps break down stereotypes and promote creativity (Ulger, 2018). In problem-solving, students must combine theoretical knowledge with practical operations and gradually develop innovative solutions through continuous attempts and corrections. This practical process can cultivate students' sense of innovation and practical ability(Kim & Hannafin, 2011). In a Group organization, students need to communicate and share ideas to solve problems, which can inspire creative thinking, broaden their thinking horizons, and cultivate teamwork and communication skills (Nelson, 2013). In

addition, teachers provide timely feedback and encourage students' creativity and problem-solving, thereby enhancing students' sense of innovation and self-confidence. This positive feedback mechanism can stimulate students' creative potential and promote the generation of ideas.

Secondly, the problem-based learning program pedagogy facilitates students' understanding of the uncertainty aspect, which is consistent with Park's findings. In the problem-based learning program, students face various unknown and uncertain situations. This teaching style encourages students to accept and tolerate uncertainty as part of the learning and innovation process(Hung et al., 2008). By accepting uncertainty, students can think more openly and flexibly, which in turn makes it easier to generate new ideas and solutions. When faced with uncertainty, the problem-based approach requires students to take the initiative in seeking out information and resources and to develop and implement solutions. This process enhances students' problem-solving skills and makes them more adept at dealing with uncertainty and challenges(Park et al., 2023). This adaptive training enhances students' adaptability and resilience, enabling them to navigate and thrive more effectively in uncertain environments. Uncertainty is a crucial driver of innovation, and the problem-based approach has a positive influence on students' attitudes toward and ways of dealing with uncertainty. It fosters a tolerance for uncertainty, enhances problem-solving skills, increases adaptability, and promotes innovative thinking.

Finally, the problem-based learning program approach promotes a shift in student focus, consistent with the findings of Hammel et al. The problem-based learning program approach promotes a shift in students' Focus, consistent with the findings. The problem-based learning program encourages active exploration, discovery, and problem solving, stimulating intrinsic motivation. When students see that the learning material is relevant to their interests and goals, they are more likely to fully engage in the learning process, leading to improved concentration(Hammel et al., 1999). In PBLP, teachers set clear learning goals and questions, which help students stay focused and oriented throughout the learning process. Clear goals help students focus on key

information and avoid distractions, thus increasing concentration. Moreover, the problem-based learning program encourages students to engage in deep processing, i.e., understanding, integrating, and applying what they have learned. This deep processing process helps students better remember and understand information while improving their problem-solving skills(Saleh et al., 2017). Through deep processing, students can stay focused longer and respond to challenges more effectively. In the problem-based learning program, teachers provide timely feedback and guidance, which helps students understand their progress and identify areas for improvement. This feedback helps students adjust their learning strategies to avoid detours and thus stay focused more effectively. By engaging in PBLP activities, students can gradually improve their self-confidence and self-efficacy. When students feel empowered to solve problems and make progress, they are more likely to stay focused and sustain their efforts. In conclusion, the problem-based learning program influences students' concentration by stimulating intrinsic motivation, setting clear goals, facilitating in-depth processing, providing timely feedback, and fostering self-efficacy.

5.5 Limitations of the study

Although the results presented in this study are positive, some limitations need to be acknowledged.

The study examined only the short-term impact of the problem-based learning program on creative self-efficacy, without conducting follow-up testing. Post-testing was conducted for the experimental and control groups at the end of all teaching activities. However, there was no retesting of the subjects in the subsequent period. Therefore, it is impossible to confirm the stability and permanence of the problem-based learning program in enhancing students' creative self-efficacy. Given that the effects of this learning style may diminish over time or change due to other factors, future research should focus on validating long-term effects to assess the sustained impact of this teaching method on students' creative self-efficacy.

5.6 Recommendations for future research

Based on this study's findings, several recommendations can be made for future research on the impact of problem-based learning programs on students' creative self-efficacy.

1. When implementing a problem-based learning program, students need to access a wide range of information, so teachers must provide them with the necessary resources, such as libraries, the Internet, and textbooks, to help them better understand and solve problems.

2. Problem-based learning emphasizes students' active learning, so teachers need to encourage students to think independently and explore actively. When students encounter problems, the teacher can provide appropriate guidance, but should not give the answers directly; instead, the teacher should let the students find their way to solve the problems.

3. In the discussion and sharing sessions, the teacher must guide students to speak actively and share their insights and experiences. At the same time, the teacher should also listen carefully to students' speeches and give timely feedback and suggestions. Through discussion and sharing, students can inspire each other and make progress together.

4. Students have diverse interests, learning habits, and cognitive levels, so teachers must consider each student's needs. When implementing problem-based learning plans, teachers can develop individualized plans to meet the needs of different students.

5. Problem-based learning often requires more time and effort, so learn to rationalize time to ensure students can fully engage in learning.

6. Problem-based learning is a step-by-step process that requires patience and perseverance. Help students encounter difficulties or setbacks; do not give up easily. Instead, persevere and seek help. The combined efforts of teachers and students are key to success when implementing a problem-based learning program.

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APPENDIX 1

Creative Self-efficacy Scale

Dear Students,

Hello! I am a master's degree student majoring in education, researching the effects of problem-based learning pedagogy on the creative self-efficacy of Chinese higher vocational students. Based on this, I have used the Chinese version of the Creative Self-Efficacy Scale (CSE) to investigate your creative self-efficacy. This is a survey; the personal information in the table is only used for this dissertation research; all the answers are not right or wrong and will not be credited to the course grade, so please answer the questions truthfully, and I wish you good luck in your study!

Part I: Basic Information

Age: _____ Gender: _____ (1. Male, 2. Female)

Part II: Scale Test

The following are some questions about the Creative Self-Efficacy Assessment. Each question has a row divided into five levels of the grid. Please read it carefully, fill in the questionnaire according to your situation, and "○" under the item that best fits your situation. Please fill in the items one by one and do not omit them. Thank you for your cooperation!

Notes: A. Strongly conforms; B. Substantially conforms; C. Neutral or uncertain; D. Substantially does not conform; E. Strongly does not conform.

1. I am good at coming up with new ideas.	A	B	C	D	E
2.I have a lot of good ideas.	A	B	C	D	E
3. I have a good imagination.	A	B	C	D	E
4. I can quickly come up with several different solutions during course projects.	A	B	C	D	E
5. When creativity is needed, I specialize in brainstorming unique ideas.	A	B	C	D	E
6. I can often come up with original ideas for my classmates or teachers.	A	B	C	D	E

7. Even when faced with conventional problems, I can try to solve them with non-traditional methods.	A	B	C	D	E
8. I can delay judgment (not making any evaluation) when coming up with ideas.	A	B	C	D	E
9. I can tolerate ambiguity.	A	B	C	D	E
10.I can wait patiently for good ideas to emerge.	A	B	C	D	E
11.Even if the mission's goals are not clear, I am confident that I can move forward through creative approaches.	A	B	C	D	E
12.When faced with unexpected problems, I can flexibly adjust my strategy and come up with innovative solutions.	A	B	C	D	E
13.With incomplete information, I'm still willing to try risky ideas.	A	B	C	D	E
14.The skepticism of others will not shake my confidence in my own creativity.	A	B	C	D	E
15.I have a strong will to master knowledge.	A	B	C	D	E
16.I constantly check to see how well I am doing.	A	B	C	D	E
17.I continue doing my task and never give up even if I face difficulty.	A	B	C	D	E
18.I have a strong will to improve skills and techniques.	A	B	C	D	E
19.I can stay focused for long periods of time on complex creative tasks.	A	B	C	D	E
20.I will polish my idea over and over again until it achieves the desired result.	A	B	C	D	E
21.When inspiration runs low, I still manage to keep trying different approaches to solving problems.	A	B	C	D	E

APPENDIX 2

Design for Problem-based learning program 1

Definition of the Problem-based learning

Problem-based Learning is a learning program that uses a student-centred teaching strategy, emphasizing teaching methods that promote learning and knowledge acquisition through solving specific problems. The teaching and learning process of the Problem-based Learning Program is divided into five main areas: Group organization, Questioning, Discussion, Debriefing, and Reflection.

Problem-based learning aims to create an environment in which students are actively engaged in solving real-world problems. Throughout the learning process, creative thinking, critical thinking, problem-solving skills, and a deeper understanding of the subject matter are developed.

This study will use the self-designed Problem-base learning program as an experimental tool for Problem-based learning. The program consists of five parts: Teaching objective, Teaching Focus and Difficulties, Teaching tools, learning process and classroom summary.

Problem-base learning program 1

Course title	User Interface (UI) design		
Course Title	Introduction		
teaching materials	UI design tutorial	Type of lesson	core curriculum
Classes	experimental class	lesson time	90minutes
Teaching objective	To equip students with the basics of user interface design, such as the concepts, principles and processes of user interface design, and to understand classroom rules and learning methods. There is also a creative self-efficacy pre-lab test for students.		
Focus and Difficulty	creative self-efficacy pre-test and UI design learning methods.		
Teaching tools	Computer, blackboard, PPT, pictures		

Teaching Procedures	Teacher	Students
Group organization (5 minutes)	The teacher groups 54 students into 9 groups of 6. And teamwork was required, with members going to find information and digging out the correct answer based on the question.	Students get to know and familiarize themselves with each other and their group members. Students are expected to actively work with, encourage, and trust others.
Questioning (50 minutes)	(1) The teacher will first systematically introduce the knowledge to be learned in this course, including icon design, app interface design, website page design software interface design, and game interface design. Moreover, the teacher will show the pictures of these five kinds of interfaces and make relevant introductions. (1) The teacher gives the learners some designed questions and asks each group to complete their part individually. Question: Because of the complexity and diversity of	(1) The students look at the pictures and listen carefully to the teacher and think about the questions she asks. (2)Group members cooperate with each other and use the computer to find relevant information to complete their tasks within the time limit.

	user needs in daily life, they are difficult to capture accurately, resulting in designers often deviating from the actual needs when designing UI. How should we solve this problem?	
Discussion (5 minutes)	Teachers can guide students to utilize role-playing, where team members can take on different roles (e.g., customers, competitors, etc.) and look at the problem from different perspectives, which can help uncover new perspectives and solutions.	(1) Group members discuss the questions asked by the teacher and clearly understand the answers to the questions. (2) Students use role-playing so team members can take on different roles (e.g., customer, competitor, etc.). Looking at a problem differently leads to discovering new perspectives and solutions.
Debriefing (20 minutes)	(1) The teacher will sort the 9 groups then take turns to let the groups show their answers. (2) The teacher should focus on the key points and the difficult points Where students	The students present the results that they have integrated.

	tend to make mistakes.	
Reflection (10 minutes)	(1) The teacher made a comprehensive evaluation of each group's presentation and suggestions for improvement, as well as a final summary of the class. (2) The teacher distributed the Creative Self-Efficacy Scale to the students and instructed them to fill it out and collect the scale when they were finished.	(1)It is very important for students to follow the teacher's lead and pay attention to what the teacher mentions as being done well and what needs to be improved. (2) students integrate the information again and review what they have learned in this lesson. (3) Students will complete the Creative Self-Efficacy Scale as requested by the teacher.
Classroom summary	The first lesson of UI Design went quite well due to the teacher's extensive preparation. First of all, the teacher made a systematic explanation of the basic theoretical knowledge of UI design to the students, and the students have mastered the basic theoretical knowledge of UI design, and the students helped each other to solve the difficulties encountered in the learning process. In addition, the creative self-efficacy pre-test for this experiment was also completed after the first class.	
Blackboard Design	Unit1 Understanding user interface (UI) design	

	Group Scores

Design for Problem-based learning program2

Definition of the Problem-based learning

Problem-based Learning is a learning program that uses a student-centred teaching strategy, emphasizing teaching methods that promote learning and knowledge acquisition through solving specific problems. The teaching and learning process of the Problem-based Learning Program is divided into five main areas: Group organization, Questioning, Discussion, Debriefing, and Reflection.

Problem-based learning aims to create an environment in which students are actively engaged in solving real-world problems. Throughout the learning process, creative thinking, critical thinking, problem-solving skills, and a deeper understanding of the subject matter are developed.

This study will use the self-designed Problem-base learning program as an experimental tool for Problem-based learning. The program consists of five parts: Teaching objective, Teaching Focus and Difficulties, Teaching tools, learning process and classroom summary.

Problem-base learning program 2

Course title	User Interface (UI) design		
Course Title	Eco-friendly icon design		
teaching materials	UI design tutorial	Type of lesson	core curriculum
Classes	experimental class	lesson time	90minutes
Teaching objective	Students will master use PhotoShop software to design an icon with the theme Eco-friendly.		
Focus and Difficulty	Master the functions of designing a Eco-friendly icon in PhotoShop and be able to design Eco-friendly icons.		
Teaching tools	Computer, blackboard, PPT, pictures		
Teaching Procedures	Teacher	Students	

Group organization (5 minutes)	The teacher groups 54 students into 9 groups of 6. And teamwork was required, with members going to find information and digging out the correct answer based on the question.	Students get to know and familiarize themselves with each other and their group members. Students are expected to actively work with, encourage, and trust others.
Questioning (50 minutes)	(1) The teacher displays an image of a Eco-friendly icon and demonstrates how to design the Eco-friendly icon using the features of the PhotoShop program. (2) The teacher gives the learners some designed questions and asks each group to complete their part individually. Question: Due to people's low environmental awareness, many behaviors generated in daily life cause environmental problems such as water pollution, air pollution, and noise pollution. To raise	(1) The students look at the pictures and listen carefully to the teacher and think about the questions she asks. (2)Group members cooperate with each other and use the computer to find relevant information to complete their tasks within the time limit.

	people's awareness of environmental protection, enhance their self-awareness of their behavior, and reduce environmental pollution, please design a creative icon that can promote environmental protection.	
Discussion (5 minutes)	The teacher instructs students to use the brainstorming method to think about problems from different perspectives and contexts. During the brainstorming process, the teacher encourages students to record the ideas of all students in the same group, even if some ideas seem irrelevant or impossible. This helps students realize their valuable ideas and encourages them to keep thinking. After recording all the ideas, the teacher can guide the students to sift through and evaluate the ideas together to find the most likely solution to	(1)Group members discuss the questions asked by the teacher and clearly understand the answers to the questions. (2)The members of each group will think out of the question according to the teacher's guidance, record all the answers, and finally reintegrate the answers after discussion.

	the problem.	
Debriefing (20 minutes)	(1) The teacher will sort the 9 groups then take turns to let the groups show their answers. (2) The teacher should focus on the key points and the difficult points Where students tend to make mistakes.	The students present the results that they have integrated.
Reflection (10 minutes)	(1) The teacher made a comprehensive evaluation of each group's presentation and suggestions for improvement, as well as a final summary of the class. (2)The teacher provided an in-depth explanation of the “Eco-friendly” icons designing process. (3) Teachers should add to their own knowledge while taking into account the composite situation of all students.	(1)It is very important for students to follow the teacher's lead and pay attention to what the teacher mentions as being done well and what needs to be improved. (2) Students integrate the information again and review what they have learned in this lesson.
Classroom summary	The UI design class went quite well due to the extensive preparation done by the students and the teacher. We can	

	learn that the students have mastered the procedures of the problem-based learning program, the students can summarize the appropriate techniques to deal with the difficulties encountered in the process of learning Eco-friendly icon design, and the students can work well with others. However, we also found some shortcomings. Some problems are difficult, such as how to design Eco-friendly icons more creatively. Therefore, there are some problems they need to complete through extra study after class.
Blackboard Design	Unit 2 Eco-friendly icon design Group Scores

Design for Problem-based learning program 3

Definition of the Problem-based learning

Problem-based Learning is a learning program that uses a student-centred teaching strategy, emphasizing teaching methods that promote learning and knowledge acquisition through solving specific problems. The teaching and learning process of the Problem-based Learning Program is divided into five main areas: Group organization, Questioning, Discussion, Debriefing, and Reflection.

Problem-based learning aims to create an environment in which students are actively engaged in solving real-world problems. Throughout the learning process, creative thinking, critical thinking, problem-solving skills, and a deeper understanding of the subject matter are developed.

This study will use the self-designed Problem-base learning program as an experimental tool for Problem-based learning. The program consists of five parts: Teaching objective, Teaching Focus and Difficulties, Teaching tools, learning process and classroom summary.

Problem-base learning program 3

Course title	User Interface (UI) design		
Course Title	Exercise for All icon design		
teaching materials	UI design tutorial	Type of lesson	core curriculum
Classes	experimental class	lesson time	90minutes
Teaching objective	Students will master use PhotoShop software to design an icon with the theme Exercise for All .		
Focus and Difficulty	Master the functions of designing a Exercise for All icon in PhotoShop and be able to design a Exercise for All icon .		
Teaching tools	Computer,blackboard, PPT, pictures		
Teaching Procedures	Teacher	Students	

Group organization (5 minutes)	The teacher groups 54 students into 9 groups of 6. And teamwork was required, with members going to find information and digging out the correct answer based on the question.	Students get to know and familiarize themselves with each other and their group members. Students are expected to actively work with, encourage, and trust others.
Questioning (50 minutes)	(1) The teacher displays an image of a Exercise for All icon and demonstrates how to design the Exercise for All icon using the features of the PhotoShop program. (2)The teacher gives the learners some designed questions and asks each group to complete their part individually. Question: Lack of awareness of exercise has led to a rise in the rate of sub-health problems and diseases among the population nowadays. Long-term lack of sufficient physical activity not only affects one's physical	(1) The students look at the pictures and listen carefully to the teacher and think about the questions she asks. (2)Group members cooperate with each other and use the computer to find relevant information to complete their tasks within the time limit.

	health but also hurts one's mental health, such as increasing the risk of anxiety, depression, and other psychological problems. Faced with the current situation of sub-health problems and rising disease rates, to enhance the awareness of exercise and promote the health of all people, please design a creative icon to publicize Exercise for All.	
Discussion (5 minutes)	The teacher instructs students to utilize the “Six Thinking Hats” method, guiding them to explore the questions posed by the teacher from different thinking perspectives (e.g., logical, emotional, creative, etc.) through role-playing to develop a holistic view of the situation. How can teachers help students to think and solve problems using the “Six Thinking Hats” approach? In applying the “Six Thinking	(1)Group members discuss the questions asked by the teacher and clearly understand the answers to the questions. (2)The members of each group will think freely according to the teacher's instructions, record all the answers, and finally reintegrate the answers after the discussion.

	Hats", the teacher can guide students through group discussions and sharing. In utilizing the "Six Thinking Hats", the teacher can guide the students to have group discussions and sharing, which will enable them to understand better and apply the method and develop their communication skills and teamwork spirit.	
Debriefing (20 minutes)	(1) The teacher will sort the 9 groups then take turns to let the groups show their answers. (2) The teacher should focus on the key points and the difficult points Where students tend to make mistakes.	The students present the results that they have integrated.
Reflection (10 minutes)	(1) The teacher made a comprehensive evaluation of each group's presentation and suggestions for improvement, as well as a final summary of the class. (2) The teacher provided an in-	(1)It is very important for students to follow the teacher's lead and pay attention to what the teacher mentions as being done well and what needs to be improved.

	depth explanation of the Exercise for All icon designing process. (3) Teachers should add to their own knowledge while taking into account the composite situation of all students.	(2)Students integrate the information again and review what they have learned in this lesson.
Classroom summary	The UI design class went quite well due to the extensive preparation done by the students and the teacher. We can learn that the students have mastered the procedures of the problem-based learning program, the students can summarize the appropriate techniques to deal with the difficulties encountered in learning Exercise for All icon design, and the students can work well with others. However, we also found some shortcomings. Some problems are difficult, such as how to design Exercise for All icons more creatively. Therefore, there are some problems they need to complete through extra study after class.	
Blackboard Design	Unit 3 Exercise for All icon design Group Scores	

Design for Problem-based learning program 4

Definition of the Problem-based learning

Problem-based Learning is a learning program that uses a student-centred teaching strategy, emphasizing teaching methods that promote learning and knowledge acquisition through solving specific problems. The teaching and learning process of the Problem-based Learning Program is divided into five main areas: Group organization, Questioning, Discussion, Debriefing, and Reflection.

Problem-based learning aims to create an environment in which students are actively engaged in solving real-world problems. Throughout the learning process, creative thinking, critical thinking, problem-solving skills, and a deeper understanding of the subject matter are developed.

This study will use the self-designed Problem-base learning program as an experimental tool for Problem-based learning. The program consists of five parts: Teaching objective, Teaching Focus and Difficulties, Teaching tools, learning process and classroom summary.

Problem-base learning program 4

Course title	User Interface(UI) design		
Course Title	Medical app interface design		
teaching materials	UI design tutorial	Type of lesson	core curriculum
Classes	experimental class	lesson time	90minutes
Teaching objective	Students will master use PhotoShop software to design a Medical app interface.		
Focus and Difficulty	Master the functions of designing a medical app interface in PhotoShop and be able to design a medical app interface.		
Teaching tools	Computer,blackboard, PPT, pictures		
Teaching Procedures	Teacher	Students	

Group organization (5 minutes)	The teacher groups 54 students into 9 groups of 6. And teamwork was required, with members going to find information and digging out the correct answer based on the question.	Students get to know and familiarize themselves with each other and their group members. Students are expected to actively work with, encourage, and trust others.
Questioning (50 minutes)	(1) The teacher displays an image of a medical application interface and demonstrates how to use the functions in Photoshop software to design the medical application interface. (2)The teacher gives the learners some designed questions and asks each group to complete their part individually. Question: Diabetic patients often face unstable blood sugar control, complication risk, and mental stress in their daily lives. To help them solve these problems, please design a	(1) The students look at the pictures and listen carefully to the teacher and think about the questions she asks. (2)Group members cooperate with each other and use the computer to find relevant information to complete their tasks within the time limit.

	medical app that assists them in managing their health. For example, providing features such as dietary advice, exercise programs, and medication reminders can help patients better control their health.	
Discussion (5 minutes)	Teachers can instruct students to use the “SCAMPER” method to generate ideas. In doing so, they can guide students to consider replacing existing solutions with other things, materials, processes, or ideas; help students combine different elements, concepts, or ideas to generate new solutions; help students adapt existing solutions to new situations or challenges; help students modify existing ideas or solutions to improve their effectiveness or feasibility; and encourage students to extend existing solutions to explore more possibilities or create	(1)Group members discuss the questions asked by the teacher and clearly understand the answers to the questions. (2)Students follow the instructor's approach to combine different elements, concepts, or ideas to produce new solutions.

	more value.	
Debriefing (20 minutes)	(1) The teacher will sort the 9 groups then take turns to let the groups show their answers. (2) The teacher should focus on the key points and the difficult points Where students tend to make mistakes.	The students present the results that they have integrated.
Reflection (10 minutes)	(1)The teacher made a comprehensive evaluation of each group's presentation and suggestions for improvement, as well as a final summary of the class. (2)The teacher provided an in-depth explanation of the medical app interface designing process. (3) Teachers should add to their own knowledge while taking into account the composite situation of all students.	(1)It is very important for students to follow the teacher's lead and pay attention to what the teacher mentions as being done well and what needs to be improved. (2)Students integrate the information again and review what they have learned in this lesson.
Classroom summary	The user interface design course is progressing well due to a lot of preparatory work done by the students and the instructor. We	

	could learn that the students have mastered the procedure of a problem-based learning program, the students could summarize appropriate techniques to cope with the difficulties encountered in learning the interface design of medical applications, and the students could work well with others. However, some shortcomings were identified. Some problems were difficult, such as how to design a medical application interface that is more in line with the user's visual design and well laid out. Therefore, some problems need to be accomplished through additional learning.
Blackboard Design	Unit 4 Medical app interface design Group Scores

Design for Problem-based learning program 5

Definition of the Problem-based learning

Problem-based Learning is a learning program that uses a student-centred teaching strategy, emphasizing teaching methods that promote learning and knowledge acquisition through solving specific problems. The teaching and learning process of the Problem-based Learning Program is divided into five main areas: Group organization, Questioning, Discussion, Debriefing, and Reflection.

Problem-based learning aims to create an environment in which students are actively engaged in solving real-world problems. Throughout the learning process, creative thinking, critical thinking, problem-solving skills, and a deeper understanding of the subject matter are developed.

This study will use the self-designed Problem-base learning program as an experimental tool for Problem-based learning. The program consists of five parts: Teaching objective, Teaching Focus and Difficulties, Teaching tools, learning process and classroom summary.

Problem-base learning program 5

Course title	User Interface(UI) design		
Course Title	Food app interface design		
teaching materials	UI design tutorial	Type of lesson	core curriculum
Classes	experimental class	lesson time	90minutes
Teaching objective	Students will master use PhotoShop software to design a Food app interface.		
Focus and Difficulty	Master the functions of designing a Food app interface in PhotoShop and be able to design a Food app interface.		
Teaching tools	Computer,blackboard, PPT, pictures		
Teaching Procedures	Teacher	Students	

Group organization (5 minutes)	The teacher groups 54 students into 9 groups of 6. And teamwork was required, with members going to find information and digging out the correct answer based on the question.	Students get to know and familiarize themselves with each other and their group members. Students are expected to actively work with, encourage, and trust others.
Questioning (50 minutes)	(1)The instructor displays a picture of the food application interface and demonstrates how to design this food application interface using the features in the PhotoShop software. (2)The teacher gives the learners some designed questions and asks each group to complete their part individually. Question: Nowadays, people often have difficulty accessing fresh and healthy food due to difficulty in traveling to buy food or lack of nutritional information when shopping. To help solve these	(1) The students look at the pictures and listen carefully to the teacher and think about the questions she asks. (2)Group members cooperate with each other and use the computer to find relevant information to complete their tasks within the time limit.

	problems, please design a Food app that provides convenient online shopping and useful nutritional information for consumers so that they can buy healthy food and daily necessities at home via their mobile phones.	
Discussion (5 minutes)	The teacher guides students to utilize the “observation and imitation” method to help them quickly improve their creativity by observing excellent products, designs, or cases, learning their strengths, and trying to imitate or improve them.	(1)Group members discuss the questions asked by the teacher and clearly understand the answers to the questions. (2)Students observe good products, designs, or examples, learn their strengths, and try to imitate or improve them to generate their ideas.
Debriefing (20 minutes)	(1) The teacher will sort the 9 groups then take turns to let the groups show their answers. (2) The teacher should focus on the key points and the difficult points Where students	The students present the results that they have integrated.

	tend to make mistakes.	
Reflection (10 minutes)	(1)The teacher made a comprehensive evaluation of each group's presentation and suggestions for improvement, as well as a final summary of the class. (2)The teacher provided an in-depth explanation of the Food app interface designing process. (3) Teachers should add to their own knowledge while taking into account the composite situation of all students.	(1)It is very important for students to follow the teacher's lead and pay attention to what the teacher mentions as being done well and what needs to be improved. (2)Students integrate the information again and review what they have learned in this lesson.
Classroom summary	The UI design class went quite well due to the extensive preparation done by the students and the teacher. We could learn that the students had mastered the procedures of the problem-based learning program, the students were able to summarize the appropriate techniques to cope with the difficulties encountered in the process of learning the interface design of the food application, and the students were able to work well with others. However, we also found some shortcomings. Some problems were difficult, such as how to design a food app interface that is more in line with the user's	

	visual design and layout. Therefore, there were some problems they needed to complete through extra learning after class.
Blackboard Design	Unit 5 Food app interface design Group Scores

Design for Problem-based learning program 6

Definition of the Problem-based learning

Problem-based Learning is a learning program that uses a student-centred teaching strategy, emphasizing teaching methods that promote learning and knowledge acquisition through solving specific problems. The teaching and learning process of the Problem-based Learning Program is divided into five main areas: Group organization, Questioning, Discussion, Debriefing, and Reflection.

Problem-based learning aims to create an environment in which students are actively engaged in solving real-world problems. Throughout the learning process, creative thinking, critical thinking, problem-solving skills, and a deeper understanding of the subject matter are developed.

This study will use the self-designed Problem-base learning program as an experimental tool for Problem-based learning. The program consists of five parts: Teaching objective, Teaching Focus and Difficulties, Teaching tools, learning process and classroom summary.

Problem-base learning program 6

Course title	User Interface(UI) design		
Course Title	Furniture e-commerce website interface design		
teaching materials	UI design tutorial	Type of lesson	core curriculum
Classes	experimental class	lesson time	90minutes
Teaching objective	Students will master use PhotoShop software to design a Furniture e-commerce website interface.		
Focus and Difficulty	Master the functions of designing a Furniture e-commerce website interface in PhotoShop and be able to design a Furniture e-commerce website interface.		
Teaching tools	Computer,blackboard, PPT, pictures		

Teaching Procedures	Teacher	Students
Group organization (5 minutes)	The teacher groups 54 students into 9 groups of 6. And teamwork was required, with members going to find information and digging out the correct answer based on the question.	Students get to know and familiarize themselves with each other and their group members. Students are expected to actively work with, encourage, and trust others.
Questioning (50 minutes)	(1) The teacher displays a picture of a furniture e-commerce website and demonstrates how to design this furniture e-commerce website interface using the features in PhotoShop software. (2)The teacher gives the learners some designed questions and asks each group to complete their part individually. Question: As consumers with disabilities often encounter problems with size adaptation, lack of	(1) The students look at the pictures and listen carefully to the teacher and think about the questions she asks. (2)Group members cooperate with each other and use the computer to find relevant information to complete their tasks within the time limit.

	accessible design, difficulties in transportation and installation, and post-maintenance when purchasing and using furniture, please design a furniture e-commerce website to help consumers with disabilities solve these problems.	
Discussion (5 minutes)	The teacher guides the students to utilize the method of “user experience map” by constructing the user experience map of furniture consumers with disabilities to understand the pain points and needs of the users in the process of using the products or services, to find out the space for improvement and creative points.	(1)Group members discuss the questions asked by the teacher and clearly understand the answers to the questions. (2)Students utilize the “user experience map” methodology to build a user experience map for furniture consumers with disabilities to understand the pain points and needs of users in the process of using the product or service, so as to find room for improvement and creative ideas.
Debriefing	(1) The teacher will sort the 9	The students present the

(20 minutes)	groups then take turns to let the groups show their answers. (2) The teacher should focus on the key points and the difficult points Where students tend to make mistakes.	results that they have integrated.
Reflection (10 minutes)	(1)The teacher made a comprehensive evaluation of each group's presentation and suggestions for improvement, as well as a final summary of the class. (2)The teacher provided an in-depth explanation of the Furniture e-commerce website interface designing process. (3) Teachers should add to their own knowledge while taking into account the composite situation of all students.	(1)It is very important for students to follow the teacher's lead and pay attention to what the teacher mentions as being done well and what needs to be improved. (2)Students integrate the information again and review what they have learned in this lesson.
Classroom summary	The UI design course is doing well due to the great preparation done by the students and the teacher. We can learn that students have mastered the procedures of the problem-based learning program, students can summarize appropriate	

	techniques to deal with difficulties encountered in learning furniture e-commerce website interface design, and students can work well with others. However, some shortcomings were identified. Some problems are difficult, such as how to design the e-commerce website interface for furniture more have to meet the user needs and interface more reasonable. Therefore, there are some issues that need to be accomplished through additional learning.
Blackboard Design	Unit 6 Furniture e-commerce website interface design Group Scores

Design for Problem-based learning program 7

Definition of the Problem-based learning

Problem-based Learning is a learning program that uses a student-centred teaching strategy, emphasizing teaching methods that promote learning and knowledge Acquisition through solving specific problems. The teaching and learning process of the Problem-based Learning Program is divided into five main areas: Group organization, Questioning, Discussion, Debriefing, and Reflection.

Problem-based learning aims to create an environment in which students are actively engaged in solving real-world problems. Throughout the learning process, creative thinking, critical thinking, problem-solving skills, and a deeper understanding of the subject matter are developed.

This study will use the self-designed Problem-base learning program as an experimental tool for Problem-based learning. The program consists of five parts: Teaching objective, Teaching Focus and Difficulties, Teaching tools, learning process and classroom summary.

Problem-base learning program 7

Course title	User Interface(UI) design		
Course Title	Book e-commerce website interface design		
teaching materials	UI design tutorial	Type of lesson	core curriculum
Classes	experimental class	lesson time	90minutes
Teaching objective	Students will master use PhotoShop software to design an Book e-commerce website interface.		
Focus and Difficulty	Master the functions of designing a Book e-commerce website interface in PhotoShop and be able to design a Book e-commerce website interface.		
Teaching tools	Computer,blackboard, PPT, pictures		

Teaching Procedures	Teacher	Students
Group organization (5 minutes)	The teacher groups 54 students into 9 groups of 6. And teamwork was required, with members going to find information and digging out the correct answer based on the question.	Students get to know and familiarize themselves with each other and their group members. Students are expected to actively work with, encourage, and trust others.
Questioning (50 minutes)	(1) Teacher displays an image of a book e-commerce website interface and demonstrates how to design this book e-commerce website using the features in PhotoShop software. (2)The teacher gives the learners some designed questions and asks each group to complete their part individually. Question: In our modern, fast-paced lives, people may not have the time to visit brick-and-mortar bookstores frequently, and	(1) The students look at the pictures and listen carefully to the teacher and think about the questions she asks. (2)Group members cooperate with each other and use the computer to find relevant information to complete their tasks within the time limit.

	because of their limited inventory, they may not be able to meet the specific needs of their readers. Please design a creative book e-commerce website to help readers solve the problems they encounter in accessing, selecting and purchasing books.	
Discussion (5 minutes)	The teacher instructs the students to use analogical thinking to think about the problem so that the students will be inspired to create new works of art by having them compare the styles and artwork of different book e-commerce websites and identify the commonalities and differences between them. Encourage students to try to use analogical thinking to solve problems, even if their ideas may seem strange or impractical. Teachers should give positive feedback and support to help them overcome	(1)Group members discuss the questions asked by the teacher and clearly understand the answers to the questions. (2)Students use analogical thinking to think through problems, comparing the styles and artwork of different book e-commerce sites, identifying commonalities and differences, and attempting to use analogical thinking to solve problems, even though some of the ideas may seem strange or infeasible.

	thinking barriers and stimulate their creativity.	
Debriefing (20 minutes)	(1) The teacher will sort the 9 groups then take turns to let the groups show their answers. (2) The teacher should focus on the key points and the difficult points Where students tend to make mistakes.	The students present the results that they have integrated.
Reflection (10 minutes)	(1)The teacher made a comprehensive evaluation of each group's presentation and suggestions for improvement, as well as a final summary of the class. (2)The teacher provided an in-depth explanation of the Book e-commerce website interface designing process. (3) Teachers should add to their own knowledge while taking into account the composite situation of all students.	(1)It is very important for students to follow the teacher's lead and pay attention to what the teacher mentions as being done well and what needs to be improved. (2)Students integrate the information again and review what they have learned in this lesson.
Classroom summary	The UI design class went quite well due to the extensive	

	preparation done by the students and the teacher. We could learn that the students had mastered the procedures of the problem-based learning program, the students could summarize the appropriate techniques to cope with the difficulties encountered in learning book e-commerce website interface design, and the students could work well with others. However, we also found some shortcomings. Some problems are more difficult, such as how to design book e-commerce more in line with user habits and interface layout more reasonable. Therefore, there are some problems they need to complete through extra learning after class.
Blackboard Design	Unit 7 Book e-commerce website interface design Group Scores

Design for Problem-based learning program 8

Definition of the Problem-based learning

Problem-based Learning is a learning program that uses a student-centred teaching strategy, emphasizing teaching methods that promote learning and knowledge acquisition through solving specific problems. The teaching and learning process of the Problem-based Learning Program is divided into five main areas: Group organization, Questioning, Discussion, Debriefing, and Reflection.

Problem-based learning aims to create an environment in which students are actively engaged in solving real-world problems. Throughout the learning process, creative thinking, critical thinking, problem-solving skills, and a deeper understanding of the subject matter are developed.

This study will use the self-designed Problem-base learning program as an experimental tool for Problem-based learning. The program consists of five parts: Teaching objective, Teaching Focus and Difficulties, Teaching tools, learning process and classroom summary.

Problem-base learning program 8

Course title	User Interface(UI) design		
Course Title	Music player software interface design		
teaching materials	UI design tutorial	Type of lesson	core curriculum
Classes	experimental class	lesson time	90minutes
Teaching objective	Students will master use PhotoShop software to design a music player software.		
Focus and Difficulty	Master the functions of designing a Music player software interface in PhotoShop and be able to design a Music player software interface.		
Teaching tools	Computer,blackboard, PPT, pictures		

Teaching Procedures	Teacher	Students
Group organization (5 minutes)	The teacher groups 54 students into 9 groups of 6. And teamwork was required, with members going to find information and digging out the correct answer based on the question.	Students get to know and familiarize themselves with each other and their group members. Students are expected to actively work with, encourage, and trust others.
Questioning (50 minutes)	(1) The teacher displays an image of a Music player software interface and demonstrates how to design this Music player software interface using the features of PhotoShop software. (2)The teacher gives the learners some designed questions and asks each group to complete their part individually. Question: Although many music platforms offer personalized recommendation services, sometimes, the algorithms fail	(1) The students look at the pictures and listen carefully to the teacher and think about the questions she asks. (2)Group members cooperate with each other and use the computer to find relevant information to complete their tasks within the time limit.

	to grasp user preferences accurately. They may recommend music that doesn't meet the user's tastes and update content that isn't timely, causing users to miss out on many new works. Please design a creative music player to help users solve the problem.	
Discussion (5 minutes)	Teachers instruct students to use analogical thinking to think about problems and to be inspired to create new works by having them compare the styles and works of different music players and identify commonalities and differences between them. Students are encouraged to try to use analogical thinking to solve problems, even though their ideas may seem strange or impractical. Teachers should give positive feedback and support to help them overcome thinking barriers and stimulate	(1)Group members discuss the questions asked by the teacher and clearly understand the answers to the questions. (2)Students use analogical thinking to think about problems, compare the styles and works of different music players, identify commonalities and differences, and try analogical thinking to solve problems, even though some ideas may seem strange or unworkable.

	creativity.	
Debriefing (20 minutes)	(1) The teacher will sort the 9 groups then take turns to let the groups show their answers. (2) The teacher should focus on the key points and the difficult points Where students tend to make mistakes.	The students present the results that they have integrated.
Reflection (10 minutes)	(1) The teacher made a comprehensive evaluation of each group's presentation and suggestions for improvement, as well as a final summary of the class. (2) The teacher provided an in-depth explanation of the Music player software interface designing process. (3) Teachers should add to their own knowledge while taking into account the composite situation of all students.	(1)It is very important for students to follow the teacher's lead and pay attention to what the teacher mentions as being done well and what needs to be improved. (2)Students integrate the information again and review what they have learned in this lesson.
Classroom summary	The UI design class went quite well due to the extensive preparation done by the students and the teacher. We could	

	learn that the students had mastered the process of the problem-based learning program, the students were able to summarize the appropriate skills to cope with the difficulties encountered in the process of learning Music player software interface design, and the students were able to work well with others. However, we also found some shortcomings. Some problems are difficult, such as how to design the interface color of the music player to be more in line with the user's visual aesthetics. Therefore, there are some problems they need to complete through extra learning after class.
Blackboard Design	Unit 8 Music player software interface design Group Scores

Design for Problem-based learning program 9

Definition of the Problem-based learning

Problem-based Learning is a learning program that uses a student-centred teaching strategy, emphasizing teaching methods that promote learning and knowledge acquisition through solving specific problems. The teaching and learning process of the Problem-based Learning Program is divided into five main areas: Group organization, Questioning, Discussion, Debriefing, and Reflection.

Problem-based learning aims to create an environment in which students are actively engaged in solving real-world problems. Throughout the learning process, creative thinking, critical thinking, problem-solving skills, and a deeper understanding of the subject matter are developed.

This study will use the self-designed Problem-base learning program as an experimental tool for Problem-based learning. The program consists of five parts: Teaching objective, Teaching Focus and Difficulties, Teaching tools, learning process and classroom summary.

Problem-base learning program 9

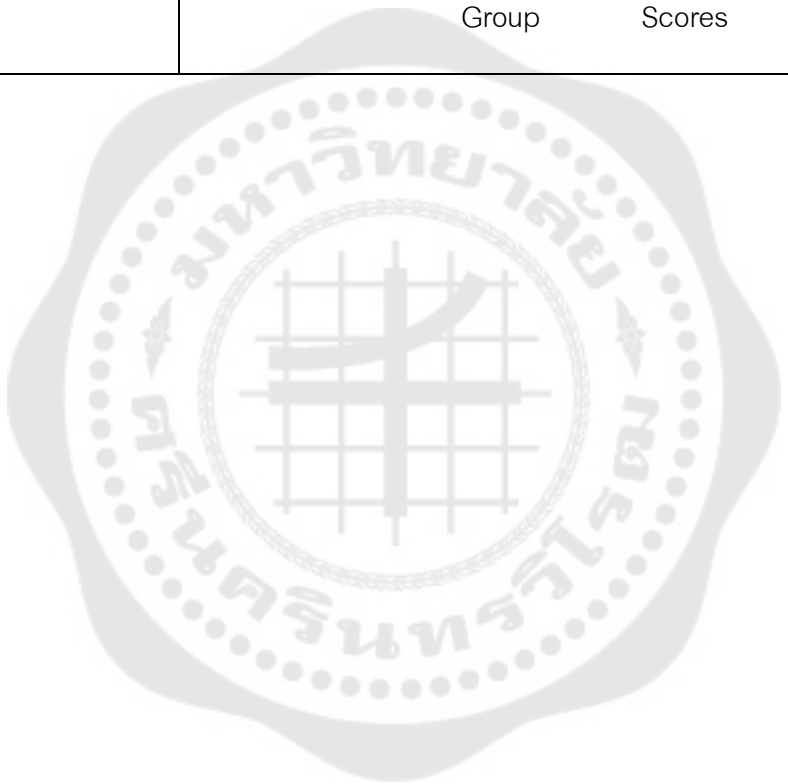
Course title	User Interface(UI) design		
Course Title	Taxi-hailing software interface design		
teaching materials	UI design tutorial	Type of lesson	core curriculum
Classes	experimental class	lesson time	90minutes
Teaching objective	Students will master use PhotoShop software to design a Taxi-hailing software interface.		
Focus and Difficulty	Master the functions of designing a Taxi-hailing software interface in PhotoShop and be able to design a Taxi-hailing software interface.		
Teaching tools	Computer,blackboard, PPT, pictures		

Teaching Procedures	Teacher	Students
Group organization (5 minutes)	The teacher groups 54 students into 9 groups of 6. And teamwork was required, with members going to find information and digging out the correct answer based on the question.	Students get to know and familiarize themselves with each other and their group members. Students are expected to actively work with, encourage, and trust others.
Questioning (50 minutes)	(1) The teacher displays an image of a Taxi-hailing software interface and demonstrates how to design this interfaces using the features of PhotoShop software. (2)The teacher gives the learners some designed questions and asks each group to complete their part individually. Question: People often encounter transportation problems during their daily travels, such as the inability to make reservations in	(1) The students look at the pictures and listen carefully to the teacher and think about the questions she asks. (2)Group members cooperate with each other and use the computer to find relevant information to complete their tasks within the time limit.

	advance, the difficulty of getting a taxi during peak hours, and the safety of traveling at night. Please design a creative taxi software to help people solve inconvenient traveling problems.	
Discussion (5 minutes)	The teacher guides the students to use the “combination of imitation and innovation” methodology to innovate and optimize their products based on successful products in the market to meet the unique needs of taxi users.	(1)Group members discuss the questions asked by the teacher and clearly understand the answers to the questions. (2)According to the teacher's method of “combining imitation and innovation”, students search and learn from the successful taxi software products in the market and then make their innovation and optimization based on this to design their solutions.
Debriefing (20 minutes)	(1) The teacher will sort the 9 groups then take turns to let the groups show their answers.	The students present the results that they have integrated.

	(2) The teacher should focus on the key points and the difficult points Where students tend to make mistakes.	
Reflection (10 minutes)	(1) The teacher made a comprehensive evaluation of each group's presentation and suggestions for improvement, as well as a final summary of the class. (2) The teacher provided an in-depth explanation of the Taxi-hailing software interface designing process. (3) Teachers should add to their own knowledge while taking into account the composite situation of all students.	(1)It is very important for students to follow the teacher's lead and pay attention to what the teacher mentions as being done well and what needs to be improved. (2)Students integrate the information again and review what they have learned in this lesson.
Classroom summary	The UI design class went quite well due to the extensive preparation done by the students and the teacher. We can learn that the students have mastered the process of the problem-based learning program, the students can summarize the appropriate skills to deal with the difficulties encountered in the learning process of Taxi-hailing software interface design, and the students can work well with others. However, we also	

	found some shortcomings. Some problems are more difficult, such as how to design the Taxi-hailing software interface to be more in line with users' habits and visual aesthetics. Therefore, there are some problems they need to complete through extra learning after class.
Blackboard Design	Unit 9 Taxi-hailing software interface design Group Scores



Design for Problem-based learning program 10

Definition of the Problem-based learning

Problem-based Learning is a learning program that uses a student-centred teaching strategy, emphasizing teaching methods that promote learning and knowledge acquisition through solving specific problems. The teaching and learning process of the Problem-based Learning Program is divided into five main areas: Group organization, Questioning, Discussion, Debriefing, and Reflection.

Problem-based learning aims to create an environment in which students are actively engaged in solving real-world problems. Throughout the learning process, creative thinking, critical thinking, problem-solving skills, and a deeper understanding of the subject matter are developed.

This study will use the self-designed Problem-base learning program as an experimental tool for Problem-based learning. The program consists of five parts: Teaching objective, Teaching Focus and Difficulties, Teaching tools, learning process and classroom summary.

Problem-base learning program 10

Course title	User Interface(UI) design		
Course Title	Puzzle game interface design		
teaching materials	UI design tutorial	Type of lesson	core curriculum
Classes	experimental class	lesson time	90minutes
Teaching objective	Students will master use PhotoShop software to design a Puzzle game interface.		
Focus and Difficulty	Master the functions of designing a Puzzle game interface in PhotoShop and be able to design a Puzzle game interface.		
Teaching tools	Computer,blackboard, PPT, pictures		
Teaching Procedures	Teacher	Students	

Group organization (5 minutes)	The teacher groups 54 students into 9 groups of 6. And teamwork was required, with members going to find information and digging out the correct answer based on the question.	Students get to know and familiarize themselves with each other and their group members. Students are expected to actively work with, encourage, and trust others.
Questioning (50 minutes)	(1) Teacher displays an image of a Puzzle game interface and demonstrates how to design a Puzzle game interface using the features in PhotoShop software. (2)The teacher gives the learners some designed questions and asks each group to complete their part individually. Question: Colorblind players may have difficulty recognizing colors when playing a puzzle game and may not be able to complete it correctly. Please design a jigsaw puzzle game to help colorblind colorblind	(1) The students look at the pictures and listen carefully to the teacher and think about the questions she asks. (2)Group members cooperate with each other and use the computer to find relevant information to complete their tasks within the time limit.

	players solve this problem. Help colorblind players enjoy and successfully complete a jigsaw puzzle by making the game more inclusive and fun for everyone.	
Discussion (5 minutes)	The teacher instructs the students to think about the problem using the “reverse thinking” approach, where students believe in the opposite direction of the problem, such as “If I were a user of this product, what features would I want it to have?” Students will be able to generate ideas in the process of thinking.	(1)Group members discuss the questions asked by the teacher and clearly understand the answers to the questions. (2)Students think about the problem according to the teacher's “reverse thinking method”, believing in the opposite direction of the problem, thus generating creativity in the thinking process.
Debriefing (20 minutes)	(1) The teacher will sort the 9 groups then take turns to let the groups show their answers. (2) The teacher should focus on the key points and the difficult points Where students	The students present the results that they have integrated.

	tend to make mistakes.	
Reflection (10 minutes)	(1) The teacher made a comprehensive evaluation of each group's presentation and suggestions for improvement, as well as a final summary of the class. (2) The teacher provided an in-depth explanation of the Puzzle game interface designing process. (3) Teachers should add to their own knowledge while taking into account the composite situation of all students.	(1)It is very important for students to follow the teacher's lead and pay attention to what the teacher mentions as being done well and what needs to be improved. (2)Students integrate the information again and review what they have learned in this lesson.
Classroom summary	The UI design class went quite well due to the great preparation done by the students and the teacher. We can learn that the students have mastered the procedures of the problem base learning program, the students can summarize the appropriate skills to deal with the difficulties encountered in learning puzzle game interface design, and the students can work well with others. However, we also found some shortcomings. Some of the problems were difficult, such as how to design more creative and attractive interfaces for puzzles. Therefore, there are some problems they need to complete through extra	

	learning after class.
Blackboard Design	Unit 10 Puzzle Game Interface design Group Scores

Design for Problem-based learning program 11

Definition of the Problem-based learning

Problem-based Learning is a learning program that uses a student-centred teaching strategy, emphasizing teaching methods that promote learning and knowledge acquisition through solving specific problems. The teaching and learning process of the Problem-based Learning Program is divided into five main areas: Group organization, Questioning, Discussion, Debriefing, and Reflection.

Problem-based learning aims to create an environment in which students are actively engaged in solving real-world problems. Throughout the learning process, creative thinking, critical thinking, problem-solving skills, and a deeper understanding of the subject matter are developed.

This study will use the self-designed Problem-base learning program as an experimental tool for Problem-based learning. The program consists of five parts: Teaching objective, Teaching Focus and Difficulties, Teaching tools, learning process and classroom summary.

Problem-base learning program 11

Course title	User Interface(UI) design		
Course Title	Adventure game interface design		
teaching materials	UI design tutorial	Type of lesson	core curriculum
Classes	experimental class	lesson time	90minutes
Teaching objective	Students will master use PhotoShop software to design a Adventure game interface design.		
Focus and Difficulty	Master the functions of designing a Adventure game interface in PhotoShop and be able to design a Adventure game interface .		
Teaching tools	Computer,blackboard, PPT, pictures		
Teaching Procedures	Teacher	Students	

Group organization (5 minutes)	The teacher groups 54 students into 9 groups of 6. And teamwork was required, with members going to find information and digging out the correct answer based on the question.	Students get to know and familiarize themselves with each other and their group members. Students are expected to actively work with, encourage, and trust others.
Questioning (50 minutes)	(2) Teacher displays an image of a Adventure game interface design and demonstrates how to design a Adventure game interface design using the features in PhotoShop software. (2)The teacher gives the learners some designed questions and asks each group to complete their part individually. Question: Children love to play games, but often, their lack of self-control leads to addiction to online gaming and, therefore, neglect of their education. Please design a creative	(1) The students look at the pictures and listen carefully to the teacher and think about the questions she asks. (2)Group members cooperate with each other and use the computer to find relevant information to complete their tasks within the time limit.

	adventure game for child gamers that seamlessly combines educational content with gameplay (e.g., historical knowledge, scientific principles, etc.) to help parents solve the problem of children who are addicted to games and not learning.	
Discussion (5 minutes)	The teacher instructs the students to think about the problem using the “reverse thinking” approach, where students believe in the opposite direction of the problem, such as “If I were a user of this product, what features would I want it to have?” Students will be able to generate ideas in the process of thinking.	(1)Group members discuss the questions asked by the teacher and clearly understand the answers to the questions. (2)Students think about the problem according to the teacher's “reverse thinking method”, believing in the opposite direction of the problem, thus generating creativity in the thinking process.
Debriefing (20 minutes)	(1) The teacher will sort the 9 groups then take turns to let the groups show their answers. (2) The teacher should focus	The students present the results that they have integrated.

	on the key points and the difficult points Where students tend to make mistakes.	
Reflection (10 minutes)	(1) The teacher made a comprehensive evaluation of each group's presentation and suggestions for improvement, as well as a final summary of the class. (2) The teacher provided an in-depth explanation of the Adventure game interface designing process. (3) Teachers should add to their own knowledge while taking into account the composite situation of all students.	(1)It is very important for students to follow the teacher's lead and pay attention to what the teacher mentions as being done well and what needs to be improved. (2)Students integrate the information again and review what they have learned in this lesson.
Classroom summary	The UI Design class went quite well with the careful preparation of students and teachers. We could learn that the students had mastered the procedures of the problem base learning program, the students were able to summarize the appropriate techniques to cope with the difficulties encountered in the process of learning the interface design of the adventure game, and the students were able to work well with others. However, we also found some shortcomings. Some problems are difficult,	

	such as how to design a more creative and attractive adventure game interface. Therefore, there are some problems they need to complete through extra learning after class.
Blackboard Design	Unit 11 Adventure game interface design Group Scores

Design for Problem-based learning program 12

Definition of the Problem-based learning

Problem-based Learning is a learning program that uses a student-centred teaching strategy, emphasizing teaching methods that promote learning and knowledge acquisition through solving specific problems. The teaching and learning process of the Problem-based Learning Program is divided into five main areas: Group organization, Questioning, Discussion, Debriefing, and Reflection.

Problem-based learning aims to create an environment in which students are actively engaged in solving real-world problems. Throughout the learning process, creative thinking, critical thinking, problem-solving skills, and a deeper understanding of the subject matter are developed.

This study will use the self-designed Problem-base learning program as an experimental tool for Problem-based learning. The program consists of five parts: Teaching objective, Teaching Focus and Difficulties, Teaching tools, learning process and classroom summary.

Problem-base learning program 12

Course title	User Interface(UI) design		
Course Title	End of Course Summary		
teaching materials	UI design tutorial	Type of lesson	core curriculum
Classes	experimental class	lesson time	90minutes
Teaching objective	A summary was given at the end. In addition, a creative self-efficacy experiment post-test was prepared for the students.		
Focus and Difficulty	creative self-efficacy post-test and UI Design Course Summary.		
Teaching tools	Computer,blackboard, PPT, pictures		
Teaching Procedures	Teacher	Students	
Group organization	The teacher groups 54	Students get to know and	

(5 minutes)	students into 9 groups of 6. And teamwork was required, with members going to find information and digging out the correct answer based on the question.	familiarize themselves with each other and their group members. Students are expected to actively work with, encourage, and trust others.
Questioning (50 minutes)	(1)The teacher firstly summarizes the knowledge of this course systematically, including the five parts of icon design, application interface design, web design software interface design, game interface design, as well as the key points and difficulties of the knowledge in each part . (2) The teacher gives the learners some designed questions and asks each group to complete their part individually. Question: After learning UI design, what problems in life do you think you can help you or people	(1) The students look at the pictures and listen carefully to the teacher and think about the questions she asks. (2)Group members cooperate with each other and use the computer to find relevant information to complete their tasks within the time limit.

	around you solve?	
Discussion (5 minutes)	Teachers can guide students to utilize role-playing, where team members can take on different roles (e.g., customers, competitors, etc.) and look at the problem from different perspectives, which can help uncover new perspectives and solutions.	(1)Group members discuss the questions asked by the teacher and clearly understand the answers to the questions. (2)Students use role-playing so team members can take on different roles (e.g., customer, competitor, etc.). Looking at a problem differently leads to discovering new perspectives and solutions.
Debriefing (20 minutes)	(1) The teacher will sort the 9 groups then take turns to let the groups show their answers. (2) The teacher should focus on the key points and the difficult points Where students tend to make mistakes.	The students present the results that they have integrated.
Reflection (10 minutes)	(1) The teacher made a comprehensive evaluation of each group's presentation and suggestions for improvement,	(1)It is very important for students to follow the teacher's lead and pay attention to what the teacher

	as well as a final summary of the class. (2) The teacher distributed the Creative Self-Efficacy Scale to the students and instructed them to fill it out and collect the scale when they were finished.	mentions as being done well and what needs to be improved. (2)students integrate the information again and review what they have learned in this lesson. (3)Students will complete the Creative Self-Efficacy Scale as requested by the teacher
Classroom summary	Under the careful preparation of the teacher, this UI design course ended successfully. First of all, the teacher made a comprehensive evaluation of the students' performance in this course and made suggestions. In addition, the students also learned the related knowledge of UI design through this course and learned to solve the difficulties encountered in the learning process in a group. In addition, the creative self-efficacy pre-test of this experiment was also completed after the first class.	
Blackboard Design	Unit12 End of Course Summary Group Scores	

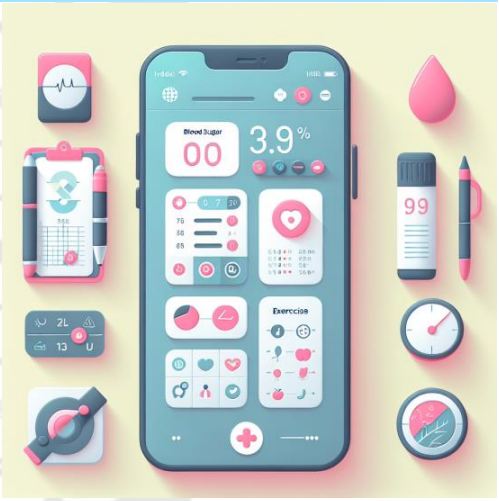
APPENDIX 3

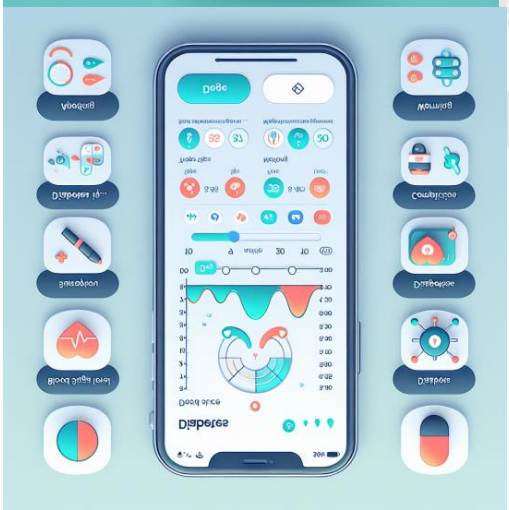
Experimental group students are part of the work

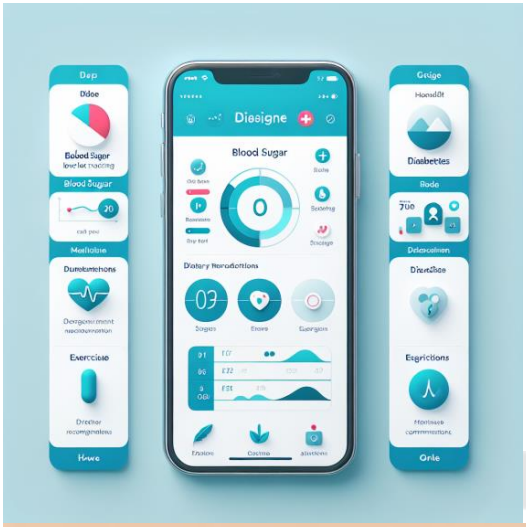
The first activity: Eco-friendly icon design

The second activity: Exercise for All icon design

The three activity: Medical app interface design



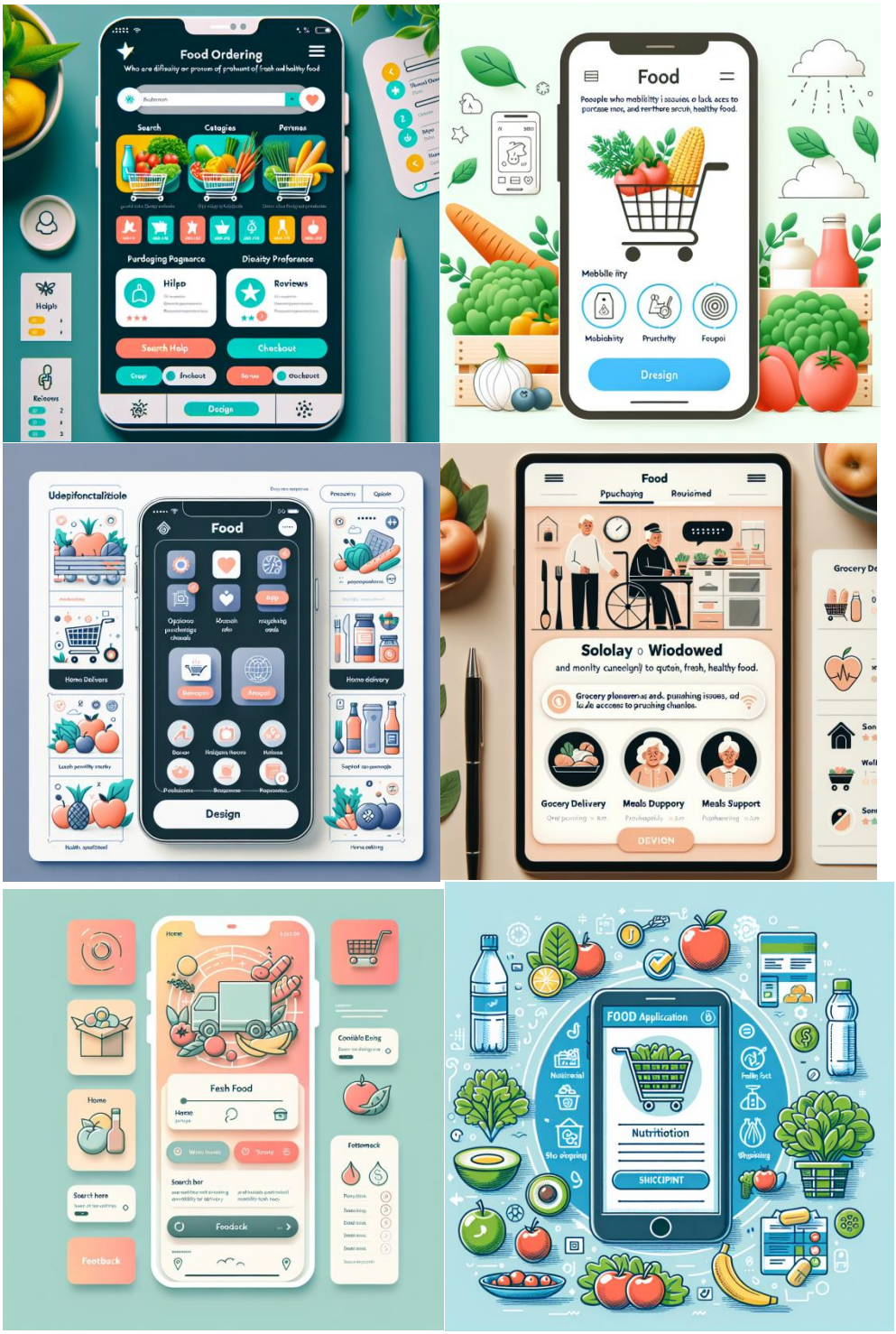



Blood Sugar
Exercise


Exercise


Design

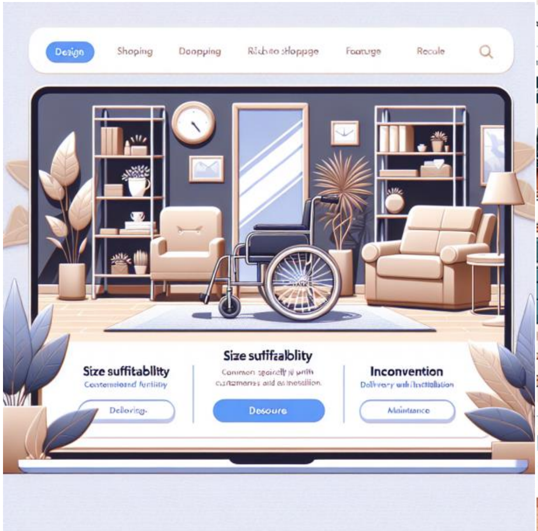
The fourth activity: Food app interface design



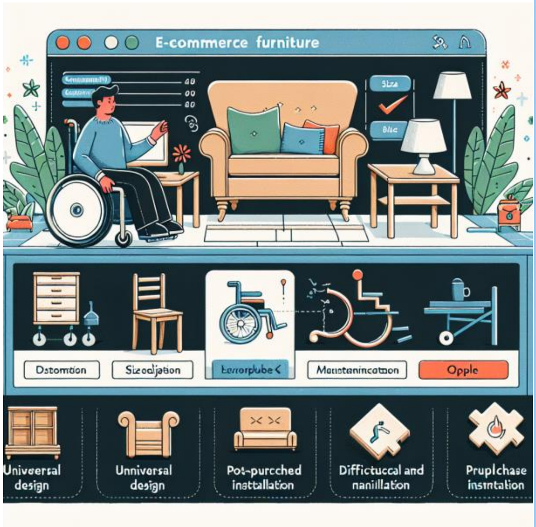

FOOD
Online Shopping
FOOD

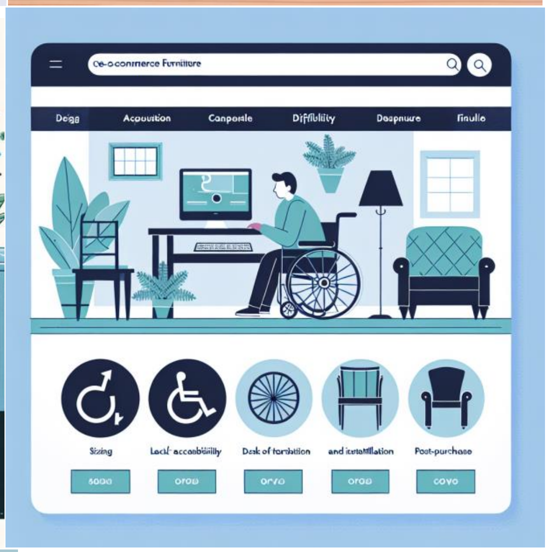

FOOD
SEARCH

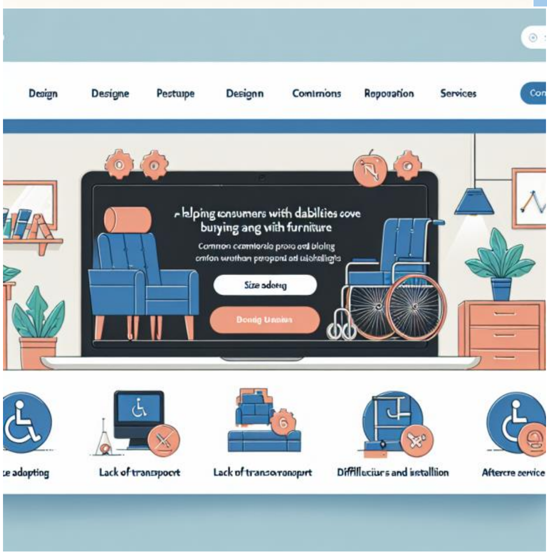
The fifth activity: Furniture e-commerce website interface design


Design
Shoping
Size suffitablity
Inconvention
Desoure

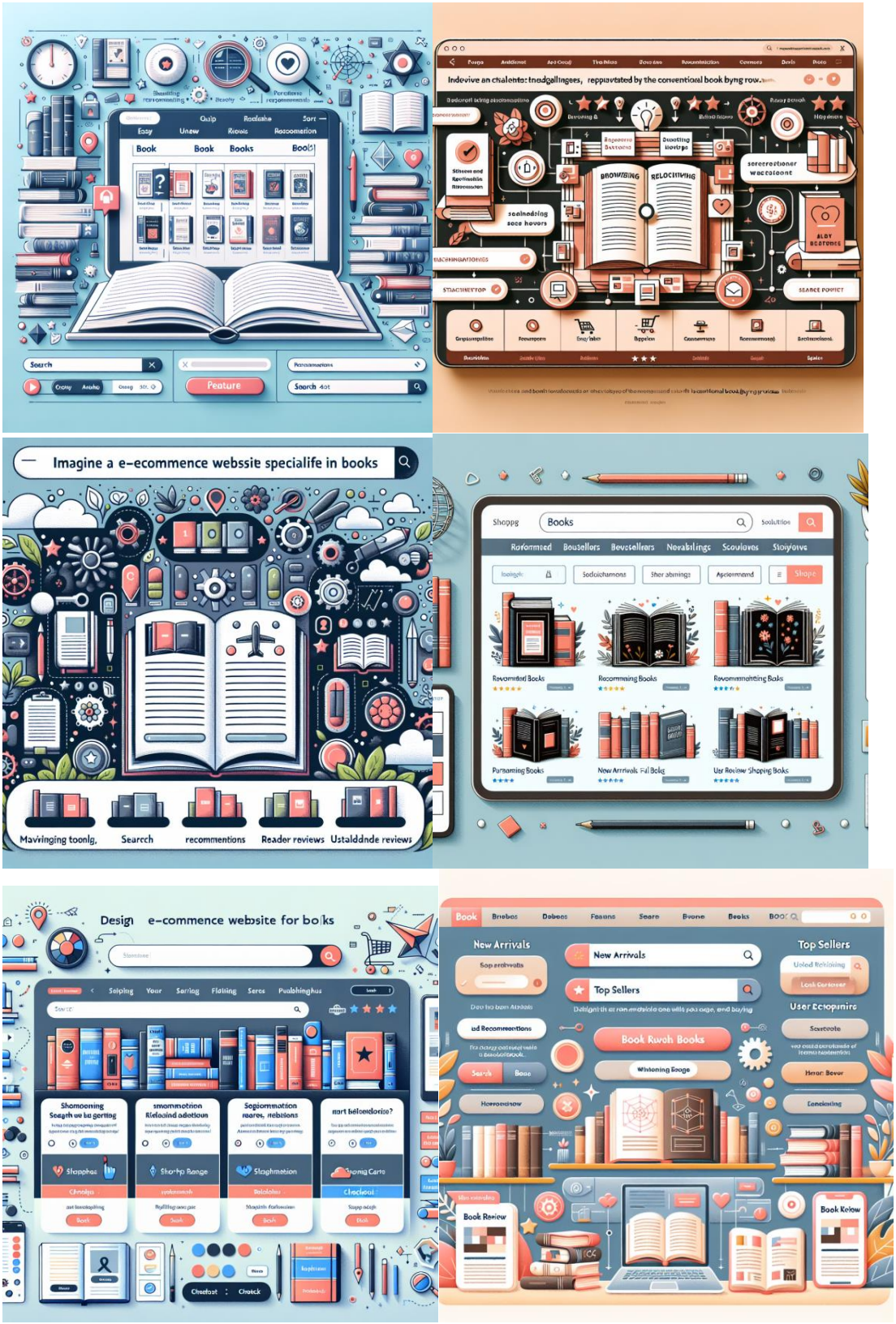

Dessign a furrniture e-commerce- websiite
Products


E-commerce furniture
Size
Opple
Universal design
Pot-purcched installation
Pruplchase insntation


Diffiblity
Sizing
Post-purchase


Design
Services
Size adong
Lack of transpoert
Aftercre service

The sixth activity: Book e-commerce website interface design

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The seventh activity: Music player software interface


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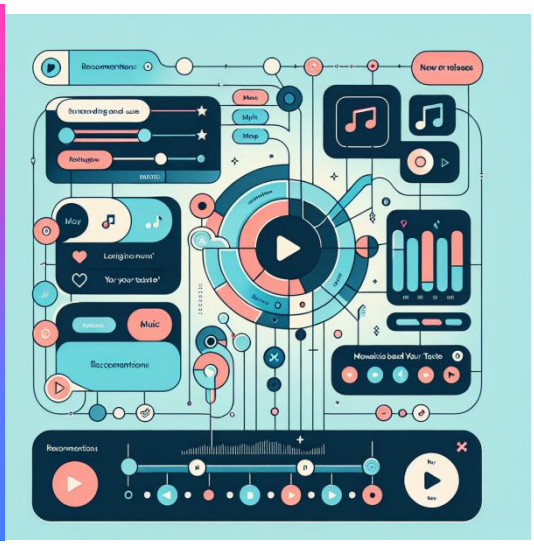
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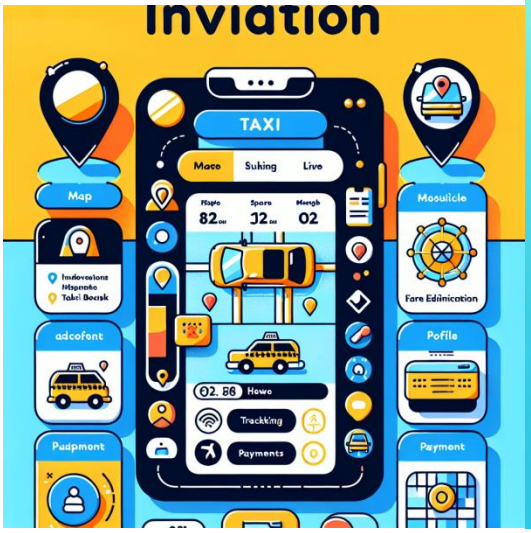
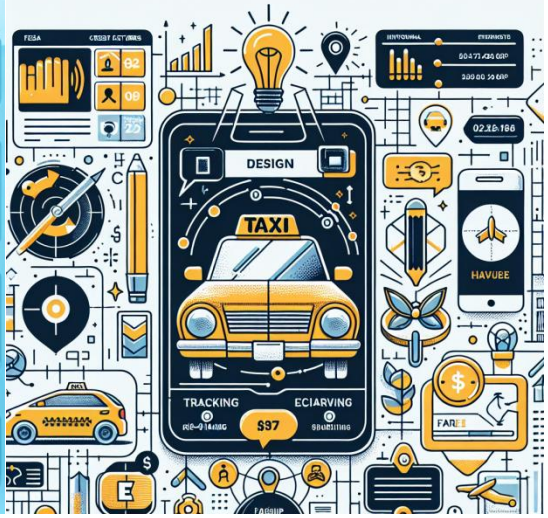
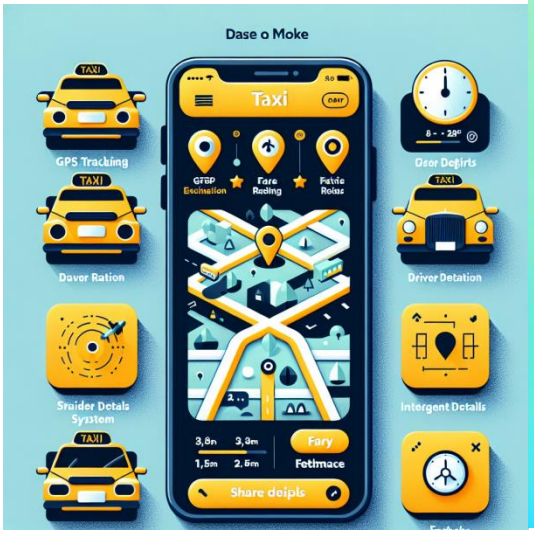
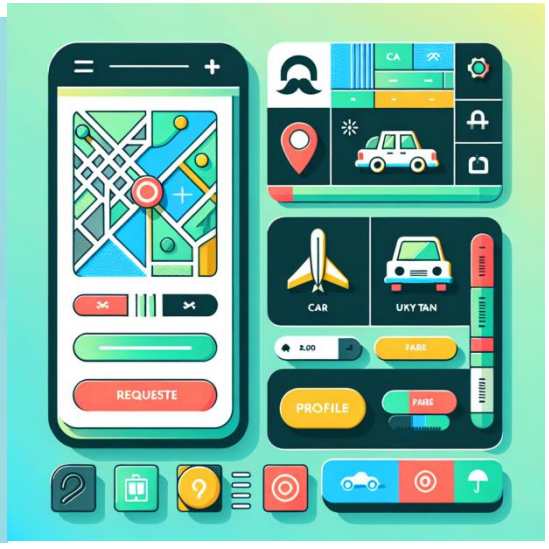
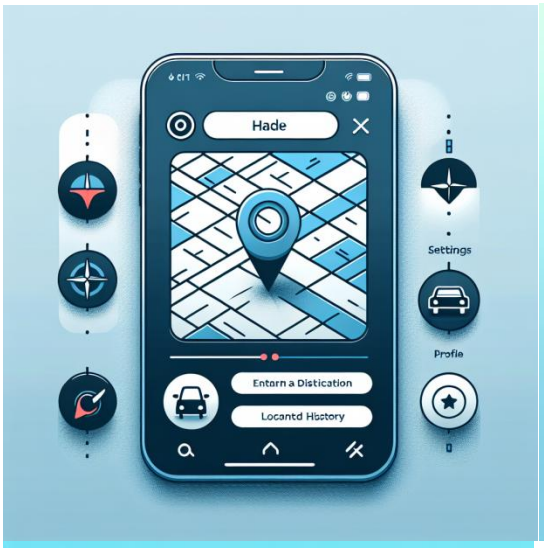
The eighth activity: Taxi-hailing software interface







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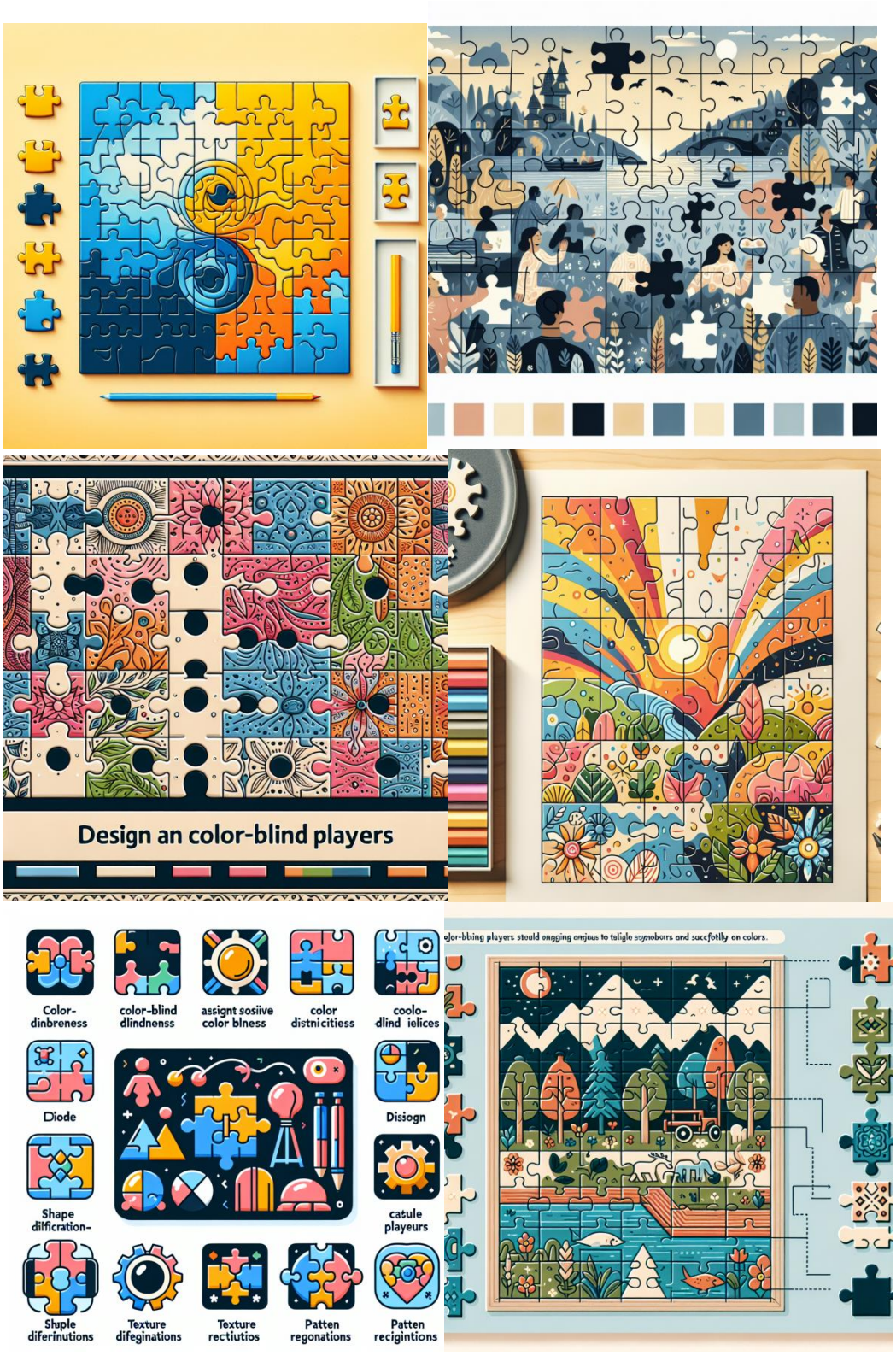
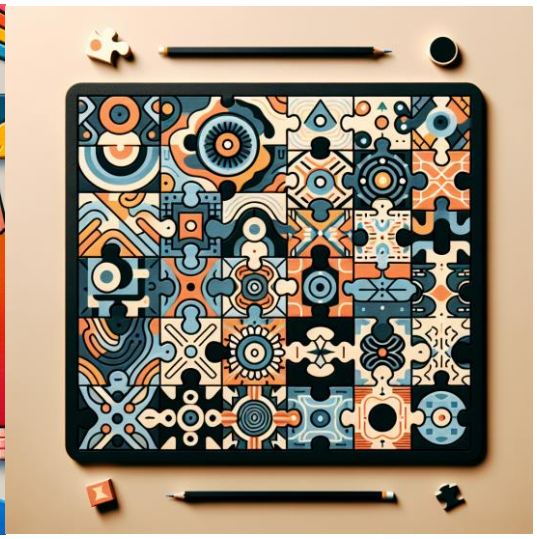
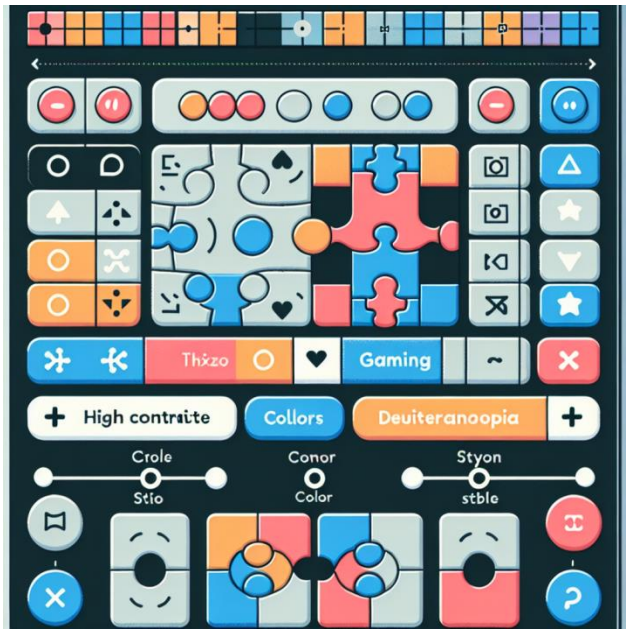
The ninth activity: Puzzle game interface design



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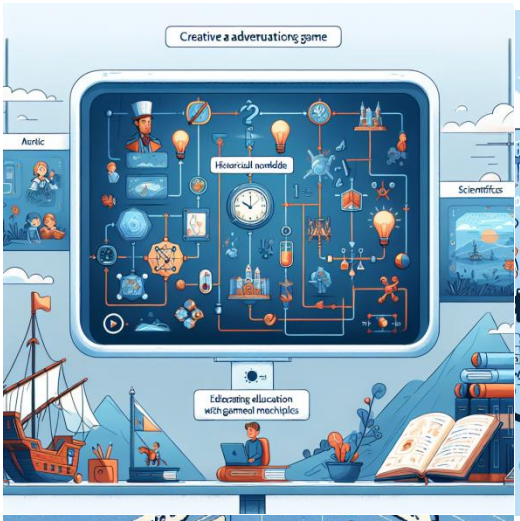
The tenth activity: Adventure game interface design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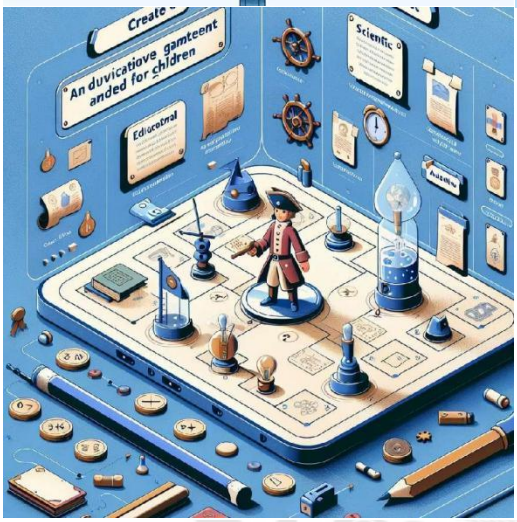
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VITA

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