

Teaching Design Creativity through Design Programs in Vocational High Schools --- Taking Mandala as an example

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ABSTRACT

Cultivating creativity and innovation capability has become the emphasis of advancements in today's education. Scholars suggest that creativity is one of the key capacities children should possess. One of the significant ways to cultivate creativity in children is through creative teaching. This study utilized the Mandala and Project-based Learning (PBL) to examine creative teaching courses regarding the creation of picture books in design programs of vocational high schools. Based on simulating the asking, thinking, doing, and evaluation (ATDE) model developed by Lung-An Chen (2008), the teaching pattern researched in this study is a creative teaching method consisting of asking-thinking-grouping-drawing-evaluation. This method primarily relies on the Mandala and is supplemented by PBL.

This study's research results show that most students believed this teaching method was beneficial. The creative teaching method consisting of asking-thinking-grouping-drawing- evaluation has been proven to be feasible, either in personal or group work creativity demonstration. In addition, when the creative teaching method adopted by this study was applied in classes, the key factors affecting creativity demonstration and learning effects of the various unit works of picture books creation included practical guidance from the teacher, student initiatives, students' creative thinking, and the incorporation of teamwork.

Keywords: Mandala; project-based learning; creative teaching; creation of picture books

INTRODUCTION

Research Background and Motives

A knowledge-based economy characterizes the 21st century. A new and inevitable trend in modern society is that the creative (design) industry is becoming increasingly important to industrial competitiveness. People continually pursue better living quality, and the creative and cultural industries have thus become pillar industries in today's economy. Societies have become more diversified consistent with 21st-century development trends, while the demonstration methods of creativity and imagination have become widely accepted by the public. Cultivating creative talent is a primary focus of the creative industry. In contrast, the most important elements for such cultivation are the education models and teaching quality that can promote creativity and creative thinking capacities (Luh & Lin, 2005; Lin, Chang, Chiu, & Lai, 2022).

Education involves identifying students' potential and teaching them how to adapt and improve their living environments. Under the education system, students are expected to survive and develop in modern society, where the media and information industries are highly developed. Students are expected to become socially competitive citizens. In the future, citizens must possess fundamental abilities such as critical thinking, creative thinking, and problem- solving skills (Wu & Yang, 2005). For this reason, the national

competitiveness of a country depends on creativity and innovation. At the same time, creative and innovative teachings are the fundamental abilities teachers of the 21st century need to possess (Huang, 2020). Teachers should put into practice new and creative teaching methods so that teaching content that is more diversified and creativity can be fostered (Chiu, 2022).

In 2019, the General Guidelines for Curriculum Guidelines of 12-Year Basic Education was promulgated. The Guidelines emphasize that individuals are the principal parts of learning, while learners should choose methods of study that suit them. Furthermore, they are expected to solve problems based on systematic thinking patterns while possessing creativity and the ability to act effectively (Ministry of Education, 2021). To break the stereotypes of traditional learning methods and cultivate students' problem-solving skills, this study suggests that the best teaching method should be a pattern under which "students are the leading actors in education activities." In other words, when students focus on problems they want to solve, their motives for learning and personal capabilities are enhanced accordingly (Jih & Chuang, 2003; Tu, 2021). Project-based Learning (PBL) is a study method that centers on students. Under the PBL pattern, students are formed into groups to solve problems jointly based on real-world situations. Students' curiosity about exploration and demands for knowledge construction are satisfied as a result (Kokotsaki et al., 2016).

On the other hand, the most crucial factor for creative teaching is creative thinking. The vertical thinking pattern is a traditional way of logical thinking; it is selective and aims to find judgment and proof so that viewpoints and relevance can be established. The horizontal thinking pattern is creative and explores and inspires new ideas (Chang, 2006). Mandala is a creative thinking pattern that incorporates both horizontal and vertical thinking patterns (Lin, 2011).

To promote students' creativity and innovative ideas in their studies, the researcher of the present study has utilized PBL, which sets the students as the center of study. Moreover, this study adopts the Mandala, which inspires students' right-brain thinking and vertical thinking (creative thinking) to examine the creative teaching of picture books during Advertisement Design in the design programs of vocational high schools. We expect that the students' "abilities for observing and solving questions," "creativity," and "capabilities of taking actions effectively" will be inspired during the teaching process. The results of this study will be helpful in designing education programs for vocational high schools.

Research Purpose

According to the research mentioned above, the researcher of this study investigates the design of creative teaching and develops the creative teaching method of asking-thinking- grouping-drawing-evaluation based on the Mandala and PBL. This creative teaching method is incorporated into teaching the creation of picture books during Advertisement Design in the design programs of vocational high schools. The research goal is as follows:

1. To investigate the process of the creative teaching method of asking-thinking-grouping-drawing-evaluation.
2. To examine the effectiveness and degree of satisfaction regarding the learning of the asking-thinking-grouping-drawing-evaluation model.

LITERATURE REVIEW

The definition of creative teaching

Creative teaching is an education pattern that cultivates students' creative thinking and behavior (Ehtiyar & Base, 2019). Under the creative teaching pattern, the teacher provides a creative environment that is supportive to guide the heated debate and feedback between the students and teachers. At the same time, the teacher inspires creative thinking and behavior in the students, which further enables students to acquire the cognitive skills for creative thinking (Lin & Rau, 2020). For this reason, creative teaching positions students at the center of learning. The students are put into creative scenarios, and, under the teacher's guidance, their thinking power, imagination, and potential are inspired, thus enhancing their creativity.

Creative teaching patterns

Creative teaching indicates that a teacher utilizes flexible teaching strategies and patterns. The teaching process centers on cultivating creativity, while creative teaching also helps students become more creative.

There are a great many teaching patterns for developing creative thinking, such as William's Taxonomy for Creative Thinking Skills, "Divergent Thinking and Creativity" advocated by Guilford, "Teaching Method of Creative Thinking for Multiple Abilities" proposed by Taylor, and the ATDE teaching method put forward by Lung-An Chen(2008).

The ATDE Model, developed by Lung-An Chen, consists of four elements: asking, thinking, doing, and evaluating. The meanings of these four elements are as follows: "Asking"--- Stands for the scenarios of "creative thinking" questions designed or arranged by the teacher, facilitating the students' reflections. The teacher would pay more attention to convergent and diffused questions, which provide the students the opportunities to develop "creative thinking" and solve the questions. "Thinking" --- After posing questions, the teacher would encourage students to connect different things in their minds so that their thinking spaces could be expanded while creative ideas could be better sought. "Doing" --- The teacher would enable students to learn from doing and seek solutions to the questions in practice through activities. "Evaluation" --- The teacher and students would jointly formulate the standards for evaluation and assess the answers given by the students. The most suitable answers would then be chosen. The teacher and students would appreciate and respect each other, while "creative thinking" would evolve from a rudimentary to a practical use phase.

The ATDE Model of creative teaching is effective and welcomed by students. Chen (2018) applied this model to a study regarding a course of creative works in a nursery. Her study results indicate that this model could enhance students' imagination and creativity as far as creative works are concerned. In addition, during a research project of practice, Lin (2021) found that the ATDE Model could strengthen the students' creativity level, innovation capabilities, and confidence.

The present study referred to the ATDE Model of creative teaching, which consists of asking-thinking-doing-evaluation. We integrated the "asking" part with Mandala and introduced a new part of "grouping," which incorporates the connotations and features of PBL. Finally, the "doing" part of this study consolidated group discussions and formulated a design scheme based on the results of these discussions. The creative teaching method of asking- thinking-grouping-drawing-evaluation has been designed and developed in this regard. This teaching method we developed focuses on promoting students' problem-solving capabilities through creative thinking.

The connotations of the Mandala

The term Mandala is originally from "māṇḍārava" in Sanskrit. "Manda" means "essence," while "la" means "having or acquiring something" in Sanskrit. The combination of "manda" and "la" means "something which is essential" or "acquiring the essence." Therefore, "Mandala" refers to a thinking pattern that evolves from the original meaning of the concept of "māṇḍārava" (Chen & Li, 2010).

The Mandala's mode and development process

The Mandala has been considered the "password" of wisdom, which evolves from the concepts of the "Garbhadhatu Mandala" and "Diamond Realm Mandala." These concepts were respectively brought back to Japan by Hiroaki Imaizumi. Kūkai. Mandala sets the square of nine as its basis, while the extensive 8 x 8 squares allow the user to rapidly acquire 8 x 8 creative ideas. The Mandala contains several creative thinking methods, such as the horizontal, vertical, network, and leaping thinking methods (Lin, 2007).

Figure 1 shows the development method of the Mandala in two manners: a ring-shaped diffusion from the center to the outer ring; the other is an orderly vortex line encircling from within.

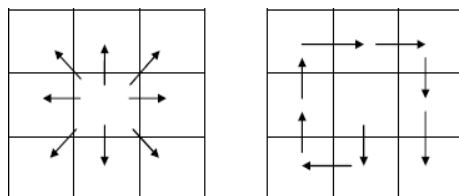


Figure 1: The development method of the Mandala

The Mandala's application and features

Mandala is a consolidated system, and the thinking pattern of the Mandala is structured as follows: (1)

Complete segmentation involves determining which element would serve as the starting point. (2) Consolidate and reconstruct the elements one by one. (3) A comprehensive analogy-type image would appear after a series of disintegration and restructuring combinations in the final phase (Hsu, 2004). Thus, Mandala is a thinking strategy that is beneficial for diffusible thinking. Using a Mandala's nine-square grid, the user writes down the main theme in the central square and then diffuses all ideas and associations stemming from the central theme to the remaining eight squares. The diffusion can be expanded if needed. The Mandala has the creative power to transform common knowledge into wisdom that can be applied in real life. It can manage the user's original thinking pattern and logic effectively and systematically, simultaneously consolidating such thinking patterns and logic. For this reason, the Mandala is often applied in art therapy, creative inspiration, and meditation (Lin, 2008).

The application of Mandala in teaching

Lo (2020) applied the concept of Mandala in teaching a writing course to a Grade 6 elementary school class. Their research results indicate that the Mandalas helped elementary students to improve the content and logic in their writing. Tung (2022) applied Mandala in a teaching course regarding humorous picture books for young children. Their research results indicate that the Mandala's thinking method evidently promoted the young children's overall creativity level.

Thus, Mandala is a method that can be applied to inspire creativity and brainstorming in various settings. When the Mandala's functionalities are appropriately utilized, they are helpful in developing students' creative thinking and course content. For a particular question, answers from different thinking aspects could be obtained based on multiple inspirations of creativity. In addition, the Mandala can significantly promote students' thinking logic, self-motivation, and mental flexibility. The Mandala comprises a creative thinking pattern with logic. The combination of creativity and logic is helpful to the goal of creative teaching, as discussed in the present study.

The development background and connotations of project-based learning

Project-based learning (PBL) is a systematic teaching method. Under PBL teaching, students can acquire the capacity for knowledge and learning capabilities through practical operation and study through in-depth exploration of complex issues and schemed study tasks (BIE, 2007). PBL is characterized by group-based collaboration. This learning method emphasizes how students should jointly investigate problems in real-world situations so that their study motives may be instigated and adequately maintained. Through collaborating with different groups, students discover, investigate, and develop feasible solutions to problems. Study results are consolidated and presented with specific outcomes regarding the learning project (Hsu, Yueh, & Lin, 2010). Project-based Learning allows students to search for solutions to problems in simulated, real-world situations. During the exploration and study process, students can learn more about their interests and further develop their independent study motives (Kose, 2010; Nastu, 2009).

PBL-related studies

The application and study of PBL have become far-reaching and more specialized in recent years in a variety of disciplines. Chuang (2019) integrated systematic thinking and PBL to encourage students' potential to face and solve difficulties through project-based teamwork, division of labor, and effective communication and coordination. Huang (2017) applied Project-based Learning in teaching physical education classes in college; their results indicate that PBL significantly enhanced student performances in courses with creative teaching and creative thinking. Tsai (2016) found that PBL could effectively strengthen the time and energy students put into their courses, instigate students' motives for study, and, at the same time, promote their confidence with the pattern of "learning through doing."

To summarize the research mentioned above, applying PBL in different fields of education is extensive and diversified. Relevant studies of PBL have been conducted in courses, teaching, and assessment, and most of them have achieved satisfactory results. In recent years, applying PBL has been actively facilitated through the Internet and through an information technology environment. PBL encourages students to collaborate with and learn from each other and promotes diversified interaction and communication among students. The influence of PBL exists in the fields above.

RESEARCH DESIGN AND IMPLEMENTATION

Research Method

This study adopted an action research and materials collection method. The materials collection method primarily involves observation, survey techniques, and document analysis. The materials utilized and collected were consolidated according to the research goals, as shown in Table 1:

Table 1: Consolidation of materials collected under this study

Target	Focus dimension	Data	Data collection method
Cultivating students' abilities of creative thinking and problem-solving.	Incorporating Mandala creative thinking and PBL creative teaching could enhance the students' abilities of creative thinking and problem-solving.	1. List of Mandala thinking and study patterns 2. Works of individual students and teams 3. Learning History Observation Form	Action research
Promoting the students' creative performance	Demonstrating creative designs, "sensitivity, fluency, flexibility, originality, and elaboration."	1. Works of individual students and teams 2. Assessment table for the creative performance of the works	Document analysis
Demonstrating the students' learning process	The students' responses to learning, participation, and particulars of group discussion.	Learning History Observation Form	Observation Document analysis
Learning about the students' degree of satisfaction	1. The degree of satisfaction with the implementation and arrangement of course teaching. 2. The degree of satisfaction with the creative thinking method of the Mandala. 3. The attitude toward learning. 4. The sense of accomplishment in learning.	Questionnaire on the degree of satisfaction with learning	Survey technique

Teaching method

The teaching pattern in this study simulated the creative thinking and teaching patterns of "Asking-Thinking-Doing-Evaluation" by Chen (2008). The researcher designed the creative thinking and teaching patterns of asking-thinking-grouping-drawing-evaluation after considering the connotations and features of Mandala and PBL, as shown in Figure 2.

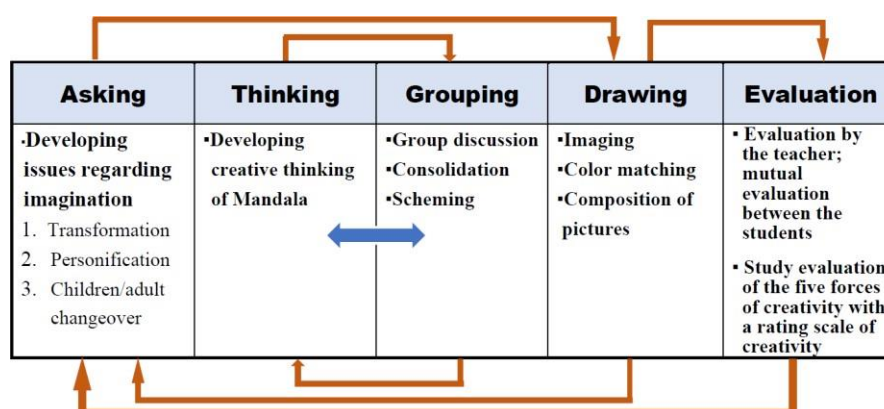


Figure 2 Creative teaching patterns of design

Illustrating the creative teaching method of asking-thinking-grouping-drawing-evaluation is as follows:

1. Asking: The teacher played the leading role in this part. The teacher was responsible for guiding and developing the questions and scenarios of reflection, which centered on imagination. The design of the following three significant units was conducted: (1) Create multiple characters of the picture books with the transformation method; (2) Create the colorful world of picture books with the personification method;

- (3) Create the multiple fascinations of stories of picture books with the children/adult changeover method.
2. Thinking: The students played the leading roles in this part. The scenarios of reflection on the questions (which were developed in the part of "asking") adopted Mandala's thinking techniques and structure for creative thinking. The main theme was written on the central part of the squares of nine, and Mandala's 8 x 8 diffusive creative thinking extended consistently with the questions first developed by the teacher.
3. Grouping: The researcher of this study adopted the heterogeneous grouping method for group-based collaboration among students, and PBL supplemented this method. Students were grouped according to their capabilities of study. Namely, students with higher learning abilities and those with lower learning abilities were allotted into one group. The goal of this grouping method was that students with higher learning abilities would set good examples for the students with lower learning abilities, which could lead the latter to having reduced learning barriers. The research results of Chen (2002) indicate that through this grouping method, the learning effect and willingness for student participation with higher learning abilities would be promoted. In comparison, student performance of students with lower learning abilities would also become better than they were in the past. Students with higher and lower learning abilities would benefit from the method of heterogeneous grouping in their studies as a result (Chen, 2006).
4. Drawing: Students of different groups drew paintings of the project themes based on consolidation. The examination and verification of the study results, which involved sensitivity, fluency, flexibility, originality, and elaboration on the three significant aspects of imaging, color matching, and composition of pictures, would be conducted.
5. Evaluation: Through the creativity rating scale, the study results would be evaluated, while the works of individuals and groups would be examined and verified.

The framework of teaching plans

This study's teaching plan framework refers to the teaching plans of creative thinking associated with the Mandala developed by Chen (2005). The framework is designed based on eight significant aspects, teaching patterns, teaching techniques, creative skills, teaching units, teacher and student roles, teaching time, teaching procedures, and teaching assessment. Figure 3 illustrates the structure of the teaching plan.

<ol style="list-style-type: none"> 1. The students: They play the leading role in the teaching activity 2. The teacher: They play a supportive role in the teaching activity 	Creative teaching patterns of design			The creative thinking method of the Mandala	
<ol style="list-style-type: none"> 1. Introduction and exercises of the creative thinking of Mandala 2. Exercises of Mandala in the three significant aspects 3. PBL application - consolidating and determining the solutions 4. Mandala application - drawing exercises 	Teacher/student roles	Teaching patterns	Creative thinking skills	<ol style="list-style-type: none"> 1. The teaching method of asking/thinking 2. The group discussion method 3. The method of experience and practice 4. The design teaching method 	
	Teaching procedures	Creative Teaching of Design through Mandala			Teaching techniques
	Teaching time	Teaching units	Teaching assessment		
Three classes each week, and a total of 36 courses in 12 weeks	Implementing teaching in a total of three central units			<ol style="list-style-type: none"> 1. Assessment of practical work 2. Assessment of archives 3. Self-assessment, mutual assessment of the students, and assessment by the teacher 	

Figure 3 :The structure of the teaching plan for "Creative Teaching of Design through Mandala"

RESEARCH RESULTS AND DISCUSSION

Learning effectiveness

This study's teaching contents were divided into three central units. Each unit contained exercises to demonstrate personal creativity and exercises on the theme project unit. The teaching method of asking-

thinking-grouping-drawing-evaluation was adopted for each of the units, while the creative thinking method of Mandala and PBL were incorporated for teaching. In each of the units, the learning performances of individual students and groups were rated by two teachers who specialized in advertisement design. The first teacher was the researcher of this study, who was also responsible for teaching the courses. The other teacher, Mr. A., has taught advertisement design at the vocational high school for approximately ten years. The two teachers analyzed the learning performances from aspects of personal and group creativity, which is detailed further below.

Personal creativity analysis

This study evaluated the creative performance of students specializing in advertisement design. A total of 45 students from Class Zhong of Grade 3 of a specific vocational high school in Pingtung County were recruited for this study's theme project. The theme was "Creative Character Design for Picture books." Students participated in tests before and after the asking- thinking-grouping-drawing-evaluation teaching method was utilized. This study adopted the scaling pattern suggested by Huang (2013) as the standard for evaluating creative performance. The works submitted by the students were to be rated from 1-10 points, while "1" stood for "minimum creativity" and "10" stood for "maximum creativity." The first test was performed before the teaching method of asking-thinking-grouping-drawing-evaluation was utilized. Another test was conducted after 12 weeks of teaching with the teaching method described above, which incorporated elements of Mandala and PBL. The students' performances were rated by this study's researcher and by another teacher, Mr. A, who specialized in advertisement design. The two teachers did not discuss with each other before they rated the students' performances. After the rating was complete, we found that the teachers' ratings elicited similar results. Moreover, the learning performances were examined and verified with paired sample t-tests to determine whether the teaching method of asking-thinking-grouping-drawing- evaluation could promote students' personal performance in creative thinking.







Table 2 (Paired sample t-test) shows that the significance values of the rating results were 0.000, less than 0.001. In other words, the students' performances in creative thinking "before the creative teaching method was implemented" were significantly better than those "after the creative teaching method was implemented." This indicates that the teaching method of asking-thinking-grouping-drawing-evaluation was, to some extent, effective in promoting the students' performances in creative thinking. The students' creative works with high rating scores are shown in Table 3.

Table 2 :Results of the Paired sample t-test

Type	Mean difference in tests before and after the creative teaching	Standard deviation	t
Assessment of the course teacher	1.169	.666	11.773***
Assessment of Mr. A	1.167	.718	10.899***

*** *p-value* =.000

Table 3: Works of students before and after the creative teaching

No.	The students' works before the creative teaching	The students' works after the creative teaching
1		
2		
3		

Analysis of the creativity demonstrated by groups

Regarding the creativity demonstrated by groups, the study units are --- Unit 1: The design of multiple characters of transformation. Unit 2: The colorful world of personification. Unit 3: The fun in children/adult changeover. The two teachers rated the learning performances of each group in the units. The creative performances of the 4th group were the best, considering the average performances in the three significant units mentioned above. Students of the 4th group performed well based on the various aspects of creativity. Table 4 shows the analysis of the works of students in the 4th group. Thus, the creative teaching method of asking- thinking-grouping-drawing-evaluation, to some extent, did promote the students' performances in creative thinking during the creation of picture books.

Table 4 The group of the best performances - Analysis of the 4th group works

Particulars of creative demonstration	Students in the 4th group made the most significant progress among all the nine groups and made substantial progress in every aspect of creative demonstration. This was especially evident in Unit 3, the Fairy Tale of Changeover. In this unit, the fairy tale of Alice's Adventures in Wonderland was selected and set as the theme. From the pictures of different characters in the fairy tale, it is evident that the students had made significant progress in imaging, color matching, and the composition of pictures compared to their performances in Units 1 and 2. Moreover, the creative demonstration of the 4th group was more colorful and diversified than those of the other groups.		
Unit title	Unit 1: The design of multiple characters of transformation	Unit 2: The colorful world of personification	Unit 3: The fun in children/adult changeover

Examples of the students' works



Analyzing the students' satisfaction degree toward learning

The goal of the questionnaire regarding the degree of satisfaction with learning was to examine the students' attitudes during the learning process. There were a total of 45 students in the class, and 45 questionnaires were distributed and returned. The following discussion represents the analysis and illustration of the different aspects after the questionnaires were completed.

1.Implementing teaching and course arrangement

The degree of satisfaction with incorporating "Mandala" and "PBL" into the implementation of teaching and course arrangement was analyzed using descriptive statistics and a one sample t-test. The analysis results are shown in Table 5:

Table 5 :Abstract of the analysis of teaching and course arrangement

Item No.	Item	Mean	SD	t
A1	The scenario guidance and illustration before the course begins to strengthen my motives for learning.	4.29	.695	12.443***
A2	The teaching materials and group activities in this course help me embark on the study journey immediately.	4.11	.859	8.680***
A3	The guidance and assistance of the teachers from time to time help me to grasp the direction of learning.	4.40	.720	13.046***
A4	The arrangement of the three study units of this course, "The Enjoyment of Transformation," "The Colorful World of Personification," and "The World of Children/Adult Changeover," is appropriate.	4.49	.727	13.742***
A5	The method of group cooperation is helpful to the progress of course teaching.	4.18	.984	8.032***
A6	I have learned a lot from the demonstration of the other groups' works.	4.33	.826	10.832***
A7	The teaching method of this course makes me fonder of thinking.	4.29	.787	10.988***
A8	The teaching method of this course makes me more interested in learning.	4.13	.894	8.500***
A9	The teaching of this course helps me to become more creative	4.69	.557	20.345***
A10	Generally speaking, I am quite satisfied with the teaching method of this course.	4.29	.843	10.260***

Thus, Table 5 indicates that the average values of the students' degree of satisfaction regarding the implementation of teaching and course arrangement are all over 3. In contrast, the significance values all reach the "Significant Level" ($p=0.000<0.001$). The score of Item A9, "The teaching of this course helps me to become more creative," was the highest (4.69). This indicates that Mandala and PBL helped promote the

students' creativity levels.

2. Learning the creative thinking of Mandala

Descriptive statistics and a one sample t-test were used to analyze the materials regarding "the degree of satisfaction with the learning of the creative thinking of Mandala." The analysis is shown in Table 6:

Table 6: Abstract of the analysis of learning the creative thinking of Mandala

Item No.	Item	Mean	SD	t
B1	I can understand this creative thinking method's basic information and development method.	4.18	.777	10.166***
B2	This creative thinking method inspires my interest in learning.	4.27	.688	12.358***
B3	This creative thinking method inspires my creative thinking	4.38	.716	12.902***
B4	This creative thinking method could effectively promote my creativity level	4.38	.684	13.515***
B5	This creative thinking method helped me to solve the problems I came across during the creation of paintings.	4.31	.701	12.540***
B6	Generally speaking, I am quite satisfied that this creative thinking method has been incorporated into the course	4.38	.684	13.515***

Note: Certified value=3; *** p-value =.000

Table 6 indicates that the average values of the students' degree of satisfaction regarding the creative thinking method of Mandala are all over 3. In contrast, the significance values all reach the "Significant Level" ($p=0.000<0.001$). The score of Item B3, "This creative thinking method inspires my creative thinking," Item B4, "This creative thinking method could effectively promote my creativity level," and Item B6, "Generally speaking, I am quite satisfied that this creative thinking method has been incorporated in the course," were the highest (4.38). This indicates that the students were highly satisfied with the creative thinking method of Mandala, and they generally believed that this thinking method helped to promote their creative thinking capacities and creativity level. It was the first time for all the students to study the Mandala creative thinking method. The results indicate that the students generally believed this method helped them solve problems they encountered while painting pictures and enabled them to acquire more creative ideas in different aspects.

3. Learning attitudes

Descriptive statistics and a one sample t-test were used to conduct data analysis regarding "the degree of satisfaction with the collective study based upon PBL and group collaboration." The analysis is shown in Table 7:

Table 7 :Abstract of the analysis of learning attitudes

Item No.	Item	Mean	SD	t
C1	I get on well with the other group members, and our communication is smooth.	4.27	.986	8.615***
C2	I will proactively participate in group discussions and sharing.	4.29	.944	9.155***
C3	When I encounter any problem during designing and painting the unit's theme, I will proactively ask my teacher or classmates how to solve it.	4.18	.886	8.912***

C4	While painting to create the picture book, I am willing to spend more time and energy on the collection, consolidation, and analysis of materials, as well as the relevant discussion and practice.	4.40	.720	13.046***
C5	Group discussions can effectively inspire my creative thinking.	4.31	.733	11.998***
C6	The group discussion can effectively enhance my creativity	4.44	.841	11.523***
C7	My attitude toward learning is more serious than usual while attending this course.	4.27	.986	8.615***

Note: Certified value=3; *** p-value =.000

Table 7 indicates that the average values of the students' degree of satisfaction of the attitude toward learning are all over 3. In contrast, the significance values reached a significant level ($p=0.000<0.001$). The score of Item C6, "The group discussion can effectively enhance my creativity," was the highest (4.44). At this level, this course incorporated project-based learning (PBL). Through the development of the topics, this course allowed group members to jointly find a suitable solution through discussion, sharing, and consolidation. The study results indicate that this incorporation effectively strengthened students' creativity.

4. The sense of accomplishment in learning

The degree of satisfaction with incorporating "Mandala" and "PBL" into the course teaching was analyzed using a survey questionnaire, descriptive statistics, and a one sample t-test. The analysis is shown in Table 8:

Table 8: Abstract of the analysis of the sense of accomplishment in learning

Item No.	Item	Mean	SD	t
D1	Incorporating the creative thinking method of Mandala and group-based PBL can strengthen my understanding of the practice of creating picture books.	4.33	.674	13.266***
D2	The incorporation of the creative thinking method of Mandala and group-based PBL can bring about better creative work results of the groups	4.51	.695	14.588***
D3	I feel a sense of accomplishment upon completion of the design project in the course through group collaboration.	4.49	.695	14.374***
D4	If there are more opportunities for me to participate in similar projects of design practice in the future, I will become more confident in my abilities in the collection and consolidation of materials.	4.40	.720	13.046***
D5	If there are more opportunities for me to participate in similar projects of design practice in the future, I will become more confident in my ability to analyze and solve problems.	4.31	.733	11.998***
D6	If there are more opportunities for me to participate in similar projects of design practice in the future, I will become more confident in my creative thinking abilities.	4.40	.751	12.509***

Note: Certified value=3; *** p-value =.000

Table 8 indicates that the average values of the students' degree of satisfaction regarding the sense of accomplishment in learning are all over 3. In contrast, the significance values reached a significant level ($p=0.000<0.05$). The score of Item D2, "The incorporation of the creative thinking method of Mandala and group-based PBL can bring about better creative work results of the groups," was the highest (4.51). This indicates that the students generally believed that the combination of Mandala and group collaboration would promote the group's creative performances and bring about a sense of accomplishment.

The revised creative teaching method of asking-thinking-grouping-drawing-evaluation

The creative teaching method in this was conducted for 12 weeks. The researcher found that during the process of such a creative teaching method, "asking," which is guided by the teacher, was the most important. When each unit is implemented, the teacher should be responsible for guiding and designing the questions that propel the project's theme forward. Therefore, reflections on the creative thinking of the Mandala should be performed based on such questions. "Asking" and "thinking" supplement each other. As such, the researcher has revised the creative teaching method of asking-thinking-grouping-drawing-evaluation, as shown in Figure 4. Reflections upon the questions, which occur during "asking" and "thinking," incorporate the Mandala's creative thinking method. Through the discussions in the "grouping," aspect of this method, the creative ideas of group members were consolidated and discussed so that an effective solution could be developed. This solution was supposed to echo the principal axis of the question. The solution summarized by group members then entered into the "drawing" part, which should apply to the image design, molding, coloring, and composition of the picture regarding the project's theme. The completed works of this study went through the "evaluation" and were published or presented as the outcomes of group collaboration. The creative learning assessment of the works created by individual students and groups was based on the creativity rating scale.

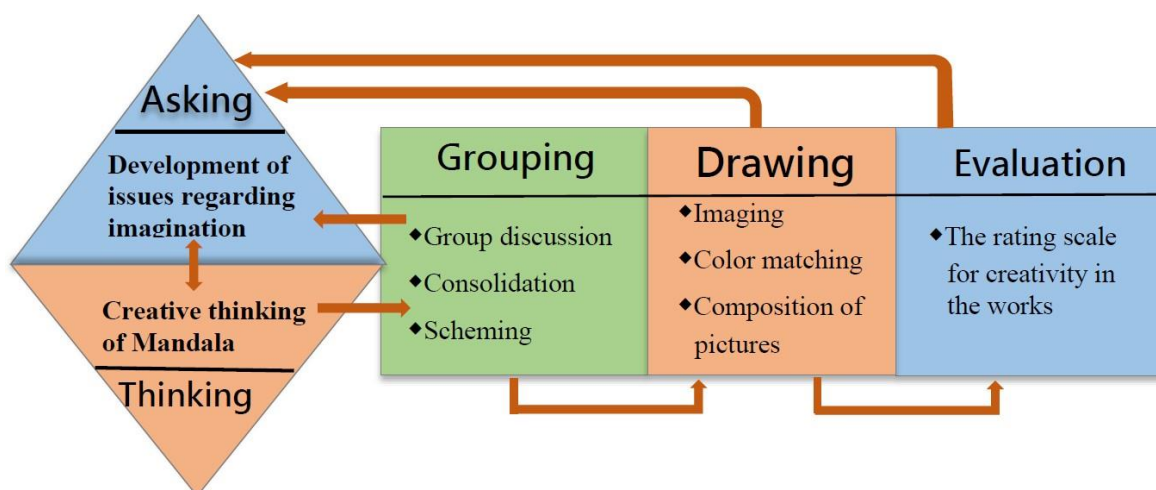


Figure 4 :The revised creative teaching method of asking-thinking-grouping-drawing- evaluation

CONCLUSION

This study applied the creative teaching method of asking-thinking-grouping-drawing- evaluation to creative teaching courses. Consistent with the research goal and results, this study focused on teaching picture book creation in design programs of vocational high schools. The following conclusions are drawn regarding the aspects of the creative teaching method (asking- thinking-grouping-drawing-evaluation), the study process, the students' study results, and the degree of learning satisfaction:

1. It is feasible to apply the creative teaching method of asking-thinking-grouping-drawing-evaluation to creating picture books.

This study's results indicate that this creative teaching method is feasible for course teaching. The students completed tests before and after the teaching method of asking- thinking-grouping-drawing-evaluation was utilized for 12 weeks. The research results indicate that this teaching method, which incorporates the creative thinking method of Mandala and PBL, was significantly helpful in promoting the students' creative performances.

2. The teaching process of the creative teaching method of asking-thinking-grouping- drawing-evaluation could promote the students' creative performances and the attitude of studying proactively

Through the results of the survey questionnaire survey regarding the degree of learning satisfaction, the students believed that the teaching method of this course helped promote their creative thinking. When the creative teaching method adopted by this study is applied to courses, the key factors of creativity demonstration and learning effects of the various unit works of picture book creation include practical guidance from the teacher, student initiatives, creative thinking, and teamwork.

3. The creative teaching method of asking-thinking-grouping-drawing-evaluation could significantly promote learning effectiveness.

This study's research results show that the students' performances in creative thinking "before the creative teaching method was implemented" were significantly better than those "after the creative teaching method was implemented." Regarding creative thinking reflected in the students' works, steady progress and growth were realized in their performances in the different units. Thus, implementing the creative teaching method of asking-thinking-grouping-drawing-evaluation significantly promoted the students' creative performances and capabilities.

4. The students demonstrated a high degree of learning satisfaction regarding the creative teaching method of asking-thinking-grouping-drawing-evaluation.

The results of the survey questionnaire analysis of learning satisfaction indicate that students' satisfaction in incorporating the "Mandala" and "PBL" in the teaching and course arrangement was "significantly satisfied." Regarding the implementation of teaching and course arrangement, the students were very satisfied with incorporating such a creative thinking method into the course. They believed that this thinking method helped to inspire and promote creativity. Concerning learning attitudes, the students were significantly satisfied with their learning attitudes. Regarding their sense of accomplishment, this creative teaching method enabled the students to acquire a sense of accomplishment through learning.

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