

Investigation of creativity and experiential learning composition in design teams

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doi.org/10.21606/iasdr.2023.175

The study aimed to examine the relationship between creativity and Experiential learning composition in design teams. The Experiential learning composition comprised two parts: Learning process composition, including team grasping experience and team transforming experience (which was the mean of both experiences for the team), and the Learning styles composition, including team Diverging, team Assimilating, team Converging, and team Accommodating (which was the percentage of each Learning style for the team). The investigation involved 20 design teams, consisting of a total of 53 Industrial Design students ranging from juniors to seniors. Participants completed the Learning Style Inventory-version 3.1, and experts evaluated the creativity of the teams using the Creative Product Semantic Scale. To analyze the relationship between creativity and team composition, Pearson correlation analysis and Regression analysis were conducted. The results demonstrated that team transforming experience positively predicted the Resolution of creativity; besides, team Diverging had a positive effect on the Novelty of creativity, while team Converging and team Assimilating were linked to Resolution, with the former having a positive effect on creativity and the latter having a negative effect on creativity.

Keywords: *experiential learning; team composition; creativity; design teams*

1 Introduction

According to Osborn (1963), creativity refers to a solution that is both original and applicable in the real world. Creativity emphasizes not only novelty and originality but also feasibility, which includes efficiency, simplicity, and effectiveness (Oldham & Cummings, 1996). O'Quin and Besemer (1989) proposed three factors, namely Novelty, Resolution, and Elaboration and Synthesis, to evaluate creativity. Novelty assesses the originality and surprise of a design, while Resolution considers its feasibility, rationality, and effectiveness. Elaboration and Synthesis evaluates whether the product is complete, attractive, and easy to understand. Shah et al. (2000) stated four variances, Quantity, Quality, Novelty, and Variety, to recognize the creativity of ideas using mathematical formulas. Later, Sozo and Ogliairi (2019) explicitly described these variances. In general, creativity is an essential aspect



of design education, and many theories and studies have been developed in this area. In addition to individual characteristics, many studies have focused on team composition and performance since most design practices or courses involve teamwork.

Previous studies have examined the relationship between creativity and team composition, with team members' academic disciplines being a common topic of discussion. Usher and Barak (2020) mentioned that team diversity of academic discipline and academic level could positively improve project innovation. This finding was also confirmed by Drach-Zahavy and Somech (2001) and Taggar (2002). In terms of personality composition, the variance of team personality traits influences innovation. Teams with low variance in emotional stability and conscientiousness tend to perform more innovative (Chatzi et al., 2022). In the field of education, several studies have investigated the connection between team performance and the composition of learning preferences or styles. Lau et al. (2012) and Orsini et al. (2022) categorized students into Learning styles based on Experiential Learning Theory (Kolb, 1984) and understood the influence of team composition on team performance.

Experiential Learning Theory proposed by Kolb (1984) defined the learning process through two concepts, grasping experience and transforming experience. The former involves Concrete experience and Abstract conceptualization, which expressed how to acquire knowledge. The latter includes Reflective observation and Active experimentation, which represented how to explain or interpret knowledge. Combining these two concepts creates four learning styles: Diverging, Assimilating, Converging, and Accommodating. Each Learning style has its own strengths, which are reflected in learners' personalities and specializations (Kolb, 2013; Kolb, 2005). For instance, more design students fall into the Assimilating or Converging (Demirbas & Demirkan, 2007; Kolsal & Kandemir, 2021). Additionally, Beckman and Barry (2007) integrated Experiential Learning Theory with the design process, and Dzombak and Beckman (2020) presented four phases to illustrate the relationship between them, including the core abilities required in each phase.

Although previous studies have examined diverse team compositions, less attention has been given to team Experiential Learning composition. Given the relationship between Experiential Learning and the design process, incorporating the perspective of Experiential Learning Theory can deepen our understanding of students' learning situations. Moreover, examining team composition from this perspective can enhance our understanding of overall team performance. Therefore, the study aims to investigate the relationship between creativity and Experiential learning composition, which involves the Learning process composition and the Learning styles composition, of the design team. We expect the results could improve insights into creativity and team composition and provide suggestions for team grouping.

2 Literature

Our literature review focused on two parts. The first one was Experiential Learning, including the Experiential Learning Theory and its application to design education research. The other part was the relationship between team composition and team performance, as well as the methods for analyzing team composition data.

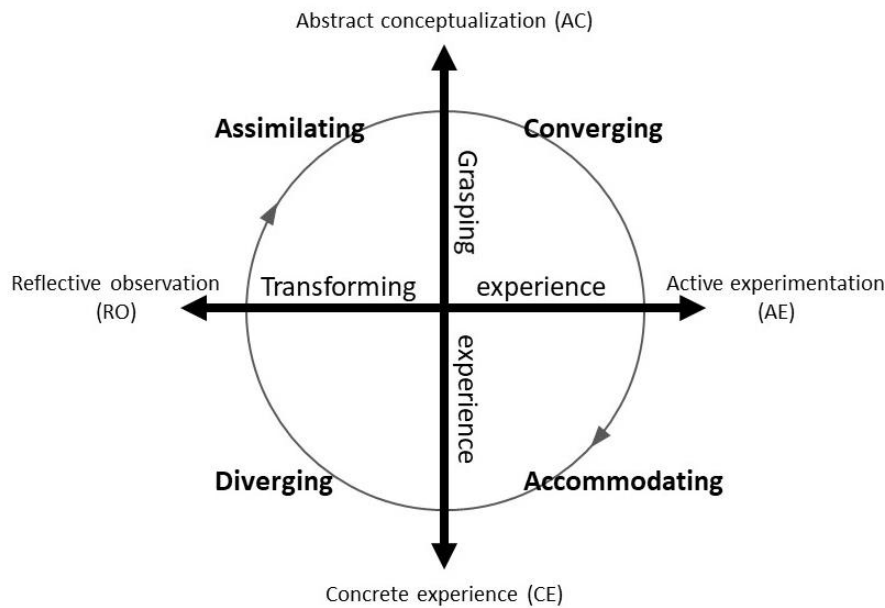


Figure 1. Learning process and four Learning styles according to Experiential Learning Theory (Kolb, 2013; Kolb, 2005)

2.1 Experiential Learning Theory and application to design education

Experience is a critical element in learning and development, and Experiential Learning Theory (ELT) was proposed by Kolb (1984) based on the work of several scholars, including John Dewey, Kurt Lewin, Jean Piaget, William James, Carl Jung, Paulo Freire, and Carl Rogers. Experiential Learning Theory consists of two concepts: grasping experience and transforming experience. Grasping experience refers to acquiring knowledge and includes Concrete experience and Abstract conceptualization. Transforming experience refers to interpreting and being impacted by knowledge or information and includes Reflective observation and Active experimentation.

	Diverging	Assimilating	Converging	Accommodating
Personality types	Introverted, Feeling	Introverted, Intuition	Extraverted, Thinking	Extraverted, Sensation
Educational Specialization	Arts, English, History, Psychology	Mathematics, Physical Science	Engineering, Medicine	Education, Nursing, Communication
Professional Career	Social Service, Arts	Sciences, Research, Information	Engineering, Medicine, Technology	Sales, Social Service, Education
Adaptive Competencies	Valuing skills	Thinking skills	Decision skills	Action skills

Table 1. Strengths of each Learning style (Kolb, 2005)

The combination of grasping experience and transforming experience sorted learners into four Learning styles: Diverging (preferring Concrete experience and Reflective observation), Assimilating (preferring Abstract conceptualization and Reflective observation), Converging (preferring Abstract conceptualization and Active experimentation), and Accommodating (preferring Concrete experience and Active experimentation), as illustrated in Figure 1. Each Learning style has its own strengths (Kolb, 2005), seen in Table 1. For instance, Diverging excels at generating new ideas and understanding things from multiple perspectives, while Assimilating is skilled at presenting information in a precise

and logical perspective. Converging prefers to apply concepts to real-world problems and make effective decisions while Accommodating thrives on hands-on learning and executing plans. Furthermore, Learning styles are related not only to people's personality types but also to their educational specializations (Kolb, 2013; Kolb, 2005).

The relationship between Learning styles and learners' performances was examined in design education. Assimilating freshmen majoring in Architecture performed better in making models or prototypes than the other three Learning styles (Demirbaş & Demirkan, 2003), whereas Converging students surpassed Diverging students in design tasks (Demirbaş & Demirkan, 2007). Kolsal and Kandemir (2021) reported that Assimilating students performed better in short design tasks. Moreover, the transformation of Learning styles from Concrete experience to Abstract conceptualization was observed among junior and senior students in Architecture, indicating the improvement in design expertise. (Yuan et al., 2018).

2.2 Team composition and team performance

The impact of team composition on creativity has been extensively studied, including factors such as discipline (Drach-Zahavy & Somech, 2001; Taggar, 2002; Usher & Barak, 2020), age (Drach-Zahavy & Somech, 2001; Taggar, 2002), gender (Lau et al., 2012), and academic level (Usher & Barak, 2020). Scholars also investigated the relationship between team personality composition and creativity. den Hartog et al. (2020) indicated that teams with smaller differences in extraversion or conscientiousness showed higher levels of team innovation, but no significant relation was found between team innovation and the variance of agreeableness or openness. Similarly, Chatzi et al. (2022) confirmed that teams with smaller variances in conscientiousness and emotional stability tended to be more innovative. On the other hand, from the perspective of team Experiential learning composition, less Converging led to higher coherence and performance in interdisciplinary graduate teams (Lau et al., 2012). Moreover, while similar experiential learning compositions decreased team conflict and increased team satisfaction, heterogeneous teams achieved better outcomes (Orsini et al., 2022).

In terms of measuring team composition, both quantitative and qualitative data analyses have been used, including Attribute-centered and Person-centered approaches. Regarding quantitative data, four definitions proposed by Steiner (1972) were used to measure the contribution of individual personalities to team performance: additive (mean), complementary (variance /standard deviation), conjunctive (minimum), or disjunctive (maximum). Various methods have been developed to convert individual characteristics into team characteristics, such as mean or variance values (Driskell et al., 2006; Macht & Nembhard, 2015). Qualitative data, such as students' disciplines or gender percentages, can also be used. Attribute-centered approaches viewed characteristics as independent variables and were useful for predicting the influence of variables on outcomes (Laursen & Hoff, 2006), while Person-centered approaches identified types of individuals with characteristics or relationships among characteristics and were particularly helpful to explore individual or group differences. An integrated approach combining both approaches is suggested to comprehensively understand an individual's feelings and behavior (Laursen & Hoff, 2006; von Eye & Bogat, 2006).

2.3 Summary of literature review

As most design practices and courses involve team collaboration, understanding the relationship between team composition and performance is crucial for design education. While previous studies have explored the impact of factors such as discipline, academic level, and personality traits on team

composition, the role of team Experiential learning composition has received relatively less attention. Given that Experiential learning has been linked to the design process, it may be beneficial to examine how Experiential learning composition is associated with team creativity in design teams. Therefore, the study aims to investigate the relationship between creativity and Experiential learning composition in design teams, and two research questions are proposed:

- RQ1. How did the Learning process composition in design teams influence creativity?
- RQ2. How did the Learning styles composition in design teams influence creativity?

The Learning process composition, including team grasping experience and team transforming experience, is the mean of both experiences for the team and the Learning styles composition, including team Diverging, team Assimilating, team Converging, and team Accommodating, is the percentage of each Learning style for the team.

3 Methods

The study consisted of two surveys: one was a self-report questionnaire assessing participants' Experiential learning styles and the other was an evaluation of team creativity by design experts.

3.1 Measures

Experiential learning styles. The Learning Style Inventory-version 3.1 (LSI 3.1) (Kolb, 2005) was used to examine participants' Experiential learning styles. The inventory consisted of 12 items, with each item containing four options that represented learning processes for grasping experience (Concrete experience and Abstract conceptualization) and transforming experience (Reflective observation and Active experimentation). Participants rated their learning preferences on a scale of 1 to 4, with 4 indicating a preference and 1 indicating a lack of preference. Each option represented a distinct learning mode: A for Concrete experience, B for Reflective observation, C for Abstract conceptualization, and D for Active experimentation. These modes of grasping and transforming experience were utilized to identify four Learning styles: Diverging, Assimilating, Converging, and Accommodating. One example of an item is:

Example 1. When I learn: A. I am open to new experiences; B. I look at all sides of issues; C. I like to analyze things, break them down into their parts; D. I like to try things out.

Creativity. The Creative Product Semantic Scale (CPSS) was developed by O'Quin and Besemer (1989) and revised by Chulvi et al. (2012) was used in our study to evaluate creativity. The questionnaire was composed of 18 factors, including Usual / Unusual, Inoperable / Operable, Commonplace / Astonishing, Non-functional / Functional, Customary / Surprising, Overused / Fresh, Unnecessary / Necessary, Commonplace / Original, Common / Astounding, Unfeasible / Feasible, Inappropriate / Appropriate, Unusable / Usable, Predictable / Novel, Inadequate / Adequate, Ineffective / Effective, Inessential / Essential, Useless / Useful, and Average / Revolutionary. These factors were sorted into the categories of "Resolution" or "Novelty" and assessed using a 7-point Semantic Differential Scale.

3.2 Participants and target courses

In the study, 20 design teams of two to four students took part in with a total of 53 undergraduate students, including 23 males and 30 females. Students were from Industrial Design at a national university in Taiwan and the target courses were "Thesis Project (2)" for seniors and "Industrial Design

(2)" for juniors, chosen for their relevance to design practice, process, and methods. Further details about the courses can be found on the website and Table 2 provides an overview of the courses.

Additionally, measuring creativity is inherently subjective and in order to decrease different interpretations or biases and increase the objectivity of the assessment, three experts with diverse backgrounds and experience (academia, industry, and mixture) were invited. All of them have 15 to 20 years of design experience and evaluated the students' creativity from diverse perspectives.

Table 2. Information about the target courses¹

Course	Introduction
Thesis Project (2)	The Department of Industrial Design offers a mandatory senior-level course that differs from other courses in that it does not offer specific project guidelines. Students are expected to apply their four years of learning flexibly. The course involves weekly progress reports, discussions with the instructor, and 2-3 formal presentations per semester. Furthermore, design experts are invited to participate in the presentations and provide feedback. At the end of the semester, students hold an exhibition to display their work and interact with the public and visitors.
Industrial Design (2)	This mandatory course is offered to junior-level students enrolled in the Department of Industrial Design. It aims to teach fundamental design principles and modeling techniques while also highlighting the significance of extensive user research during the initial phase and design refinement and iteration in the later phase. The course is taught by a team of three instructors, each with specialized knowledge in industrial design, and the students are divided into three separate classes to allow for more personalized attention and engagement. Each class will undertake a project based on the instructor's area of expertise, such as lean product development, transportation design, or human-computer interaction.

3.3 Procedure

At the beginning of the courses, the research purpose and investigation process was explained to the students, and the volunteers spent approximately 5 to 10 minutes assessing the Experiential learning styles. At the end of the semester, students presented their works in the form of videos, and experts evaluated the creativity of the works produced by each team.

3.4 Data analysis

According to the Learning Style Inventory-version 3.1, the scores of grasping experience and transforming experience, as well as the corresponding Learning styles were identified. To reduce assessment variance across different courses, we transformed the scores given by three experts into standard scores (z-scores) for creativity evaluation. To analyze the team composition data, we refer to the data analysis method from Chen and Chang (2021) and use both Attribute-centered and Person-centered approaches (Laurson & Hoff, 2006; von Eye & Bogat, 2006). Table 3 displays the types of data we collected and analyzed. After that, the mean of the Learning process (grasping experience and transforming experience) for the team was organized and Pearson correlation analysis was performed

¹ Retrieved from https://class-qry.acad.ncku.edu.tw/syllabus/online_display.php?syyear=0110&sem=2&co_no=F340421&class_code=A; https://class-qry.acad.ncku.edu.tw/syllabus/online_display.php?syyear=0110&sem=2&co_no=F330121&class_code=C

to inspect the relationship between the Learning process and creativity. Regression analysis was conducted to determine how the team grasping experience and team transforming experience predict creativity. We also identified the percentage of each of the four Learning styles within each team and performed a Pearson correlation analysis to investigate the relationship between Learning styles and creativity. Finally, we conducted a regression analysis to determine how the percentage of each Learning style predicts creativity.

Table 3. Types of data collected and analyzed in the study

Learning process composition	Learning styles composition
Team grasping experience: the mean of grasping experience for the team	Team Diverging: the percentage of Diverging for the team
Team transforming experience: the mean of transforming experience for the team	Team Assimilating: the percentage of Assimilating for the team
	Team Converging: the percentage of Converging for the team
	Team Accommodating: the percentage of Accommodating for the team
Quantitative data	Qualitative data
Attribute-centered approaches	Person-centered approaches

4 Results

The study searched the relationship between creativity and Experiential learning composition in a design team consisting of 20 teams (53 undergraduate students). Table 4 presented additional information about the students and courses. The results were divided into two sections. The first section examined the influence of the Learning process composition, team grasping experience, and team transforming experience, on creativity. In the second section, the relationship between the Learning styles composition and creativity was discussed.

Table 4. Information about the students and courses

Course	Number of		Gender (%)		Learning styles (%)			
	Students	Teams	Male	Female	Converging	Assimilating	Diverging	Accommodating
Thesis Project (2)	18	6	38.9	61.1	33.3	38.9	5.6	22.2
Industrial Design (2)	35	14	45.7	54.3	54.3	25.7	11.4	8.6

4.1 Relationship between creativity and learning process

The study conducted Pearson correlation analysis to investigate the relationship between creativity and the Learning process, which was calculated as the mean of grasping experience and transforming experience for each team. The results are presented in

Table 5 and indicate a significant positive correlation between team transforming experience and five creativity factors: Inoperable / Operable, Unfeasible / Feasible, Inappropriate / Appropriate, Unusable / Usable, and Inadequate / Adequate ($p < .05$). However, no significant correlation was found between team grasping experience and creativity. Next, multiple regression analysis was conducted to determine how much these creativity factors could be predicted by team transforming experience.

The results, seen in Table 6 to Table 10, showed that team transforming experience had a significant positive predictive effect on the five factors related to Resolution.

Table 5. Results of Pearson Correlation Analysis for Team transforming experience and Creativity factors

	1	2	3	4	5
Team transforming experience	.561*	.556*	.454*	.625**	.527*

Note. **1:** Inoperable / Operable; **2:** Unfeasible / Feasible; **3:** Inappropriate / Appropriate; **4:** Unusable / Usable; **5:** Inadequate / Adequate. **. Correlation is significant at the 0.01 level (2-tailed). *. Correlation is significant at the 0.05 level (2-tailed).

Table 6. Results of Regression Analysis for the Prediction of Inoperable / Operable by Team transforming experience

Variable	B	SE B	Beta
Team transforming experience	.081	.028	.561**
R ²	.314		
Adj. R ²	.276		
F	8.256**		

Note. **p < .01.

Table 7. Results of Regression Analysis for the Prediction of Unfeasible / Feasible by Team transforming experience

Variable	B	SE B	Beta
Team transforming experience	.078	.027	.556*
R ²	.309		
Adj. R ²	.270		
F	8.042*		

Note. *p < .05.

Table 8. Results of Regression Analysis for the Prediction of Inappropriate / Appropriate by Team transforming experience

Variable	B	SE B	Beta
Team transforming experience	.062	.029	.454*
R ²	.206		
Adj. R ²	.162		
F	4.674*		

Note. *p < .05.

Table 9. Results of Regression Analysis for the Prediction of Unusable / Usable by Team transforming experience

Variable	B	SE B	Beta
Team transforming experience	.085	.025	.625**
R ²	.391		
Adj. R ²	.357		

F 11.554**

Note. ** $p < .01$.

Table 10. Results of Regression Analysis for the Prediction of Inadequate / Adequate by Team transforming experience

Variable	B	SE B	Beta
Team transforming experience	.074	.028	.527*
R^2	.278		
Adj. R^2	.238		
F	6.927*		

Note. * $p < .05$.

4.2 Relationship between creativity and learning styles

After conducting Pearson correlation analysis, significant correlations were found between creativity factors and team Learning styles. Table 11 demonstrated that team Diverging (the percentage of Diverging for the team) was positively related to creativity factors, Customary / Surprising, Overused / Fresh, Commonplace / Original, and Common / Astounding. But, the team Assimilating was negatively correlated to creativity factors: Inoperable / Operable, Unfeasible / Feasible, Inappropriate / Appropriate, Unusable / Usable, and Inadequate / Adequate. Additionally, team Converging was positively related to creativity factors, Inoperable / Operable, Inappropriate / Appropriate, Unusable / Usable, Inadequate / Adequate, and Useless / Useful while no significant relationship was found between team Accommodating and creativity.

Table 11. Results of Pearson Correlation Analysis for team Learning styles and Creativity factors

	1	2	3	4	5	6	7	8	9	10
Team Diverging	.176	.525*	.510*	.456*	.540*	.161	.318	.424	.341	.290
Team Assimilating	-.593**	-.030	-.046	-.298	-.002	-.555*	-.609**	-.778**	-.698**	-.428
Team Converging	.455*	-.139	-.011	.097	-.074	.387	.494*	.638**	.514*	.512*
Team Accommodating	.194	-.077	-.264	.067	-.260	.250	.049	.035	.168	-.309

Note. **1:** Inoperable / Operable; **2:** Customary / Surprising; **3:** Overused / Fresh; **4:** Commonplace / Original; **5:** Common / Astounding; **6:** Unfeasible / Feasible; **7:** Inappropriate / Appropriate; **8:** Unusable / Usable; **9:** Inadequate / Adequate; **10:** Useless / Useful. ** Correlation is significant at the 0.01 level (2-tailed). * Correlation is significant at the 0.05 level (2-tailed).

Then, multiple regression analysis was manipulated to inspect how the percentage of Learning styles predicted the variance in creativity. Learning styles were utilized as predictors of each factor and the results indicated a significant relationship, as presented in Table 12 to Table 21. Specifically, from Table 13 to

Table 16, team Diverging positively predicted the four creativity factors relating to Novelty. On the other hand, team Assimilating negatively predicted the five factors which connect to Resolution, presented in Table 12 and Table 17 to

Table 20. Lastly, Table 21 indicated that team Converging positively predicted the creativity factor relating to Resolution.

Table 12. Results of Regression Analysis for the Prediction of Inoperable / Operable by Team Assimilating

Variable	B	SE B	Beta
(Constant)	.732	.241	
Team Assimilating	-1.565	.501	-.593**
R ²	.351		
Adj. R ²	.315		
F	9.748**		

Note. ** $p < .01$.

Table 13. Results of Regression Analysis for the Prediction of Customary / Surprising by Team Diverging

Variable	B	SE B	Beta
Team Diverging	3.063	1.170	.525*
R ²	.276		
Adj. R ²	.235		
F	6.849*		

Note. * $p < .05$.

Table 14. Results of Regression Analysis for the Prediction of Overused / Fresh by Team Diverging

Variable	B	SE B	Beta
Team Diverging	3.386	1.346	.510*
R ²	.260		
Adj. R ²	.219		
F	6.329*		

Note. * $p < .05$.

Table 15. Results of Regression Analysis for the Prediction of Commonplace / Original by Team Diverging

Variable	B	SE B	Beta
Team Diverging	2.739	1.261	.456*
R ²	.208		
Adj. R ²	.164		
F	4.715*		

Note. * $p < .05$.

Table 16. Results of Regression Analysis for the Prediction of Common / Astounding by Team Diverging

Variable	B	SE B	Beta
Team Diverging	3.363	1.235	.540*
R ²	.292		
Adj. R ²	.252		
F	7.416*		

Note. * $p < .05$.

Table 17. Results of Regression Analysis for the Prediction of Unfeasible / Feasible by Team Assimilating

Variable	B	SE B	Beta
(Constant)	.675	.242	
Team Assimilating	-1.425	.503	-.555*
R^2	.308		
Adj. R^2	.270		
F	8.014*		

Note. * $p < .05$.

Table 18. Results of Regression Analysis for the Prediction of Inappropriate / Appropriate by Team Assimilating

Variable	B	SE B	Beta
(Constant)	.721	.226	
Team Assimilating	-1.532	.470	-.609**
R^2	.371		
Adj. R^2	.336		
F	10.617**		

Note. ** $p < .01$.

Table 19. Results of Regression Analysis for the Prediction of Unusable / Usable by Team Assimilating

Variable	B	SE B	Beta
(Constant)	.893	.179	
Team Assimilating	-1.952	.371	-.778**
R^2	.605		
Adj. R^2	.583		
F	27.616**		

Note. ** $p < .01$.

Table 20. Results of Regression Analysis for the Prediction of Inadequate / Adequate by Team Assimilating

Variable	B	SE B	Beta
(Constant)	.795	.210	
Team Assimilating	-1.806	.436	-.698**
R^2	.488		
Adj. R^2	.459		
F	17.124**		

Note. ** $p < .01$.

Table 21. Results of Regression Analysis for the Prediction of Useless / Useful by Team Converging

Variable	B	SE B	Beta
Team Converging	1.329	.526	.512*
R^2	.262		

Adj. R^2	.221
F	6.392*

Note. * $p < .05$.

The results of regression analysis were summarized in Table 22, which revealed that team transforming experience and team Converging had a positive relationship with the creativity of Resolution while team Assimilating had a negative relationship with the creativity of Resolution; additionally, team Diverging positively predicted creativity of Novelty.

Table 22. Summary of the Results of Regression Analysis

	Creativity	Learning process	Learning styles
Resolution	Inoperable / Operable	Team transforming experience (+)	Team Assimilating (-)
	Unfeasible / Feasible	Team transforming experience (+)	Team Assimilating (-)
	Inappropriate / Appropriate	Team transforming experience (+)	Team Assimilating (-)
	Unusable / Usable	Team transforming experience (+)	Team Assimilating (-)
	Inadequate / Adequate	Team transforming experience (+)	Team Assimilating (-)
	Useless / Useful	---	Team Converging (+)
Novelty	Customary / Surprising	---	Team Diverging (+)
	Overused / Fresh	---	Team Diverging (+)
	Commonplace / Original	---	Team Diverging (+)
	Common / Astounding	---	Team Diverging (+)

Note. (+) positive prediction, (-) negative prediction.

5 Discussion

The study investigated the relationship between creativity and Experiential learning composition in the design team. The following sections discussed the influence of Learning process composition on creativity (RQ1) and the influence of Learning styles composition on creativity (RQ2).

About Learning process composition, team grasping experience did not show a significant correlation with creativity while team transforming experience had a positive predictive effect on creativity (RQ1). From team grasping experience, students in the design fields changed their Learning process from Concrete experience to Abstract conceptualization with grades owing to the difference in design expertise (Tucker, 2009; Yuan et al., 2018). Since our participants were either juniors or seniors with a certain level of design expertise, they may change their Learning process of grasping experience simultaneously and this change may account for the lack of significant impact of grasping experience on creativity. On the other hand, the team transforming experience was associated with improved performance in five creativity factors relating to Resolution, which represent the practicality and necessity of the design (Chulvi et al., 2012) when the team transforming experience is high (tend Active experimentation). It is possible that experimenting and testing ideas could enhance the creativity of Resolution.

In terms of the four Learning styles composition (Diverging, Assimilating, Converging, and Accommodating), team Diverging and Converging positively predicted creativity, whereas team Assimilating negatively predicted creativity (RQ2). The following would discuss the relationship between the four styles and creativity separately. First, teams with more Diverging performed better in four creativity factors which relate to Novelty standing for the originality and uniqueness of the design (Chulvi et al., 2012). Diverging with Concrete experience and Reflective observation excels in conceiving new ideas and performing well in brainstorming, (Kolb, 2005) which enhances the Novelty of the team. Second, the negative influence of Assimilating on five creativity factors consisting of Resolution was observed. Although Assimilating is excellent at integrating and streamlining information, they tend to focus on abstraction and conceptualization and consider logic more important than practicability (Kolb, 2005), leading to low-Resolution evaluation when the team with a high percentage of Assimilating. Third, Converging is the predictor as one creativity factor of Resolution. Converging likes to try novel things and explore practical purposes for the idea (Kolb, 2005), thereby boosting the Resolution of creativity in teams. Unlike the findings of Lau et al. (2012), our study did not discover any negative impact of Converging on team performance, which may be related to team members' disciplines or creativity evaluation. Our study focused on the composition of the design teams while Lau et al. discussed the composition in the cross-disciplinary teams and team members' disciplines or backgrounds seem to cause the different results; thus, more studies to discuss the difference between design teams and cross-disciplinary teams are necessary. Additionally, our creativity evaluation was conducted by experts, whereas Lau et al. (2012) assessed team performance and coherence through self-report studies. Therefore, the percentage of Converging in the team may negatively influence the subjective feelings or emotions of team members, but it can improve the team's creative performance from an objective perspective; moreover, we also suggest employing multiple assessment methods to understand the influence of team composition on team performance in a comprehensive way. The last Learning style, Accommodating, which prefers to obtain information from people to solve problems, does not connect to any creativity factors. While Accommodating may be good at testing and iterating the design, limited time in design courses means that most students cannot test their prototypes and even modify the design completely, resulting in Accommodating having no significant influence on creativity.

In addition, we explored the Learning styles from the perspectives of the Learning process. One is grasping experience (Assimilating and Converging) and the other is transforming experience (Diverging and Accommodating). The results showed that both Assimilating and Converging learning styles tend to grasp experience similarly but transform the experience in different ways. Their opposite effects on the Resolution of creativity imply a relationship between transform experience and Resolution. For design teams, actively experimenting and trying new things (doing) effectively improves their creative performance, especially in terms of Resolution. Conversely, relying solely on reflection and observation (seeing) can hinder team creativity. The other finding is that both Diverging and Assimilating transform experience with Reflective observation, but they acquire experience in different ways, which may be the reason why their percentages in the team differently impact creativity. Learning from concrete experience seems to be an effective approach for generating innovative ideas while learning from abstract concepts may impede the practicality of an idea.

In sum, the results suggest that team transform experience significantly influences the Resolution of creativity. Furthermore, team composition of Learning styles can positively impact creativity, with

Diverging and Converging being particularly beneficial, and it may be useful to ensure a balance of Assimilating in each team. To enhance creativity in design teams, instructors can encourage students to draw inspiration from concrete experiences (such as their own experience) and use reflection and observation to transform their ideas. They should also encourage students to test and modify their abstract concepts to improve their practicability and resolution.

6 Conclusion

Our study aimed to understand the relationship between creativity and Experiential learning composition in the design team. We analyzed the team composition of the Learning process and Learning styles of 20 design teams, whose members were Industrial Design students from juniors to seniors. The main findings are as followed:

Concerning Learning process composition and creativity, no significant connection is found between team grasping experience and creativity while team transforming experience positively predicted the creativity factors related to Resolution.

Concerning Learning styles composition and creativity, team Diverging and team Converging positively predicted creativity, but team Assimilating negatively predicted creativity. Team Diverging is connected with Novelty and both team Converging and team Assimilating connects with Resolution.

6.1 Limitation and future work

In summary, our study provides insights into the relationship between creativity and Experiential learning composition in the design team. However, several limitations should be addressed in future research. Firstly, the study was conducted with a single university and the sample size was imbalanced in terms of the number of both teams and participants with each Learning style, and furthermore, the findings may not directly translate to other disciplines or educational contexts since we focused specifically on design teams. The limitation may restrict the generalizability of the findings to a broader population. In order to increase the generalizability and strengthen the validity and applicability of the results, future studies should expand the sample size and include participants from other universities, relevant fields, or diverse disciplines, such as cross-disciplinary teams. As the sample size increased enough, more factors such as individual skills, domain knowledge, or organizational culture may also be integrated to provide a more comprehensive understanding of the complexities involved. Second, while experts' evaluations were used to assess creativity, it would be beneficial to include self-report questionnaires to examine the difference between external evaluations and internal members' perceptions. Lastly, we plan to implement the findings from this study in our courses and examine the effectiveness of team composition and grouping strategies in promoting creativity.

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Acknowledgement: We appreciate the financial support from the National Science and Technology Council, Taiwan (Project number: 112-2410-H-006-063-MY2). We are also very grateful to National Cheng Kung University (NCKU), Taiwan and the participants for their assistance in the research.