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### THE EFFECT OF PROJECT-BASED LEARNING AND PROJECT-BASED FLIPPED CLASSROOM ON CRITICAL THINKING AND CREATIVITY FOR BUSINESS ENGLISH COURSE AT HIGHER VOCATIONAL COLLEGES

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### ABSTRACT

**Purpose** – With the evolving demands of the global and Chinese economies, cultivating critical thinking and creativity has become imperative for social and economic development. However, contemporary educational practices have not kept pace with this essential need. This study examines the effects of project-based learning and project-based flipped classrooms on critical thinking

and creativity in higher vocational colleges. Moreover, this research delves into the disparity and comparative analysis between the two approaches.

**Methodology** – A between-group quasi-experimental study was designed. Data were collected from 120 respondents from one higher vocational college in Shanxi District using cluster sampling. The Ennis-Weir Critical Thinking test and District creativity test were used to collect data for further analysis. Data were analysed using analysis of covariance (ANCOVA) and paired-sample t-test. Paired-sample t-tests are employed to test the effects of two teaching methods, while ANCOVA is used to compare the discrepancy between the two methods. With the combination of paired sample t-test and ANCOVA, the more effective teaching method can be determined.

**Findings** – The results indicated that project-based learning and flipped classrooms significantly affected critical thinking and creativity. Besides, the project-based flipped classrooms had a larger effect on critical thinking and creativity, proving to be a more effective teaching approach to transform the present curriculum pedagogy.

**Significance** – This study theoretically integrates class activities into higher-order thinking skills and guides teachers and educators to cultivate talents in higher vocational education.

**Keywords:** Project-based learning, project-based flipped classroom, business English learners, critical thinking, creativity.

## INTRODUCTION

In the 21<sup>st</sup> century, soft skills such as creativity and critical thinking are becoming increasingly important and drawing more attention. Therefore, it becomes crucial for the workforce to think innovatively and independently. However, educational practices continue to lag despite the pressing demand for critical thinking and creativity. According to a survey conducted among Canadian university faculty members, 87.8 percent considered creativity and critical thinking important, but only 45.9 percent incorporated them into their students' learning outcomes (Marquis & Henderson, 2015). In addition, Adobe conducted international surveys indicating that a majority

of employees, averaging 59 percent, felt that their prior educational experiences hindered their creative potential (62% in the US, 61% in the UK, 59% in Germany, 62% in France, and 51% in Japan) (Egan et al., 2017). This discrepancy between high demand and present status also exists in China (Egan et al., 2017).

According to “*Made in China 2025*,” China is committed to promoting vocational education and developing students into T talents to adapt to the Artificial Intelligence (AI) era, which calls for the adoption of an interdisciplinary teaching approach and incorporating soft skills such as critical thinking and creativity into the existing education system. As a result, some of China’s higher vocational colleges provide non-English major students with business English, embedding the core skills of the 21<sup>st</sup> century into teaching and curricula. However, according to a popular survey, employers reported that employees lack independent thinking and innovation skills. The traditional curriculum and teaching methods are proposed as barriers to promoting creativity and critical thinking (Fan, 2018).

Based on the backgrounds mentioned above, methods to cultivate critical thinking and creativity and make innovations to the curriculum are essential. Project-based learning, a collaborative learning method, has been reported to be effective and applied in various contexts, such as high school (Setuju et al., 2023) and undergraduates (Kemaloglu, 2022). Besides, the idealised model has improved critical thinking and creativity (Loyens et al., 2023). However, other studies have indicated that project-based learning does not efficiently improve the learners’ critical thinking and creativity. The potential reasons behind the insignificant effect of project-based learning may lie in the shortcomings of project-based learning (Listiqowati et al., 2022). The major shortcomings can be summarised as time-consuming and lacking knowledge coverage (Fan, 2018).

As a complementary approach, the flipped classroom is an instructional approach that reverses the traditional learning model. In this approach, students are provided with instructional content, often in the form of pre-recorded videos or readings, to review outside of class, which saves time and provides sufficient coverage knowledge for more activities in class. The flipped classroom model has been used in various disciplines, including social humanities, medicine, visual arts, biology, and natural science (Durrani et al., 2022). Tomesko et al.

(2022) indicated that flipped classrooms significantly affect creativity and critical thinking (Islim, 2018). With the consideration of the traits of flipped classrooms, project-based is supposed to integrate with flipped classrooms, exploring the effect of the new teaching model on creativity and critical thinking.

Among the existing cases, the project-based flipped classroom mostly stresses the effect on motivation and academic achievement in one or more aspects, such as listening, vocabulary, pronunciation, and writing (Bin & Hazaea, 2022). Fewer cases emphasise its effect on critical thinking and creativity (Listiqowati et al., 2022). In addition, there is still a research gap in the higher-order thinking of business English learners. More importantly, the context of vocational colleges has not been fully explored. Limited studies have investigated the higher-order thinking abilities of business English learners in a Chinese context (Chow et al., 2011). To our knowledge, population and knowledge gaps exist in the field.

As a consequence, this study has the following research questions:

1. Does project-based learning affect business English learners' critical thinking and creativity in higher vocational colleges?
2. Does a project-based flipped classroom affect business English learners' critical thinking and creativity in higher vocational colleges?
3. Is there any difference between the effects of project-based learning and project-based flipped classrooms on business English learners' critical thinking and creativity in higher vocational colleges?
4. Which teaching method improves students' critical thinking and creativity more effectively?

## **LITERATURE REVIEW**

### **Integrated Theories**

Higher-order thinking theory is supported by Bloom's taxonomy. This theory has been applied in various fields, such as higher-order thinking (Huang et al., 2023), curriculum development (Karanja

& Malone, 2021), and assessment (Jauhariyah et al., 2021). The framework organises cognitive learning and thinking skills into six levels. The levels are arranged in a pyramid shape, with lower-order thinking skills forming the base and higher-order thinking skills at the apex, including remembering, understanding, applying, analysing, evaluating, and creating.

There are two theories for teaching methods included in this model: behaviourism and constructivism. The teaching methods involved in this research are project-based learning and flipped classrooms. According to the flipped classroom, the classroom is divided into three stages: before, during, and after. In comparison, traditional project-based teaching is in the in-class and after-class stages. The pre-class phase corresponds to the initial stages of higher-order thinking: remembering and understanding.

According to behaviourism, all behaviours are the result of experience. Regardless of the background or race of the person, given the proper conditioning, a particular behaviour can be trained (Roulean et al., 2016). In the pre-class phase, teachers will assign recorded lecture videos or other materials for students to preview. Those who perform well will receive higher formative assessment, whereas those who do not will receive lower formative assessment, facing the risk of being punished by the teacher. This method occurs through reinforcement and punishment, known as behaviourism (Elzeky et al., 2022). The last four stages of higher-order thinking, from low to high, are application, analysis, evaluation, and creation. These stages correspond to the experience, reflection, interpretation, and knowledge acquisition of project-based teaching (Astawa et al., 2017). Constructivism is the theoretical basis of project-based learning (Powell & Kalina, 2009). In class, project-based learning was applied with the guidance of teachers. Teachers gave students tasks based on the materials provided ahead. Students worked collaboratively and learned from peers with the instruction of teachers. This peer learning can be elucidated by social constructivism (Powell & Kalina, 2009). After that, students established and innovated a knowledge system, known as cognitive constructivism, according to their former experience in this learning process (Powell & Kalina, 2009).

All the above explanations can be elucidated in Table 1. In this study, the related theories were used to guide the teaching approach being

tested for its effect on the critical thinking and creativity of business English vocational students.

**Table 1**

*Integrated Theories of Higher Order Thinking and Teaching Methods*

Bloom's Taxonomy	Theories of teaching methods	Teaching Stage	Breakdown of Teaching Procedures
Remember	Behaviorism	Pre-class in FC	Students watch assigned videos and materials to get appraised or avoid punishment;
Understand	Behaviorism	Pre-class in FC	Students digest knowledge and transfer to their understanding based on basic knowledge;
Apply	Social constructivism	During a class with PBL in FC	Students put knowledge into application and learn from peers and teachers during this process;
Analyse	Social constructivism	During a class with PBL in FC	Students analyse their application with considerations from teachers' and peers' advice;
Evaluate	Cognitive constructivism	After class in FC with PBL	Students get evaluations about their draft work when they do the presentation;
Create	Cognitive constructivism	After class in FC with PBL	Students do the amendments and creations based on the evaluation, during which they upgrade cognition.

*Note:* FC = Flipped Classroom, PBL = Project-based Learning

**Previous Research**

*Project-based Learning on Critical Thinking and Creativity*

Project-based learning enables students to work collaboratively and acquire new knowledge based on their previous experience and knowledge (Viswambaran & Shafeek, 2019). It has been applied

in diverse contexts such as biology, engineering, crafts, math, and nursing (Chang & Chen, 2022; Siew & Ambo, 2020). Moreover, its effectiveness has been demonstrated in fields such as engagement (Yilmaz et al., 2020), academic achievement (Astawa et al., 2017), communicative skills (Abu et al., 2019) and other soft skills (Wurdinger et al., 2020).

Regarding its effect on soft skills, project-based learning is proposed to improve critical thinking significantly (Wang, 2022) and creativity (Chang & Chen, 2022). Moreover, multiple studies have indicated that the quality of vocational education can be greatly enhanced by project-based learning (Sukamta et al., 2018), strengthening students' involvement, attitude, and higher-order thinking skills by providing learners with diversified perspectives from others (Viswambaran & Shafeek, 2019). However, other scholars also proposed different conclusions, indicating that project-based learning did not significantly affect critical thinking and creativity (Siew & Ambo, 2020). The inconclusive results may arise from the shortcomings of project-based learning, which refer to its time limitations in class and requirements for comprehensive knowledge coverage (Sezer & Esenay, 2022). Therefore, some researchers are evaluating other approaches to overcome the disadvantages of project-based learning.

### ***Project-based Flipped Classroom on Critical Thinking and Creativity***

The flipped classroom is interpreted as class activities being reversed from inside to outside of the class (Durrani et al., 2022). It is known to provide learners with videos or learning materials ahead of time, giving more time for students to discuss and collaborate in class with the guidance of teachers (Huang et al., 2022). This trait of flipped classroom supplements the shortcomings of project-based learning (Fan, 2018). It imposes significant effects on motivation (Elzeky et al., 2022), self-efficiency (Huang et al., 2022) and soft skills (Atwa et al., 2022).

A limited number of cases integrate project-based learning into flipped classrooms. Among the few cases, studies testified to the significant effect of the hybrid learning method on motivation (Durrani et al., 2022), achievement (Paristiowati et al., 2017), and critical thinking (Listiqowati et al., 2022). However, these studies concentrate

on disciplines such as chemistry, engineering, and biology. The application of project-based flipped learning in enhancing business English learners' creativity and critical thinking skills remains unexplored. The knowledge gap and population gap will be filled up in this study.

### ***Difference between the Effects of Project-Based Learning and Project-Based Flipped Classroom***

Only a few studies have simultaneously compared simple project-based learning and project-based flipped classrooms. The comparison of these two methods stresses the effects on academic achievement (Paristiowati et al., 2017), scientific literacy (Sholahuddin et al., 2023), critical thinking (Listiqowati et al., 2022), and problem-solving skills (Chua & Islam, 2021). Nearly all the existing studies showed the more practical effects of project-based flipped classrooms. However, most of these comparison studies concentrate on fields such as biology and engineering (Chua & Islam, 2021; Fan, 2018; Sholahuddin et al., 2023). Moreover, comparison studies in the discipline of business English are lacking. As for vocational higher colleges, the research is far less.

## **METHODOLOGY**

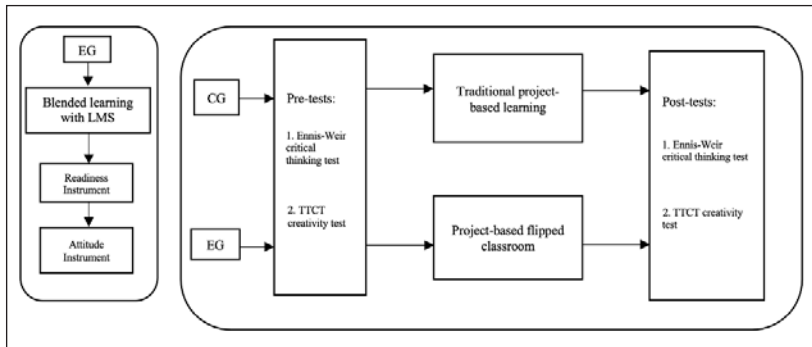
### **Research Design**

This study was designed as a quasi-experimental research to explore the effects of project-based learning and project-based flipped classrooms on Chinese higher vocational business English learners' creativity level and critical thinking. The study consisted of three stages: pre-intervention, intervention, and after-intervention. In the pre-intervention stage, which lasted for two weeks, pre-testing of the instruments was conducted. Different teaching methods were applied to different groups over 12 weeks in the intervention stage. The experimental group (EG) was taught using the project-based flipped classroom mode, while the control group (CG) received traditional project-based learning. In the after-intervention stage, post-tests were administered, and data were collected for further analysis. Figure 1 illustrates the research design.



**Figure 1**

*Research Design*



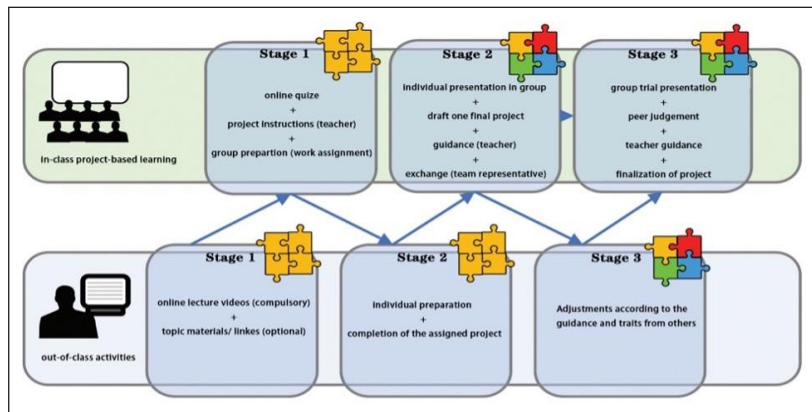
**Teaching Procedure of Project-Based Flipped Classroom**

This hybrid project-based flipped classroom approach covered six projects over 12 weeks, each divided into three in-class and three out-of-class stages (Figure 2). During out-of-class stage 1, students were provided with lecture videos from the teacher as compulsory tasks and optional material links. Students could choose to learn the content at their own pace. In in-class stage 1, students took online quizzes through an app to assess their knowledge of the assigned topic. Teachers then reviewed quiz results and focused on areas with high error rates. Students had the opportunity to ask questions and receive guidance. Following this, teachers provided project instructions to familiarise students with the project based on their prior knowledge. Students in groups discussed ideas and selected their preferred roles. During out-of-class stage 2, students prepared their chosen project roles, considering other group members' contributions to ensure the project was logical and well-organised. They also collected materials and completed their assigned parts. In in-class stage 2, individuals presented their roles within their groups and provided detailed explanations. Other group members evaluated and discussed the connections among different parts of the project. Students collaborated to draft the entire project, seeking guidance from the teacher. Additionally, representatives from other groups had the opportunity to assess and learn from each other's projects. During out-of-class stage 3, individuals made adjustments based on teacher and peer feedback. Each group assigned one student to consolidate

their project parts into a whole. In in-class stage 3, each group had one representative deliver a trial presentation, with the teacher and other groups evaluating based on SWOT principles. Finally, each group completed their project and received a score from the teacher.

**Figure 2**

*Teaching Procedure of Project-based Flipped Classroom*



**Population and Sampling**

This study focused on business English learners majoring in e-commerce at a higher vocational college in Shanxi District, China. This particular college was chosen due to the convenience of the researcher, a business English teacher, in collecting data. The e-commerce programme was selected as it had the largest number of business English learners in the school and was considered a representative major for business English education. The total number of e-commerce students was 573, with an average of 30 students per class, providing an adequate sample size for random selection.

The sample size of 120 participants was determined using G\*Power software with predefined parameters. Cluster sampling was employed to select the 120 participants. In this technique, the population was divided into clusters, and entire clusters were randomly selected (Rahman et al., 2022). For this study, 4 out of 20 classes were randomly chosen and divided into two groups: experimental (EG) and control (CG). The EG was taught using the project-based flipped classroom

mode, while the CG received instruction using the traditional project-based learning method.

## **Instruments**

This study employed two instruments: the TTCT test for measuring creativity and the Ennis-Weir Critical Thinking test for assessing critical thinking. The following provides details about these instruments.

### **TTCT Creativity Test**

Creativity was measured using a test adapted and modified from TTCT verbal A. TTCT verbal A was selected due to its established validity and reliability in previous literature (Kim, 2017). This verbal test requires students to provide subjective answers, making it more suitable for assessing creativity than other multiple-choice questionnaires (Said et al., 2020).

The test consists of five activities, each with three dimensions to assess creativity. Students were instructed to provide subjective responses based on the requirements of the five activities. Scores were awarded based on their responses' fluency, flexibility, and originality. Fluency was measured by the total number of answers provided by students, with each answer earning 1 point. Flexibility referred to the variety of responses, while the uniqueness of the answers determined originality. The total creativity score for each student was calculated based on their fluency, flexibility, and originality scores.

Content validation for the creativity instrument was conducted by experts in the field, involving six expert judgments from education professors and experts familiar with the evaluation of creativity. The expert selection was based on their expertise and experience. The I-CVI values for each activity ranged from 0.83 to 1, and the S-CVI value exceeded 0.9, indicating excellent content validity of the instrument (Yusoff, 2019). A pilot study involving 30 business English learners not participating in the formal research confirmed the instrument's reliability. Reliability was assessed using Cronbach's alpha, with values of 0.87 for fluency, 0.83 for flexibility, and 0.78 for originality, all exceeding the 0.70 thresholds considered indicative of moderate internal reliability. Thus, the reliability of the test was confirmed (Chua, 2020).

### ***Ennis-Weir Critical Thinking Test***

The Ennis-Weir Critical Thinking test was used to evaluate critical thinking levels in this study. This test was chosen for its established validity and reliability in formal research. Besides, it offers a comprehensive and well-structured test and scoring criterion, simplifying data collection. The test included a series of clear instructions and a letter to a newspaper editor explaining the concept of car prohibition in eight short paragraphs. Scores were used to assess the quality of argumentation and thinking in each paragraph based on the scoring criterion provided by Ennis-Weir.

Content validation for this instrument was conducted by experts in the field, involving expert judgments from education professors and experts familiar with the evaluation of critical thinking. The I-CVI values for each activity ranged from 0.83 to 1, and the S-CVI value exceeded 0.9, indicating excellent content validity of the instrument (Yusoff, 2019). Thirty business English learners not involved in the formal research experiment were randomly chosen from the sampling frame. An inter-rater reliability assessment yielded an intraclass correlation value of 0.92, exceeding the 0.90 threshold and indicating excellent reliability (Shrout & Fleiss, 1979).

### **Data Collection**

Data collection instruments were distributed to participants in person during class. Upon introducing the tests, students were given 30 minutes to complete the TTCT test and 40 minutes for the critical thinking test. Both groups underwent pre-tests for critical thinking and creativity, lasting two weeks. After the intervention, post-tests using the same instruments were conducted over two weeks. Subsequently, students received their pre-test and post-test scores via email to ensure privacy. All collected data remained confidential and was solely used for research purposes.

### **Data Analysis**

The research objectives and questions were analysed using paired-sample t-tests and ANCOVA. Paired-sample t-tests were employed for within-group analysis, while ANCOVA was used for between-group analysis. The combination of these two methods aimed to provide a comprehensive understanding of the effects of the two

teaching methods and their differences, ultimately determining the more effective teaching method.

For research questions 1 and 2, paired-sample t-tests were used to compare the means of two related groups (pre-test and post-test scores) and assess whether a significant difference existed between them. This test was particularly valuable when evaluating the efficacy of an intervention within the same group over time. Research questions 1 and 2 aimed to investigate the effects of the two teaching methods on critical thinking and creativity using paired-sample t-tests.

Regarding research question 3, ANCOVA was employed to determine group differences in post-test scores between the two teaching methods while controlling for pre-test scores as covariates. The significance value was used to identify differences between the groups.

For research question 4, the more effective teaching method was determined by interpreting the effect size of each group's paired-sample t-test (eta squared) separately and the difference size (Cohen's d) between groups. This approach provided a more comprehensive understanding and conclusion regarding the most effective teaching method.

## RESULTS

The results were interpreted using both descriptive and inferential statistics based on the research questions outlined earlier.

### Descriptive Data Analysis

As shown in Table 2, the EG comprised 60 students, including 36 girls and 24 boys, while the CG consisted of 60 participants, with 29 girls and 31 boys. The gender distribution showed minimal differences between the two groups.

**Table 2**

#### *Demographic Information of Respondents*

Groups	Experimental Design	N	Female	Male
Experimental group	Project-based flipped classroom	60	36	24
Control group	Only project-based learning	60	29	31
Total		120	65	55

## Assumptions of Data Analysis

Before conducting inferential data analysis, certain assumptions must be met. The significance values of Shapiro-Wilk were above 0.5, suggesting that the data were normally distributed (Chua, 2020). Besides, both groups' skewness and kurtosis of creativity and critical thinking fell between -1.96 and +1.96 (Chua, 2020). Consequently, it can be concluded that critical thinking and creativity data were normally distributed in both groups. Furthermore, the data for dependent variables were continuous, and observations in both groups were independent. No outliers were detected. As a result, paired-sample t-tests were appropriately used with all these assumptions met.

In addition, according to Levene's test, all the significance values for critical thinking and creativity were above 0.5, indicating that the homogeneity of variance had been met. Moreover, the linearity relationship between the covariate (pre-test scores of critical thinking and creativity) and dependent variable (post-test score of critical thinking and creativity) could be observed in the scatter plot, showing a roughly linear relationship (Appendix 2). The major assumptions of ANCOVA were met, with the homogeneity of regression slope illustrated in the subsequent detailed description.

Therefore, the assumptions of normality, homogeneity of variance, and linearity have all been met, allowing further data analysis.

## Inferential Data Analysis

Research question 1 and 2 employed paired-sample t-tests to explore the differences in critical thinking and creativity within group, while research questions 3 utilized ANCOVA for between group difference in critical thinking and creativity. Research question 4 was concluded based on the values of effect size: eta squared in paired sample t-test and Cohen's d in ANCOVA analysis. After ensuring that all assumptions were met, paired-sample t-tests and ANCOVA were conducted as follows according to the research questions.

***RQ1: Does project-based learning affect business English learners' critical thinking and creativity in higher vocational colleges?***

The effect of project-based learning on the critical thinking skills of business English learners was assessed through a paired-sample t-test. The results in Table 3 revealed a significant increase in critical thinking scores from the pre-test ( $M=7.00$ ,  $SD=1.93$ ) to the post-

test ( $M=9.75$ ,  $SD=2.42$ ). The  $t(59)=8.78$  with a  $p\text{-value}=0.00<0.01$ , indicating a significant effect of project-based learning on critical thinking. Besides, the eta squared value is  $\eta^2=0.56$ , signifying a large effect size and following Cohen's guidelines (Chua, 2020): 0.01=small effect, 0.06=moderate effect, and 0.14=large effect. As for this study, project-based learning greatly affects the critical thinking of business English learners.

**Table 3**

*Results of the Effect of Project-based Learning on Critical Thinking (N=60)*

Post-test		Pre-test		Paired sample t-test			
M	SD	M	SD	t	df	p-value	$\eta^2$
9.75	2.42	7.00	1.93	8.78	59	.00	0.56

Note: Sig.<.01\*\*\*

The effect of project-based learning on the creativity level of business English learners was examined using a paired-sample t-test. Results in Table 4 demonstrated a significant increase in creativity scores from the pre-test ( $M=7.86$ ,  $SD=2.59$ ) to the post-test ( $M=10.70$ ,  $SD=2.86$ ). The  $t(59)=2.84$  with a  $p\text{-value}=0.00<0.01$ , indicating a significant effect of project-based learning on creativity. Besides, the eta squared value is  $\eta^2=0.12$ , indicating a medium effect size. According to Cohen's guidelines (Chua, 2020): 0.01=small effect, 0.06=moderate effect, 0.14=large effect. As for this study, project-based learning has a medium effect on the creativity level of business English learners.

**Table 4**

*Results of the Effect of Project-based Learning on Creativity (N=60)*

Post-test		Pre-test		Paired sample t-test			
M	SD	M	SD	t	df	p-value	$\eta^2$
10.70	2.86	7.86	2.59	2.84	59	.00	0.12

Note: Sig.<.01\*\*\*

***RQ2: Does project-based flipped classrooms affect business English learners' critical thinking and creativity in higher vocational colleges?***

The effect of a project-based flipped classroom on the critical thinking skills of business English learners was evaluated through a paired-

sample t-test. Results in Table 5 indicated a significant increase in critical thinking scores from the pre-test (M=6.60, SD=2.65) to the post-test (M=14.91, SD=2.09). The  $t(59)=17.76$  with a  $p\text{-value}=0.00<0.01$ , indicating a significant effect of project-based flipped classrooms on critical thinking. Besides, the eta squared value is  $\eta^2=0.84$ , indicating a large effect size. According to the guidelines of Cohen (Chua, 2020): 0.01=small effect, 0.06=moderate effect, and 0.14=large effect. As for this study, a project-based flipped classroom has a large effect on the critical thinking of business English learners.

**Table 5**

*Results of the Effect of Project-based Flipped Classroom on Critical Thinking (N=60)*

Post-test		Pre-test		Paired sample t-test			
M	SD	M	SD	t	df	p-value	$\eta^2$
14.91	2.09	6.60	2.65	17.76	59	.00	.84

Note: Sig.<.01\*\*

The effect of a project-based flipped classroom on the creativity level of business English learners was evaluated through a paired-sample t-test. Results in Table 6 demonstrated a significant increase in creativity scores from the pre-test (M=7.06, SD=2.67) to the post-test (M=14.73, SD=2.83). The  $t(59)=7.67$  with a  $p\text{-value}=0.00<0.01$ , indicating a significant effect of project-based flipped classrooms on creativity. Besides, the eta squared value is  $\eta^2=0.50$ , representing a large effect size. According to the guidelines of Cohen (Chua, 2020): 0.01=small effect, 0.06=moderate effect, and 0.14=large effect. As for this study, a project-based flipped classroom has a large effect on the creativity level of business English learners.

**Table 6**

*Results of the Effect of Project-based Flipped Classroom on Creativity (N=60)*

Post-test		Pre-test		Paired sample t-test			
M	SD	M	SD	t	df	p-value	$\eta^2$
14.73	2.83	7.06	2.67	7.67	59	.00	.50

Note: Sig.<.01\*\*\*



***RQ3: Is there any difference between the effects of project-based learning and project-based flipped classrooms on business English learners' critical thinking and creativity in higher vocational colleges?***

The difference in critical thinking between groups can be observed in Table 7. There is no interaction effect between the independent variable (method) and the covariate (pre-testing scores), as indicated by a p-value of 0.361, which is greater than 0.01, meeting the assumption of homogeneity of regression slopes in ANCOVA.

According to the table, the method significantly affects critical thinking skills ( $F=201.56$ ,  $p=0.00<0.01$ , partial eta squared=0.50). According to Cohen's guidelines from 1988, this is considered to be a large effect size, with a partial eta squared=0.50. This value indicates that 50% of the variance in critical thinking scores can be attributed to the teaching method after controlling for the pre-scores' effects. In the meantime, the covariate of pre-score also has a significant effect on critical thinking with a large effect size ( $F=786.24$ ,  $p=0.00<0.01$ , partial eta squared=0.68).

With the assistance of a calculator (based on the M, SD, and N in each group), Cohen's d was calculated to indicate the difference magnitude between groups (Sullivan & Feinn, 2012). Cohen's  $d=1.41$ , indicating a large magnitude of group difference according to Cohen (Cohen, 2013).

To sum up, there is a significant difference between the effect of project-based learning and project-based flipped classrooms on business English learners' critical thinking in higher vocational colleges.

**Table 7**

*Test of Between-Subjects Effects on Critical Thinking*

Source	DF	Mean Square	F	Sig.	Partial Eta Squared
Corrected Model	3	1567.718	741.354	0.000	0.789
Intercept	1	569.975	289.701	0.000	0.635
Method	1	398.648	201.562	0.000	0.502
Pre-score	1	972.616	786.243	0.000	0.683
Method*Pre-score	1	1.987	0.701	0.271	0.001

Note: Cohen's  $d=1.41$

The difference in creativity between groups can be observed in Table 8. There is no interaction effect between the independent variable (method) and the covariate (pre-testing scores), as indicated by a p-value of 0.310, which is greater than 0.01, meeting the assumption of homogeneity of regression slopes in ANCOVA.

According to the table, the method has a significant effect on creativity ( $F=52.10$ ,  $p=0.00<0.01$ , partial eta squared=0.27). According to Cohen's guidelines from 1988, this is considered to be a large effect size, with a partial eta squared=0.27. This value indicates that 27% of the variance in the creativity scores can be attributed to the teaching method after controlling for the effects of the pre-scores. In the meantime, the covariate of pre-score also has a significant effect on creativity with a large effect size ( $F=0.875$ ,  $p=0.00<0.01$ , partial eta squared=0.154). With the assistance of a calculator (based on the M, SD, and N in each group), Cohen's d was calculated to indicate the difference magnitude between groups (Sullivan & Feinn, 2012). Cohen's  $d=1.12$ , indicating a large difference in magnitude according to Cohen (Cohen, 2013).

To sum up, there is a significant difference between the effect of project-based learning and project-based flipped classrooms on business English learners' creativity in higher vocational colleges.

**Table 8**

*Test of Between-Subjects Effects on Creativity*

Source	DF	Mean Square	F	Sig.	Partial Eta Squared
Corrected Model	3	987.138	104.568	0.000	0.586
Intercept	1	576.972	211.842	0.000	0.593
Method	1	453.164	52.101	0.000	0.265
Pre-score	1	421.375	0.875	0.000	0.154
Method*Pre-score	1	7.334	0.701	0.310	0.002

Note: Cohen's  $d=1.12$

***RQ4: Which teaching method improves students' critical thinking and creativity more effectively?***

According to RQ1 and RQ2, it can be inferred that the effect size of project-based learning on critical thinking is  $\eta^2=0.56$ , while the

effect size of project-based flipped classrooms on critical thinking is  $\eta^2=0.84$ . The higher the eta squared value is, the stronger the effect of the independent variable on the dependent variable will be (Sullivan & Feinn, 2012). Based on this perspective, the project-based flipped classroom is more effective than traditional project-based learning on participants' critical thinking skills. The practical significance of using Cohen's  $d$  is also discussed and considered to make it a more comprehensive conclusion.

Besides, based on the conclusion of RQ3, the group difference magnitude between project-based flipped classroom and project-based learning in terms of critical thinking is Cohen's  $d=1.41$ , indicating a large group difference. From this perspective, it can be easily concluded that a project-based flipped classroom is more effective in improving participants' critical thinking.

In the same way, from RQ1 and RQ2, the effect size of project-based learning on creativity is  $\eta^2=0.12$ , while the effect size of project-based flipped classrooms is  $\eta^2=0.50$ , indicating a more effective impact on creativity compared to the previous.

Besides, based on the conclusion of RQ3, the group difference magnitude between project-based flipped classroom and project-based learning in terms of creativity is Cohen's  $d=1.12$ , which indicates a large group difference. From this perspective, it can be easily concluded that a project-based flipped classroom is more effective in improving participants' creativity.

## **DISCUSSION**

This study indicated that project-based learning and project-based flipped classrooms can positively affect students' creativity and critical thinking. However, the project-based flipped classroom has a larger effect on creativity and critical thinking than traditional project-based learning. Therefore, the project-based flipped classroom is supposed to be more effective in improving business English learners' critical thinking and creativity levels.

### **The Effect of Project-based Learning on Critical Thinking and Creativity**

Project-based learning is shown to have a significant effect on critical thinking and creativity, which is in line with the corresponding results

of Amorati and Hajek (2021), Chang and Chen (2022), Sukamta et al. (2018), Wurdinger et al. (2020), and Wang (2022), supporting the positive and significant effects of project-based learning on soft skills. Nevertheless, these findings focused on either creativity or critical thinking. For those investigating two variables simultaneously, they concentrated on other research contexts instead of higher vocational colleges, and none of them explored the application of project-based learning in business English teaching.

However, the finding in this study is contradictory to the study by Siew and Ambo (2020), which showed the insignificant effect of project-based learning on creativity and critical thinking. For their insignificant effects, the potential reasons in that study are listed in the limitation section, indicating the insufficient teacher training, time limitations in class and more requirements for comprehensive knowledge coverage, interpreted as the shortcomings of project-based learning by Sezer and Esenay (2022).

In this study, the findings of the effects of project-based learning used paired sample t-tests to compare the pre-test and post-test scores. With the significant increase from pre-scores to post-scores of critical thinking and creativity, the effects of project-based learning on soft skills were concluded in this research context. There are some potential reasons for the significant effect.

Based on the theory of constructivism, project-based learning acquires knowledge through previous knowledge application, self-reflection, and evaluation (Powell & Kalina, 2009), which correspond to the theory of the upper four steps of Bloom's Taxonomy: application, analysis, and evaluation and creation. With the similar and common steps of these two theories, students' critical thinking and creativity can be theoretically improved to some extent. According to Wang (2022), students instructed through project-based learning are exposed to more chances to do self-reflection and evaluate a diverse range of perspectives from their peers, thus enhancing their capacity for critical thinking. In the meantime, Chang and Chen (2022) believed that under the framework of project-based learning, students could foster their creative abilities through the acquisition of novel knowledge and the subsequent application of that knowledge, informed by prior experiences and evaluations.

Besides the empirical and practical application of project-based learning, it provides participants with real-life problems and scenarios, motivating them to explore further and discuss with their collaborative peers. During collaborative work on various projects, students can find it easier to consider others' perspectives and self-reflect, allowing them to think independently (Wurdinger et al., 2020; Sukamta et al., 2018).

In addition, this research context is business English, an interdisciplinary course that allows students to do more original reading and knowledge preservation. This interdisciplinary teaching encourages students to make connections between different fields of knowledge, leading to more holistic and creative thinking.

Finally, the instruments for measuring creativity and critical thinking differ from other studies. This study's instruments for creativity and critical thinking ask the participants to provide subjective responses, which can more accurately measure learners' level of critical thinking and creativity. Previously, the instruments were mostly multiple-choice, which lacked subjective responses from learners and could not fully reflect learners' soft skill levels (Said et al., 2020).

### **The Effect of Project-based Flipped Classroom on Critical Thinking and Creativity**

Among the few cases of project-based flipped classrooms, the result of this study is in line with existing findings by Listiqowati et al. (2022), which support the significant effect of project-based flipped classrooms on critical thinking. Listiqowati et al. (2022) indicated that integrating project-based learning in flipped classrooms can efficiently improve learners' performance and critical thinking by giving learners more flexible time for discussion and guidance in class. This advantage of flipped classrooms can also be supported by Fan (2018) and Atwa et al. (2022). As a complement to project-based learning, the flipped classroom includes a pre-class stage, saving more time and providing enough knowledge coverage for participants to participate in class activities and collaborations, receiving more guidance from teachers (Fan, 2018).

Nevertheless, it is worth noting that Listiqowati et al. (2022) conducted their research on the implementation of project-based

flipped classrooms within the Geography Education Study Program, which differs from the context of the business English domain. Furthermore, it is important to acknowledge that, to the best of the researcher's knowledge, no existing studies on the impact of a project-based flipped classroom on creativity have been found. According to the integrated theories mentioned in the literature review section, the significant effects of project-based flipped classrooms on critical thinking and creativity in this research context can be understood and explained as following reasons.

In the pre-class preparation stage, students are required to review instructional materials, which can make them more familiar with the content and lead to greater knowledge retention and coverage (Atwa et al., 2022). This, in turn, fosters critical thinking skills by allowing students to spend more time analysing, evaluating, and applying the information (Huang et al., 2022; Sezer & Esenay, 2022).

When they enter the stage of in-class activities, students work on projects, engage in discussions, and participate in group activities that require them to think critically and apply their knowledge in real-world contexts (Hu et al., 2022). In this actual scenario application process, students combine their pre-stage knowledge with the simulated situation, applying their knowledge to this situation while also critically analysing and using their critical thinking to solve problems. After the project, students receive guidance, feedback, and evaluation from the instructor and peers throughout the project. Students use critical thinking to judge whether their suggestions are reasonable and suitable for their projects. They can even defend their ideas if they have sufficient reasons to support them. To this extent, this application and analysis process also encourages students to think critically as they evaluate and provide feedback on each other's work, enhancing their ability to analyse, evaluate, and synthesise information (Wang, 2022).

Then, in the after-class activities, students are encouraged to reflect on their learning process, evaluate their performance, and engage in metacognition (thinking about their thinking). This reflection and metacognition promote critical thinking skills as students analyse their learning strategies, evaluate their strengths and weaknesses, and identify areas for improvement (Listiqowati et al., 2022). This self-awareness and reflective practice contribute to developing higher-order thinking skills, such as critical analysis, evaluation, and reflection (Lamsyah et al., 2022).

## **Difference between Two Methods in Terms of Creativity and Critical Thinking**

There is a lack research comparing project-based learning with project-based flipped classrooms. This study aims to investigate the difference between these two teaching methods in terms of their impact on critical thinking and creativity. The result indicates that project-based learning and project-based flipped classrooms have significant differences in terms of their effect on critical thinking and creativity. This finding is consistent with the research conducted by Listiqowati et al. (2022) and Chua and Islam (2021). While these studies focused on different disciplines and groups.

Considering the more effective teaching method, effect size and difference magnitude are used to make the comparisons. The result of this study indicates that a project-based flipped classroom is shown to be a more effective method for improving critical thinking and creativity, in line with the results of Listiqowati et al. (2021) as well as Chua and Islam (2021). There are some potential reasons for the significant difference, specifically, the more efficient effects of project-based flipped classrooms on critical thinking and creativity.

Theoretically, the flipped classroom, supported by behaviourism (Elzeky et al., 2022), is combined with project-based learning, backed up by constructivism (Powell & Kalina, 2009), corresponding to the six steps of higher-order thinking (critical thinking and creativity), as referred to in Bloom's Taxonomy (Huang et al., 2023). Drawing upon the assimilation and application of knowledge in the pre-class phase of the flipped classroom, the subsequent stages of project-based learning during and after class can reinforce and elevate higher-order thinking skills, explicitly encompassing critical thinking and creativity.

Compared with traditional project-based learning, the hybrid mode provides students with a solid knowledge foundation, laying the solid basis for further collaborative work and discussion (Listiqowati et al., 2022; Chua & Islam, 2021). Additionally, a project-based flipped classroom gives students more flexibility for self-reflection before and during class. This self-reflection time can stimulate idea generation and allow students to connect concepts, make meaning, and generate new insights. Students can engage in more discussions during class and receive guidance promoting critical thinking and creativity (Atwa

et al., 2022). After accumulating diverse perspectives and knowledge, students are more likely to develop their creativity ability (Fan, 2018).

## CONCLUSION

This study examined how project-based learning and project-based flipped classrooms affect students' critical thinking and creativity. The results provide valuable insights into the effectiveness of these teaching methods. Project-based learning and project-based flipped classrooms positively impact critical thinking and creativity, with project-based flipped classrooms demonstrating a more significant effect than traditional project-based learning. This conclusion confirms previous findings regarding the effectiveness of project-based teaching and adds new insights into the benefits of flipped project-based teaching. The research also integrates teaching methods with thinking theories, contributing to innovation and expansion within related educational theories.

Theoretical contributions of this study include the integration of curriculum development with higher-order thinking and the combination of Bloom's Taxonomy with constructivism. From a practical standpoint, this research contributes to the training of talents required for social and economic development. It also provides educators and lecturers with guidance for implementing teaching reforms. It is recommended that educators consider reforming teaching methods to adapt to the rapidly evolving society and foster individuals with critical thinking and creativity in the Chinese context.

However, a limitation of this research lies in the generalizability of its results. All respondents in the study are from one higher vocational college in Shanxi, China, which limits the sample's diversity. Therefore, not generalising these results to other populations is strongly recommended. Future studies should expand their sample frames and increase sample diversity for broader generalisation. Additionally, qualitative methods, such as interviews with learners to gather their perspectives on teaching methods, could provide a more comprehensive understanding of the study. Finally, exploring effective and comprehensive implementations of project-based flipped classrooms in the future is an area ripe for further research.



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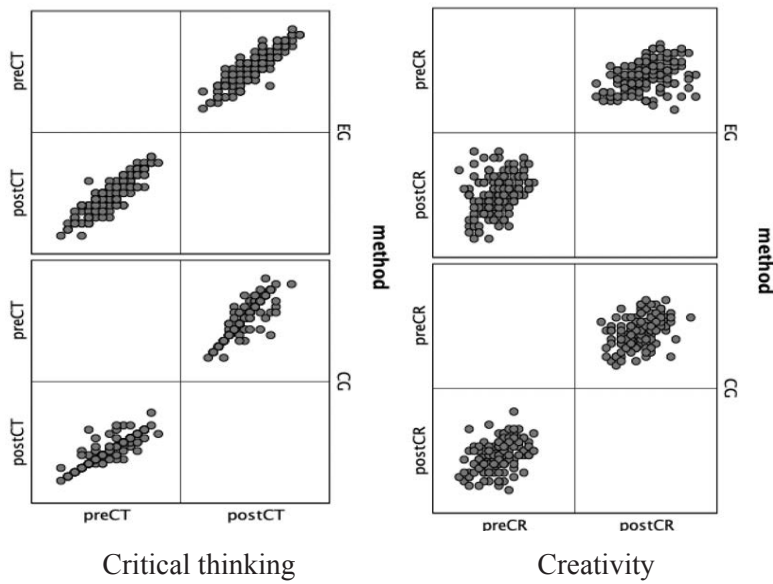
## Appendix 1: Project-based Flipped Classroom Lesson Plan

Week	Topic	Project	Teaching Objective	Assignment
1-2	1	Set Up Your Business	Students can understand the structure of a company/ organisation/ institution;	Students are asked to watch online lecture videos and look for information on company structure and departments.
			Students can improve their language proficiency and efficiently introduce the institution and exchange their company information in English;	Students working in groups are encouraged and required to establish their own company, with every student playing a certain role in the company (individual preparation).
			Students can present their duties according to the structure of the company.	Students should present their proposed company according to the advice from others.
3-4	2	Work in Your Office	Students can get to know the appropriate behaviours in the office or workplace, as well as how to create the agenda or make their working timetable;	Students need to watch lecture videos and find more information about the topic.
			Students can make timetables and arrange their agenda in English;	Students in groups played roles in the office and let others comment on their behaviour within groups
			Students can work collaboratively and comment on other works' strengths and weaknesses;	Students present to others, and the adjustments according to the comments of teachers and other groups.
5-6	3	How to Arrange Business Activities & Meals;	Students get to know different types of business activities and how to organise business activities;	Students are assigned to watch lecture videos and search for more information about different types of business activities.
			Students can find the etiquette of business meals and the difference between Western and Chinese business meal habits.	Students in groups are assigned to write invitation letters to others to attend their organised business activities;
			Students can draft the business activities and write invitation letters in English. Students can work collaboratively and efficiently communicate in these business situations;	Students working in groups are proposed to present their arrangement for business meals and receive feedback from others.

(continued)

<b>Week</b>	<b>Topic</b>	<b>Project</b>	<b>Teaching Objective</b>	<b>Assignment</b>
7-8	4	How to Introduce Your Products	Students can accumulate basic knowledge about the topic	Students watch lecture videos and search for related information.
			Students can introduce their company's products, making them outstanding;	Students in groups are assigned to do individual work.
			Students can present based on comments and develop their critical thinking and creativity ability;	Students are required to present their company's products and make refurbishments according to other groups' suggestions.
9-10	5	How to Promote Your Products	Students can figure out sales promotion strategies and play roles in promoting their company's products;	Students are required to watch lecture videos and accumulate knowledge about their promotion strategies.
			Students can promote their products in English in written form and orally. They can also be able to read and understand other companies' promotions in English;	Students in groups are assigned to do individual work.
			Students can present and develop their thinking skills like creativity and critical thinking;	Students in groups present their products with various strategies and adjustments according to the comments from others.
11-12	6	How Do We Transport Our Goods	Students accumulate basic knowledge for further study.	Students are required to watch lecture videos and expand their knowledge.
			Students can choose the best transportation method according to the simulated products in the company;	Students in groups compare the advantages and disadvantages of different modes of transportation and share with other students;
			Students present and think critically and logically;	Students in groups can present their reasons for choosing the transportation modes of their products and their English waybill. Other students give comments and suggestions;

Appendix 2: Scatter Plot for Linearity



Note:  
preCT: pre-test score of critical thinking  
postCT: post-test score of critical thinking  
preCR: pre-test score of creativity  
postCR: post-test score of creativity  
EG: experimental group (flipped classroom project-based learning)  
CG: control group (project-based learning)