Volume 17 Number 2 (2025)
July-December 2025
Page: 871-886

E-ISSN: 2656-9779
P-ISSN: 1907-6355
DOI: 10.37680/qalamuna.v17i2.5708

QALAMUNA
JURNAL PENDIDIKAN, SOSIAL, DAN AGAMA

Development of a Team-Project-Based Flip Classroom Learning Model to Enhance Creativity in Teacher Training High School Students

Sumarni Sri [1], Nurhayati Riska [2], Saputro Ida Nugroho [3]

[1] Universitas Sebelas Maret, Indonesia; srisumarni@staff.uns.ac.id
[2] Universitas Sebelas Maret, Indonesia; riskanurhayati431@gmail.com
[3] Universitas Sebelas Maret, Indonesia; idanugroho@ staff.uns.ac.id

Received: 20/07/2024 Revised: 16/07/2025 Accepted: 18/08/2025

Abstract

This study aims to analyze the needs of students' creativity skills in learning, develop a Team Project-Based Flip Classroom Learning Model, and determine the learning model's effectiveness. The research was conducted at one of the vocational schools in Sukoharjo Regency. This research was conducted as research and development using mixed methods in data collection. The instrument's validity for measuring the learning model was evaluated using the Aiken V coefficient, and the model's effectiveness was determined using the N-gain score. The results showed that the team project-based flip classroom learning model is reliable and efficient. This model has three main steps: independent learning, face-to-face learning, and guided learning for self-reflection. These findings imply that teachers, particularly at the vocational education level, can utilize the team-project-based flipped classroom learning model as an alternative learning strategy that emphasizes material mastery and optimizes student creativity development. This model is also relevant for applications in subjects requiring technical skills and creative problem-solving.

Keywords Creativity; Flip Classroom; Project-Based; Vocational High School

Corresponding Author
Sumarni Sri
Universitas Sebelas Maret, Indonesia; srisumarni@staff.uns.ac.id

1. INTRODUCTION

The 21st century is marked by major transformations in various sectors of life due to technological advances, globalization, and the increasingly complex dynamics of the workplace. In this context, creativity is one of the essential competencies students need to develop, including in vocational education settings. (Safitri & Sutadji, 2025)(Mutohhari et al., 2021); (Thornhill-Miller et al., 2023). World Economic Forum (2020) places creativity as one of the ten key skills most needed by the current and future workforce. Creativity is no longer just the domain of art or innovation, but has become a vital life skill for problem-solving (Hadayani et al., 2020); (Adeoye & Jimoh, 2023), create added value (Gede Agung, 2016); (Ciarli et al., 2021), and adapt to change (Taufik et al., 2024); (Vasylkevych et al., 2020); (Darvishmotevali et al., 2020). Vocational education in particular has a strategic role in preparing an adaptive, innovative, and competitive workforce. Many studies have focused on increasing creativity (McGrath & Yamada, 2023; Kirschner & Stoyanov, 2020.

A learning approach that supports creativity is essential to produce graduates capable of innovation amidst the demands of the Industrial Revolution 4.0 and Society 5.0. Therefore, exploring

and developing learning models systematically designed to foster creativity in vocational education environments is necessary. Therefore, the learning model implemented must stimulate students' creativity and facilitate them in exploring ideas, creating original products, and solving real-world problems. Project-based learning has proven effective in fostering creativity in vocational high school students in engineering (Syahril et al., 2022); (Hao et al., 2024): (S. T. Ahmad et al., 2023). Problem-based learning directs students to solve complex, open-ended problems so that students are trained to think and find creative solutions based on learning experiences (Rizaldi & Putri, 2021): (Jabarullah & Iqbal Hussain, 2019); (Anggraeni et al., 2023); (Hidayati & Wagiran, 2020); (Simanjuntak et al., 2021). The STEAM model combines multiple disciplines to complete creative tasks that are often open-ended to spark students' creativity (D. N. Ahmad et al., 2021); (Conradty, 2020). Of the several learning models, there are several weaknesses, including student and teacher readiness, facilities, long-term requirements, and student character, limitations in students' critical thinking (Megayanti et al., 2020).

Barus (2019) Seven learning models had been studied for their influence on students' creative abilities. The seven models include Discovery Learning, Inquiry Learning, Problem-Based Learning, Project-Based Learning, Production-Based Training, Teaching Factory, and the Blended Learning Model. These seven models have different learning strategies. To improve learning efficiency, new learning models need to be developed. Many learning models, such as Flip Classroom, Project-Based Learning, and Team-Based Learning, can enhance student creativity.

Flip Classroom was first introduced by Jonathan Bergmann and Aaron Sams in 2006 and commissioned in 2012. According to Bergmann & Sams (2014) Flip Classroom is a form of inverted classroom learning. Students are provided with content that they can learn independently before the lesson, and then continue the discussion during the educational session (Usmadi & Ergusni, 2019) . According to Jonathan Bergmann and Aaron Sams, students prefer learning to be carried out when students feel the need to be explained.

Meanwhile, according, the Flip Classroom learning method is a learning method that uses two types of approaches (blended learning): traditional learning and content learning outside the classroom. Online learning is usually done by providing learning videos, online discussions, or modules before the learning begins. After providing material in the form of videos, modules, or other media, face-to-face learning is carried out to discuss and discuss the material given together. In addition to group discussions, assignments, and exams are given to test students' understanding of the material that has been covered. Learning with the Flip Classroom approach does not change the pedagogical concept. This approach changes the role of students from being passive listeners to students who are active participants.

The second learning method is the Project-Based Learning model. According to Krajcik & Blumenfeld (2006) The Project-Based Learning model allows students to implement learning by doing. In other words, students learn while doing and applying their developed ideas. The Project-Based Learning model requires students to be active in learning. According to Saputro & Rayahub (2020) The Project-Based Learning model is a learning model that uses project assignments as a learning medium. The Project-Based Learning model requires students to be able to learn creatively and produce work. In the Project-Based Learning model, learning is based on the concept of constructivism, where students gain a deeper understanding of the material when they actively develop ideas and apply them (Krajcik & Blumenfeld, 2006). Hybrid activities that combine flipped classrooms, project-based learning, and puzzle techniques can develop innovative and creative strategies for solving complex problems (Sanchez-Muñoz et al., 2020). The advantages of project-based learning bridge the gap between academic preparation and the demands of the world of work (Naseer et al., 2025).

The third learning model is the Team-Based Learning model. Team-Based Learning (TBL) is a teacher-directed learning method that forms several small groups within a class. TBL is a learning approach to provides learning opportunities by providing tutorials through small groups (Smeby et al.,

2020). According to Gullo et al., (2015) . TBL has been widely applied in the curriculum with a pedagogical approach.

However, few studies develop models from these models by combining the three models. Therefore, in this study, a Team project-based flip class learning model will be developed, a combination of learning models that involve students in groups to create projects or work on learning, carried out inside and outside the classroom (blended flip). This model was developed with the constructivism theory. Constructivism is based on the idea that people build their version of reality by using past experiences and knowledge, as well as their current experiences. Thus, learners are creative and actively involved in their learning, and there is a dynamic relationship rather than a passive one between teachers and learners. The three main principles of Vygotsky's thinking related to social constructivism are (1) social interaction. The development of higher mental functions initially occurs in communication and cooperation between individuals (inner psychology) before occurring within the individual (intra psychology) (2)—zone of proximal development (ZPD). ZPD describes the zone between the ability to solve problems independently and the ability to solve problems through direction or collaboration with other, more experienced people (teachers or peers) (3) Scaffolding. The implications of this research are expected to be one of the learning strategies for increasing student creativity by creating creative products. The purpose of this research is to determine the development of a flip classroom learning model based on team projects and to determine the effectiveness of this learning model. This paper aims to analyze the characteristics of learning models that support the development of creativity and are relevant to the vocational context.

2. METHODS

Type of research

This type of research is Research and Development (R&D) to test the effectiveness of the resulting research product (Roper et al., 2016). The research approach uses mixed methods for data collection (Gall et al., 2003). Qualitative data is used for needs analysis, and quantitative data is used to measure the validity of the model design.

Development Model (ADDIE)

The development model used is the ADDIE model, which has five stages: Analysis, Design, Development, Implementation, and Evaluation (Sweller, 2021). The ADDIE model research procedure is discussed in Figure 1 below.

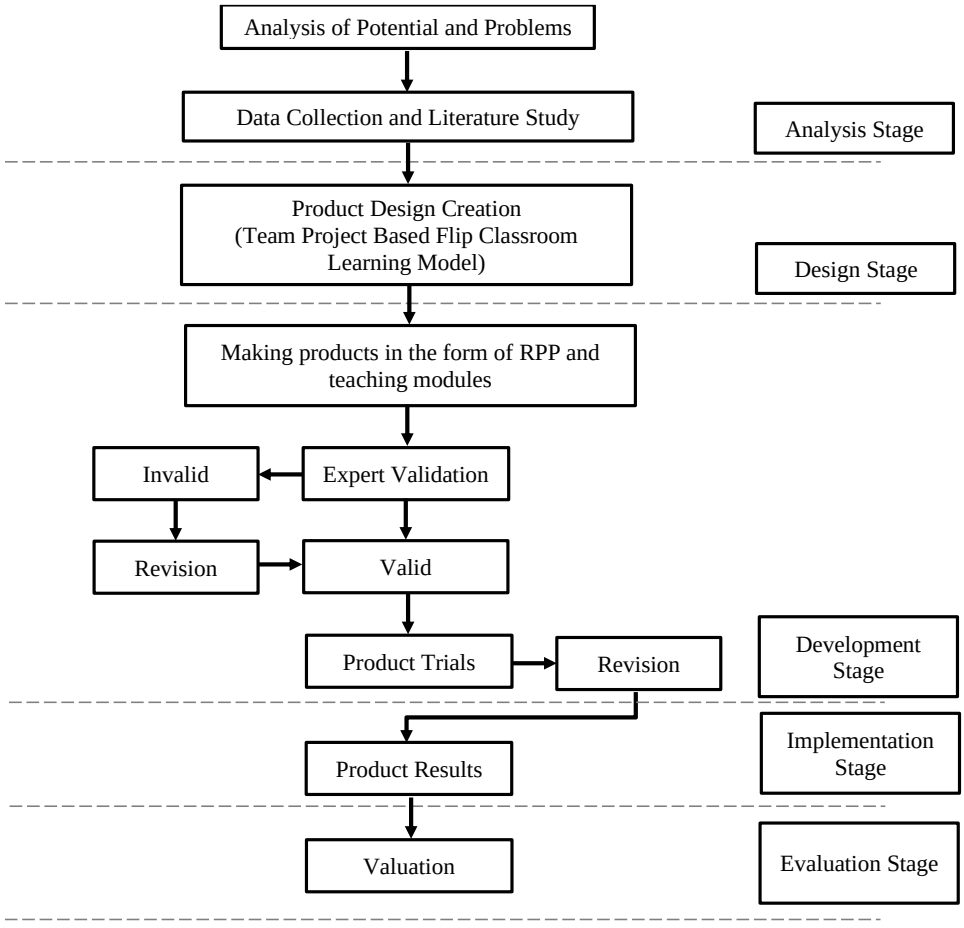

Figure 1. ADDIE model research procedure

Research Design

This research design used a One Group Pre-test pretest-posttest design, conducted on one group without a comparison group (control class). This design used a pre-test before treatment and a post-test after treatment to determine differences before and after treatment.

Sample and Research Object

This research was conducted at a vocational high school (SMK) in Sukoharjo Regency, specifically in the Building Modeling and Information Design (DPIB) expertise program, with the subject studied being Road and Bridge Construction (KJJ). Using a purposive sampling technique, the sample consisted of 35 students majoring in Building Modeling and Information Design (DPIB).

Instruments and Validity

The analysis stage involves identifying problems and determining appropriate solutions in the road and bridge construction class (Pribadi, 2018) . The analysis stage provides researchers with an overview and insight into the causes of learning problems. Data sources were obtained from interviews with grade XII DPIB students, subject teachers, and supporting documents. The data collection technique used was interviews Pujaastawa (2016) . The analysis used content analysis (Ferdiansyah et al., 2020) . Data validation used the member checking technique.

This stage aims to develop the design into a product. The development stage involves creating a learning model and its stages. The learning model refers to the Lesson Implementation Plan (RPP) and learning methods, and is validated for feasibility by experts. After the learning model is validated, the

next step is implementation. The model is applied to grade XII DPIB students. The learning model is reviewed, observed, and modified during implementation to increase effectiveness.

Experts provided the data used in the development and implementation stages during validation. This data consisted of suggestions for improving the quality of the learning model. The experts appointed for this study included lecturers with expertise in the field of education.

The data collection instrument was an expert assessment questionnaire containing aspects of the model. The questionnaire was developed following guidelines. The questionnaire was assessed using a Likert scale (Vagias, 2006) . The grid is as shown in Table 1.

Table 1. Expert Assessment Grid

No.	Assessment Criteria
1	Complete RPP components (containing: identity, learning objectives, indicators, materials, methods, learning activities, learning resources, and assessments)
2	Conformity between Basic Competencies (KD) and Core Competencies (KI)
3	Conformity between competency achievement indicators and learning objectives
4	Compatibility of learning activities with the stages of the team project-based flip classroom learning model
5	Learning activities support the improvement of students' creativity abilities
6	The learning steps are spelled out
7	Suitability of evaluation techniques to learning objectives
8	Evaluation techniques support the improvement of creativity ability
9	Conformity of the estimated time allocation with the activities carried out
10	References used according to the material taught
11	References used to support the enhancement of creativity
12	Completeness of the content of the guidelines (background, concept, preparation steps, learning model steps)
13	Completeness of the content of the team project-based flip classroom learning model
14	Readability
15	Good and correct use of Indonesian
16	Ease of Use
17	Compatibility of media materials with learning materials
18	Material update
19	The collapse of the delivery of the material
20	Ease of Use
21	Visually acceptable readability/usability
22	Suitability of media to learning objectives to improve creativity
23	Conformity of evaluation instruments to indicators
24	Compatibility of evaluation instruments with the team project-based flip classroom model
25	Completeness of instrument types (instruments for evaluating the project work process and instruments for project results)
26	Completeness of the contents of each instrument

The data collection method in the development and implementation stages used a questionnaire. Experts were consulted for advice and initial validation in developing the learning model before implementation.

Data analysis used descriptive analysis, and validation in the evaluation stage used content validity to calculate the content validity coefficient based on expert assessments (Aiken, 1985). This validation determined the extent of the influence of the team project-based flip-classroom learning model on student creativity, thereby determining the effectiveness of the implemented learning model. The formula used in equation 1 is as follows.

$$V = \sum \frac{s}{n(C-1)} \quad (1)$$

With:

s = r – lo

lo = lowest rating figures

c = highest rating figures

r = figures given by the appraiser

Data Analysis Techniques

The evaluation phase aims to assess the feasibility of the learning model, determine the level of student effectiveness with the resulting product, and identify changes and modifications for further development.

Data in the evaluation phase includes primary data in the form of creativity questionnaires adapted from several previous studies (Fields & Bisschoff, 2017) . The data source was students who received the learning model or research participants. A questionnaire was used as the data collection technique. Data analysis used paired-sample t-tests, with significant differences in the results of the paired t-test, was performed using SPSS paired-sample t-test. Data were considered different if the average pre-test score was < the average post-test score and the significance value of the paired-sample correlation was <0.05. This data analysis was used to determine the effectiveness of the team project-based flip class model in terms of the N-gain value. The N-gain value was considered high if N-gain > 0.7; moderate if 0.3 < N-gain < 0.7; and low if N-gain < 0.7 (Hake, 1998). The formula for calculating the N-gain score is as follows in equation 2.

$$N \text{ Gain} = \frac{\text{post-test score} - \text{pre-test score}}{\text{ideal score} - \text{pre-test score}} \quad (2)$$

3. FINDINGS AND DISCUSSIONS

Findings

Needs Analysis

The team-based flip classroom learning model requires good group work, creativity in working on projects, and technological skills for learning effectiveness. So, in analyzing this need, the dominant learning model in the classroom is lectures and making work drawings. Motivation students want to have the ability to design architectural drawings. The dominant student skills are sketching and mockups; the obstacles experienced are low motivation, teacher ability, time management, and ineffective groups. The resource persons expect to pay more attention to the teacher, attention and advice from the teacher, and more practical learning than assignments and detailed explanations from the teacher.

Planning Stage

The planning stage of the learning model begins with the determination of concepts, the preparation of syntax, and the initial design.

Preparing a team project-based flip classroom learning model is based on the study of Team-Based Learning, Project-Based Learning, and Flip Learning theories. The concept design of the team project-based flip classroom learning model is shown as shown in Figure 2.

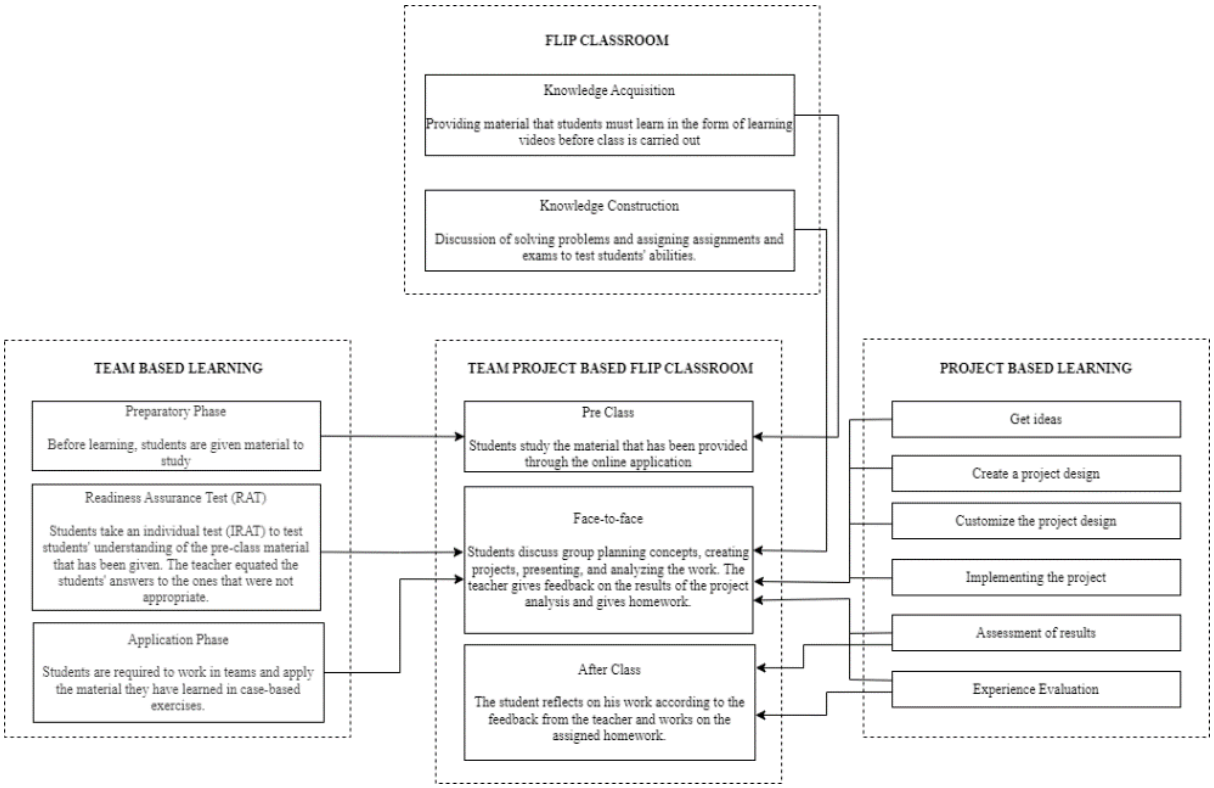

Figure 2. The theoretical framework of the team-based flip classroom research model

Before designing a learning model, it begins with preparing a syntax used as a reference in determining learning activities. Syntax preparation based on the results of the conceptual theory. The learning syntax consists of three stages, namely the preparation stage, the face-to-face stage, and the after-class stage. The syntax has been compiled as follows.

A preparatory stage that includes self-study to build knowledge (exposure). Learners listen to learning videos and read learning modules related to the material (facilitation stage).

Face-to-face stage, to increase student experience (experience), the activities include: 1) The teacher reviews the material from the learning video. 2) Teachers provide individual tests to determine students' learning readiness. The Individual Readiness Assurance Test (IRAT) is conducted by providing quizzes that all students take. 3) The teacher checks the results of the tests that have been done. If the score obtained is still lacking, the teacher briefly explains the answer to the question and the material to be studied. 4) The teacher assigns a pre-planned task or project. 5) Students are directed to form a team to design and perform project tasks in a team, and discuss project concept plans. 6) The team prepares the tools and materials needed for creating the project. 7) Students review work/projects that have been planned in teams, and students carry out project creation. The teacher is a facilitator in project work. 8) The team communicates the project results with presentations and Q&A discussions with the rest of the team. 9) The teacher conducts observation and analysis of the results of the project. 10) The teacher gives feedback on the tasks of the already analyzed project.

The stage after class is to reflect on the results of the project assignment. In this stage, students reflect and refine project tasks that the teacher has given feedback on. In addition, students work on homework that has been given.

Initial Design

The initial design results are a Learning Implementation Plan (RPP), which contains identity, core, and basic competencies, learning objectives, achievement indicators, media used, learning models and methods, and learning activities, and is equipped with evaluation instruments.

Development and Implementation Stage

After the product is designed, the next stage is to carry out development with a validity assessment. The validation method used is content validation using Aiken V. Validation is carried out by five experts in educational research, linguists, and substance experts. The data obtained are quantitative as primary data and qualitative input suggestions for improvement.

Four model assessment indicators include learning implementation plans, learning models, learning media, and learning evaluation instruments. The four indicators are described in 26 model scoring items. The value of V obtained from the table is 0.80. The item is declared valid if the calculated V value exceeds table V. Table 2 shows the validation results of the team project-based flip classroom learning model.

Table 2. Team Project-Based Flip Classroom Model Validation Results

No	Assessment Criteria	Aiken V value	Statement
1	Complete RPP components (containing: identity, learning objectives, indicators, materials, methods, learning activities, learning resources, and assessments)	0.950	Valid
2	Conformity between Basic Competencies (KD) and Core Competencies (KI)	0.950	Valid
3	Conformity between competency achievement indicators and learning objectives	0.950	Valid
4	Compatibility of learning activities with the stages of the team project-based flip classroom learning model	0.900	Valid
5	Learning activities support the improvement of students' creativity abilities	0.900	Valid
6	The learning steps are spelled out	0.900	Valid
7	Suitability of evaluation techniques to learning objectives	0.800	Valid
8	Evaluation techniques support the improvement of creativity ability	0.800	Valid
9	Conformity of the estimated time allocation with the activities carried out	0.800	Valid
10	References used according to the material taught	0.950	Valid
11	References used to support the enhancement of creativity	0.850	Valid
12	Completeness of the content of the guidelines (background, concept, preparation steps, learning model steps)	0.950	Valid
13	Completeness of the content of the team project-based flip classroom learning model	1.000	Valid
14	Readability	0.850	Valid

No	Assessment Criteria	Aiken V value	Statement
15	Good and correct use of Indonesian	0.900	Valid
16	Ease of Use	0.850	Valid
17	Compatibility of media materials with learning materials	1.000	Valid
18	Material update	0.900	Valid
19	The collapse of the delivery of the material	0.950	Valid
20	Ease of Use	0.850	Valid
21	Visually acceptable readability/usability	0.850	Valid
22	Suitability of media to learning objectives to improve creativity	0.850	Valid
23	Conformity of evaluation instruments to indicators	0.900	Valid
24	Compatibility of evaluation instruments with the team project-based flip classroom model	0.850	Valid
25	Completeness of instrument types (instruments for evaluating the project work process and instruments for project results)	0.850	Valid
26	Completeness of the contents of each instrument	0.850	Valid

The value of V obtained from the table is 0.80. The calculated V value is greater than the table V value, representing 26 valid items. The expert team's assessment states that the team's project-based flip classroom learning model is declared feasible to develop.

Evaluation Stage

Student learning was evaluated while implementing the classroom project-based flip class team project learning model. During three meetings, the topic of making road and bridge models was discussed, and student reflection was evaluated at each meeting. Fakhrurrazi (2018) and Triana (2022) Explain that effectiveness is a change that brings certain influence, meaning, and benefits from the results of implementing an activity and testing the effectiveness of the flip classroom team project learning model, as seen from the results of student self-evaluation assessments of creative thinking abilities before and after learning using the learning model. The reflection results used a self-evaluation questionnaire to measure students' creative abilities that had been developed and tested for normality using the Kolmogorov-Smirnov normality test. The normality test used the SPSS Statistics 22 application, with results as in Table 3.

Table 3. Normality Test Statistics

	Class	Kolmogorov-Smirnov[a]		
		Statistic	df	Sig.
Model implementation results	Pretest_creativity	.094	35	.200*
	Postest_ creativity	.133	35	.121

Based on the normality test results, a significance value of 0.200 was obtained for the pre-test and 0.121 for the post-test. Both significance values were in the range of ≥ 0.05, indicating a normal distribution of the data. After determining normality, a paired sample t-test was conducted to determine the difference in the means of two paired or related samples. To determine the effectiveness of the flip class team project-based model, the paired t-test formula was used, with results shown in Tables 4 and 5.

Table 4. Paired Sample Statistics

		Mean	N	Std. Deviation	Std. Error Mean
Pair 1	Pre-test	104.11	35	7.107	1.201
	Post-test	121.06	35	5.179	.875

Table 5. Correlation of Paired Samples

		N	Correlation	Sig.
Pair 1	Pre-test & Post-test	35	.602	.000

Calculations using SPSS Statistics 22 yielded a significance value of 0.000. Based on the decision-making process, the significance value was <0.05, indicating a difference in the average pretest and posttest scores. This difference in average scores indicates that the developed learning model significantly increased students' creativity.

After implementing the innovative team-based project-based flip classroom model, the effectiveness of the team-based project-based flip classroom model on improving student creativity was calculated using the N-Gain formula. The N-Gain formula calculates effectiveness based on the results of the pre-test and post-test administered before and after the treatment. The results of the respondents' average N-Gain scores are presented in Tables 6 and 7.

Table 6. N-Gain Score

No	Pre-Test	Pos-Test	N Gain Percent	No	Pre-Test	Pos-Test	N Gain Percent
1	98	121	44.23	19	96	113	31.48
2	109	122	31.71	20	105	121	35.56
3	92	121	50.00	21	102	119	35.42
4	91	112	35.59	22	111	125	35.90
5	112	126	36.84	23	111	125	35.90
6	99	117	35.29	24	111	125	35.90
7	107	120	30.23	25	113	124	29.73
8	101	119	36.73	26	108	121	30.95
9	109	121	29.27	27	94	129	62.50
10	109	120	26.83	28	113	128	40.54
11	91	115	40.68	29	104	118	30.43
12	108	120	28.57	30	116	127	32.35
13	98	113	28.85	31	105	128	51.11
14	105	120	33.33	32	101	116	30.61
15	103	121	38.30	33	94	112	32.14
16	106	133	61.36	34	96	122	48.15
17	104	116	26.09	35	106	118	27.27
18	116	129	38.24				

Table 7. Descriptive Statistics of N-Gain Values

	N	Minimum	Maximum	Mean	Standard Deviation
N-Gain_score	35	.26	.63	.365	.088
N-Gain_ percentage	35	26.09	62.50	36.51	8.86
Valid N (*listwise*)	35				

Discussion

The study results indicate that implementing the team project-based flip class learning model can significantly improve students' creativity. This is evident from the paired sample t-test results, which indicate a significant difference between the pretest and posttest scores. The N-Gain value of 36.5 places the model's effectiveness in the moderate category, which means this learning successfully facilitates increased creativity. However, there is still room for further development. Developing a team project-based flip class learning model can improve students' creativity, aligning with previous research that group learning fosters creativity (Boon et al., 2016). Through the creation of road and bridge model-making projects, students are allowed to innovate to foster student creativity. Through flip class, students build knowledge through learning videos as material for constructing knowledge when preparing projects. This also encourages students' creativity.

The team-based flip classroom learning model begins with independent learning through modules and video tutorials. This independent learning aims to build student knowledge. Independent learning packaged through the flipped classroom learning model requires students to be prepared for real-life learning in the classroom. From this independent learning, according to constructivism theory, through the social domain, a student observes their environment, listens to people in their environment, and then begins to imitate people, teachers, or anyone else in their environment who is more expert in directing, making corrections, and providing challenges in learning. Next, the intellectual development process enters the internal realm. When a learner becomes more competent, new knowledge has been internalized (Pritchard & Woollard, 2010). The flipped classroom approach does not change the pedagogical concept but only shifts the student's role from passive listeners to active participants, which is called social interaction (Vygotsky, 1978). The learning strategy in the flipped classroom model uses a blended learning approach by reversing the traditional learning environment and providing learning content outside the classroom by utilizing technological advances.

The second stage in the team project-based flip class model is a class meeting, commonly called a face-to-face meeting. In this face-to-face activity, the learning plan that has been created is implemented. Face-to-face activities are carried out three times. These meetings include discussions on concept creation and mock-up design, mock-up creation, and presentation of the final results. According to constructivism theory, this stage is called the Zone of Proximal Development (ZPD). The ZPD describes the zone between the ability to solve problems independently and the ability to solve problems through guidance or collaboration with others who are more experienced (teachers or peers). The third stage is the self-reflection stage. Students reflect on project assignments that the teacher has given feedback on. Feedback from the teacher is a scaffolding in the constructivism theory stage. The three stages of Team Project-Based Flip Classroom learning are similar to the research-based blended flip learning model: independent learning, class meeting learning, and guided learning, one of the practical learning methods.

Thus, according to constructivist theory, particularly Piaget's and Vygotsky's perspectives, increased creativity occurs because students are not merely recipients of information but actively construct their understanding through independent exploration and interaction with teachers and peers. Team-based project-based flip-class learning allows students to access materials before face-to-face meetings, allowing class time to be used for discussion, problem-solving, and creative projects. This

process aligns with the constructivist principle that knowledge is built through active engagement, hands-on experience, and critical reflection, which can stimulate new ideas and innovative solutions.

These results align with findings (Zhou, 2023) , which reported that the flipped classroom model can improve vocational high school students' creative thinking skills by increasing collaborative learning activities. The use of face-to-face time for interactive discussions in flipped learning contributes significantly to the development of creativity and 21st-century skills (Fung et al., 2022). Similarly, the flipped learning model enhances students' ability to generate original ideas due to learning flexibility and active classroom engagement kelas (Herreid et al., 2021).

However, this study has several limitations. First, the moderate effectiveness rate indicates that other factors influence student creativity, such as learning motivation, prior knowledge, or a supportive learning environment. Second, this study was conducted over a limited period and within a specific subject context, so generalizing the findings to other subjects or levels of education requires caution. Third, the instrument used to measure creativity focused on cognitive aspects, so creativity's affective and psychomotor dimensions were not fully explored. Therefore, further research is recommended to expand the variables measured, involve more diverse samples, and use a mixed methods approach to obtain more comprehensive results.

4. CONCLUSION

This study demonstrates that implementing the team-project-based flipped classroom learning model significantly improves student creativity. This is demonstrated by an average N-Gain score of 36.5%, which falls into the moderate improvement category, and paired t-test results showing significance at $p < 0.05$. This improvement indicates that integrating the flipped learning approach with project-based collaboration provides more space for students to explore ideas, develop creative solutions, and develop higher-order thinking skills.

These findings imply that teachers, particularly at the vocational education level, can utilize the team-project-based flipped classroom learning model as an alternative learning strategy that emphasizes material mastery and optimizes student creativity development. This model is also relevant for applications in subjects requiring technical skills and creative problem-solving.

Suggestions for future research include replicating this model with a more diverse population, across subjects, and educational levels to test its consistent effectiveness. Further research could also integrate more comprehensive creativity assessment instruments, examine student engagement during the learning process, and develop more interactive technological support to adapt this model to online and hybrid learning.

ACKNOWLEDGMENTS

The author would like to thank Sebelas Maret University for providing financial support through a research group grant under contract number 371/UN27.22/PT.01.03/2025.

REFERENCES

Adeoye, M. A., & Jimoh, H. A. (2023). Problem-Solving Skills Among 21st-Century Learners Toward Creativity and Innovation Ideas. *Thinking Skills and Creativity Journal*, *6*(1), 52–58. https://doi.org/10.23887/tscj.v6i1.62708

Ahmad, D. N., Astriani, M. M., Alfahnum, M., & Setyowati, L. (2021). Increasing the creative thinking of students through a learning organization with STEM education. *Jurnal Pendidikan IPA Indonesia*, *10*(1), 103–110. https://doi.org/10.15294/jpii.v10i1.27146

Ahmad, S. T., Watrianthos, R., Samala, A. D., Muskhir, M., & Dogara, G. (2023). Project-based Learning in Vocational Education: A Bibliometric Approach. *International Journal of Modern Education and Computer Science*, *15*(4), 43–56. https://doi.org/10.5815/ijmecs.2023.04.04

Anggraeni, D. M., Prahani, B. K., Suprapto, N., Shofiyah, N., & Jatmiko, B. (2023). Systematic review of problem-based learning research in fostering critical thinking skills. *Thinking Skills and Creativity*, *49*(February), 101334. https://doi.org/10.1016/j.tsc.2023.101334

Barus, D. R. (2019). Model–Model Pembelajaran yang Disarankan untuk Tingkat SMK dalam Menghadapi Abad 21. *Universitas Negeri Medan*, 1–13.

Beer, P., & Mulder, R. H. (2020). The effects of technological developments on work and their implications for continuous vocational education and training: A systematic review. *Frontiers in Psychology*, *11*(May). https://doi.org/10.3389/fpsyg.2020.00918

Bergmann, J., & Sams, A. (2014). Book Review: Flip your classroom: Reach every student in every class daily. In *Christian Education Journal: Research on Educational Ministry* (Vol. 11, Issue 1). https://doi.org/10.1177/073989131401100120

Boon, A., Vangrieken, K., & Dochy, F. (2016). Team creativity versus team learning: Transcending conceptual boundaries to inspire future framework building. *Human Resource Development International*, *19*(1), 67–90. https://doi.org/10.1080/13678868.2015.1096635

Ciarli, T., Kenney, M., Massini, S., & Piscitello, L. (2021). Digital technologies, innovation, and skills: Emerging trajectories and challenges. *Research Policy*, *50*(7), 104289. https://doi.org/10.1016/j.respol.2021.104289

Conradty, C. (2020). STEAM Teaching Professional Development Works: *Conradty and Bogner Smart Learning Environments Https://Doi.Org/10.1186/S40561-020-00132-9*, *9*.

Darvishmotevali, M., Altinay, L., & Köseoglu, M. A. (2020). The link between environmental uncertainty, organizational agility, and organizational creativity in the hotel industry. *International Journal of Hospitality Management*, *87*(January), 102499. https://doi.org/10.1016/j.ijhm.2020.102499

Fakhrurrazi, F. (2018). Hakikat Pembelajaran Yang Efektif. *At-Tafkir*, *11*(1), 85–99. https://doi.org/10.32505/at.v11i1.529

Ferdiansyah, S., Supiastutik, & Angin, R. (2020). Thai students' experiences of online learning at Indonesian universities during the COVID-19 pandemic. *Journal of International Students*, *10*(Special Issue 3), 58–74. https://doi.org/10.32674/jis.v10iS3.3199

Fields, Z., & Bisschoff, C. A. (2017). *Developing and Assessing a Tool to Measure the Creativity of University Students of University Students*. *8923*. https://doi.org/10.1080/09718923.2014.11893233

Fung, C. H., Poon, K. K., & Ng, S. P. (2022). Fostering student teachers' 21st-century skills by using flipped learning by teaching in STEM education. *Eurasia Journal of Mathematics, Science and Technology Education*, *18*(12). https://doi.org/10.29333/EJMSTE/12728

Gall, M. D., Gall, J. P., & Borg, W. R. (2003). *Educational Research: An Introduction* (7th ed.). Allyn and Bacon.

Gede Agung, A. A. (2016). Pengembangan Model Wisata Edukasi-Ekonomi Berbasis Industri Kreatif Berwawasan Kearifan Lokal Untuk Meningkatkan Ekonomi Masyarakat. *Jurnal Ilmu Sosial Dan Humaniora*, *4*(2), 585–597. https://doi.org/10.23887/jish-undiksha.v4i2.6380

Gullo, C., Ha, T. C., & Cook, S. (2015). Twelve tips for facilitating team-based learning. *Medical Teacher*, *37*(9), 819–824. https://doi.org/10.3109/0142159X.2014.1001729

Hadayani, D. O., Delinah, & Nurlina. (2020). Prosiding seminar nasional pendidikan program pascasarjana universitas pgri palembang 10 januari 2020. *Prosiding Seminar Nasional Pendidikan Program Pascasarjana Universitas PGRI Palembang*, 293–306.

Hao, L., Tian, K., Salleh, U. K. M., Leng, C. H., Ge, S., & Cheng, X. (2024). The Effect of Project-Based Learning and Project-Based Flipped Classroom on Critical Thinking and Creativity for Business English Course At Higher Vocational Colleges. *Malaysian Journal of Learning and Instruction*, *21*(1), 159–189. https://doi.org/10.32890/mjli2024.21.1.6

Herreid, C. F., Homme-Genereux, A. P., Wright, C., Schiller, N., & Herreid, K. F. (2021). Survey Of Case Study Users During Pandemic Shift To Remote Instruction. *Advances in Physiology Education*, *45*(3), 620–625. https://doi.org/10.1152/ADVAN.00046.2021

Hidayati, R. M., & Wagiran, W. (2020). Implementation of problem-based learning to improve problem-solving skills in vocational high school. *Jurnal Pendidikan Vokasi*, *10*(2), 177–187. https://doi.org/10.21831/jpv.v10i2.31210

Jabarullah, N. H., & Iqbal Hussain, H. (2019). The effectiveness of problem-based learning in technical and vocational education in Malaysia. *Education and Training*, *61*(5), 552–567. https://doi.org/10.1108/ET-06-2018-0129

Kirschner, P. A., & Stoyanov, S. (2020). Educating Youth for Nonexistent/Not Yet Existing Professions. In *Educational Policy* (Vol. 34, Issue 3). https://doi.org/10.1177/0895904818802086

Krajcik, J. S., & Blumenfeld, P. C. (2006). *Project-Based Learning* (pp. 317–334).

McGrath, S., & Yamada, S. (2023). Skills for development and vocational education and training: Current and emergent trends. *International Journal of Educational Development*, *102*(July), 102853. https://doi.org/10.1016/j.ijedudev.2023.102853

Megayanti, T., Busono, T., & Maknun, J. (2020). Project-based learning efficacy in vocational education: Literature review. *IOP Conference Series: Materials Science and Engineering*, *830*(4). https://doi.org/10.1088/1757-899X/830/4/042075

Mutohhari, F., Sutiman, S., Nurtanto, M., Kholifah, N., & Samsudin, A. (2021). Difficulties in implementing 21st-century skills competence in vocational education learning. *International Journal of Evaluation and Research in Education*, *10*(4), 1229–1236. https://doi.org/10.11591/ijere.v10i4.22028

Naseer, F., Tariq, R., Alshahrani, H. M., Alruwais, N., & Al-Wesabi, F. N. (2025). Project-based learning framework integrating industry collaboration to enhance student future readiness in higher education. *Scientific Reports*, *15*(1), 1–25. https://doi.org/10.1038/s41598-025-10385-4

Ningsih, Y. S., Yanriko, A., Jalinus, N., & Mardizal, J. (2024). *Pendidikan kejuruan dan tantangan globalisasi : perspektif strategi pengembangan tvet di negara berkembang*. *9*(2), 11–15.

Pribadi, B. A. (2018). *Model Desain Sistem Pembelajaran*. Dian Rakyat.

Pritchard, A., & Woollard, J. (2010). Psychology for the classroom: Constructivism and social learning. In *Routledge*. Routledge. https://doi.org/10.4324/9780203855171

Pujaastawa, I. B. G. (2016). Teknik wawancara dan observasi untuk pengumpulan bahan informasi. *Universitas Udayana*, 4.

Rizaldi, N. I. N., & Putri, A. S. (2021). Apakah model pembelajaran problem-based learning efektif diterapkan pada pendidikan kejuruan abad 21? *INTEGRATED (Journal of Information Technology and Vocational Education)*, *3*(1), 1–18. https://doi.org/10.17509/integrated.v3i1.32735

Rongmin, L., Chan, B., & Fah, Y. (2024). Rethinking Education and Training: Creating High-Quality Employment Opportunities for Vocational Students. *Advances in Vocational and Technical Education*, *6*(2), 90–95. https://doi.org/10.23977/avte.2024.060214

Roper, S., Micheli, P., Love, J. H., & Vahter, P. (2016). The roles and effectiveness of design in new product development: A study of Irish manufacturers. *Research Policy*, *45*(1), 319–329. https://doi.org/10.1016/j.respol.2015.10.003

Safitri, F. S. A., & Sutadji, E. (2025). Strategi Pengembangan Kompetensi Lulusan Pendidikan Kejuruan Guna Meningkatkan Daya Saing Global. *Didaktika: Jurnal Kependidikan*, *14*(1), 1507–1522. https://jurnaldidaktika.org

Sanchez-Muñoz, R., Carrió, M., Rodríguez, G., Pérez, N., & Moyano, E. (2020). A hybrid strategy to develop real-life competences combining the flipped classroom, the jigsaw method, and project-based learning. *Journal of Biological Education*, *00*(00), 1–12. https://doi.org/10.1080/00219266.2020.1858928

Sander Smit, Tacke, T. A., Lund, S., Manyika, J., & Thiel, L. (2020). The future of jobs report 2020. In the *World Economic Forum* (Issue October). https://www.weforum.org/reports/the-future-of-jobs-

report-2020/digest

Saputro, O. A., & Rayahub, T. S. (2020). Perbedaan Pengaruh Penerapan Model Pembelajaran Project Based Learning (PJBL) dan Problem Based Learning (PBL) Berbantuan Media Monopoli terhadap Kemampuan Berpikir Kritis Siswa. *Jurnal Imiah Pendidikan Dan Pembelajaran*, *4*(1), 185–193.

Simanjuntak, M. P., Hutahaean, J., Marpaung, N., & Ramadhani, D. (2021). Effectiveness of problem-based learning combined with computer simulation on students' problem-solving and creative thinking skills. *International Journal of Instruction*, *14*(3), 519–534. https://doi.org/10.29333/iji.2021.14330a

Smeby, S. S., Lillebo, B., Slørdahl, T. S., & Berntsen, E. M. (2020). Express Team-Based Learning (eTBL): A Time-Efficient TBL Approach in Neuroradiology. *Academic Radiology*, *27*(2), 284–290. https://doi.org/10.1016/j.acra.2019.04.022

Sumarni, S., Akhyar, M., Nizam, M., Widyastono, H., Maret, U. S., & Maret, U. S. (2022). *Validity and Effectiveness Test of the Research-Based Blended Flipped Learning (RBBFL) model to Improve Research Competence of Prospective Teachers in Engineering Education*.

Susanti, L., & Pitra, H. (2019). *Flipped Classroom Sebagai Strategi Pembelajaran pada Era Digital*. 54–58.

Syahril, Purwantono, Wulansari, R. E., Nabawi, R. A., Safitri, D., & Kiong, T. T. (2022). The Effectiveness of Project-Based Learning On 4Cs Skills of Vocational Students in Higher Education. *Journal of Technical Education and Training*, *14*(3), 29–37. https://doi.org/10.30880/jtet.2022.14.03.003

Taufik, Y., Harto, B., Sumarni, T., Panji Pramuditha, & Marhanah, S. (2024). Inovasi dan Resiliensi Untuk Mengoptimalkan Transformasi Digital di Sektor Kreatif. *ATRABIS Jurnal Administrasi Bisnis (e-Journal)*, *9*(2), 299–309. https://doi.org/10.38204/atrabis.v9i2.1756

Thornhill-Miller, B., Camarda, A., Mercier, M., Burkhardt, J. M., Morisseau, T., Bourgeois-Bougrine, S., Vinchon, F., El Hayek, S., Augereau-Landais, M., Mourey, F., Feybesse, C., Sundquist, D., & Lubart, T. (2023). Creativity, Critical Thinking, Communication, and Collaboration: Assessment, Certification, and Promotion of 21st Century Skills for the Future of Work and Education. *Journal of Intelligence*, *11*(3). https://doi.org/10.3390/jintelligence11030054

Triana. (2022). *Inovasi Model Problem Based Learning melalui Google Classroom untuk Menguatkan Civic Knowledge Siswa pada Pembelajaran Dalam Jaringan (Studi pada Mata Pelajaran PPKn di SMK Negeri 9 Surakarta)*. Universitas Sebelas Maret.

Usmadi, U., & Ergusni, E. (2019). Penerapan Strategi Flipped Classroom dengan Pendekatan Scientific dalam Pembelajaran Matematika pada Kelas XI SMKN 2 Padang Panjang. *Jurnal Eksakta Pendidikan (Jep)*, *3*(2), 192. https://doi.org/10.24036/jep/vol3-iss2/333

Vagias, W. (2006). Likert-type scale response anchors. *Clemson International Institute for Tourism & Research Development, Department of Parks, Recreation and Tourism Management. Clemson University*. https://doi.org/10.1525/auk.2008.125.1.225

Vasylkevych, Y. Z., Lomak, O. M., Zozulia, I. M., Kochereva, D. V., & Kikinezhdi, O. M. (2020). Creativity as a Resource of Adaptation in a Politically and Economically Unstable Environment. *Journal of Intellectual Disability - Diagnosis and Treatment*, *8*(4), 710–718. https://doi.org/10.6000/2292-2598.2020.08.04.14

Vygotsky, L. (1978). *Mind in Society. The development of higher psychological processes*. Harvard University Press, London, England.

Xinming, Z. (2023). Research on Cultivating Innovation and Practical Skills in Higher Vocational Education. *Frontiers in Educational Research*, *6*(26), 29–36. https://doi.org/10.25236/fer.2023.062606

Yang, C. C. R. (2017). An Investigation of The Use of The "Flipped Classroom" Pedagogy in Secondary English Language Classrooms. *Journal of Information Technology Education: Innovations in Practice*, *16*(1), 1–20.

Zhou, X. (2023). A conceptual review of the effectiveness of flipped learning in vocational learners' cognitive skills and emotional states. *Frontiers in Psychology*, *13*(January), 1–10. https://doi.org/10.3389/fpsyg.2022.1039025