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The Effect of the Blended Project-based Learning Model and Creative Thinking Ability on Engineering Students' Learning Outcomes

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Abstract

This research examines the effect of the blended project-based learning (PjBL) model and creative thinking ability on engineering students' drawing learning outcomes. Using a pre and post-test quasi-experimental design, the research included a sample of 80 students from two different classes at the Faculty of Engineering, UNIMED, North Sumatra, Indonesia. The data were analyzed using descriptive and inferential statistics through two-way ANOVA. Subsequently, the results showed that the members of experimental group I, comprising students who participated in the blended PjBL model, obtained the highest engineering drawing learning outcomes. The creative thinking ability outcomes of the students taught with this model were higher than those of the group II students who used the ordinary blended learning model. However, those with low thinking abilities taught with the ordinary model exhibited higher learning outcomes than the experimental group. These results show an interaction between the effect of the PjBL model and creative thinking ability on the learning outcomes of engineering students. Therefore, lecturers need to use a blended PjBL model to ensure improved outcomes, alongside enhancing students' creative thinking abilities to increase the model's effectiveness.

Introduction

The use of learning media during the teaching process can generate new desires, motivation, stimulate learning activities, and even exert psychological effects on students (Junaidi, 2019; White, 2020). These media signify a promising factor for learning processes in the Information and Communication Technology field (Budiman, 2017; Tadeu et al., 2019). Therefore, lecturers should understand technological advances to avoid providing outdated information to students. They should act as facilitators for students, especially in utilizing various forms of learning media to ensure teaching and learning activities are more effective, efficient, and not monotonous (Kalimullina et al., 2021; Keskin, Akcay, & Kapici, 2020; Muna & Hadisi, 2015; Mursid & Yulia, 2016; Surani, 2019; Williams et al., 2021).

Generally, engineering drawing courses are mandatory for students of mechanical engineering education, and such courses necessitate their ability to create and read engineering drawings. The students should comprehensively explain the parts or components while planning the development of machine-building construction through information in drawing lines based on ISO standards. According to Panjaitan et al. (2020), engineering drawing is appropriate for conveying ideas to others. The study specifically stated that "information transmission is an important function for language or drawings. Therefore, drawings are expected to include accurate and objective information obtained from visual drawings, symbols, and standards. It is an idea or abstract concept that is realized with drawings." Hence, engineering drawing functions as a medium for delivering communicative information because drawings can be understood, measured (have a scale), accurate (precision), effective (used right), and aesthetic (beautiful). However, these drawings should not be interpreted differently by people who observe them (Alfajri & Nasution, 2016; Panjaitan et al., 2020). Therefore, certain signs or standards contained in the International Organization for Standardization (ISO) are required as a collective agreement.

Orthogonal projection drawings are used to provide accurate and complete information of three-dimensional objects placed parallel to the projection plane, particularly the vertical plane (Mesin et al., 2015; Mursid, 2016; Waluya & Wiyono, 2015). The projection material requires an example of real or almost real media, as students should be able to draw theoretical and orthogonal projections (Kurniawan et al., 2016). Meanwhile, an orthogonal projection is a drawing in which the projection plane has a perpendicular angle to the projector. It has several views, including the front, top, side, and visual aspects, and is classified into two types, namely the European and American systems. Generally, these projections are used to clarify drawing information to look real and realize and describe three-dimensional objects (Mesin et al., 2015; Oky Purmadi & Dwi Handayani, 2018).

Project-Based Learning (PjBL) is a strategy that can improve various competencies such as academic achievement, thinking levels, critical thinking, problem-solving ability, creativity, independence, and it presents the ability to see situations from a better perspective. It also offers a deeper understanding of learning, more positive attitudes towards studies, supportive relationships among peers, flexibility in communication, and learning motivation (Azizah & Widjajanti, 2019; Manshur, 2020; Zubaidah et al., 2017). Furthermore, it is one of the models that support student-centered learning (SCL), which is currently a challenge for university learning. The PjBL model prepares assignments based on complex problems for students to investigate in groups (Linda et al., 2019; Prajanto, 2020). It also provides opportunities for students to become more active in learning, as they are encouraged to ask, investigate, explain, and interact with problems. Furthermore, students are asked to generate and present the products from the investigation results. As stated by the previous study, PjBL is an individual or group project executed within a certain period to create a product and present results. Besides developing and using various learning resources, taking an active or student-centered learning approach is necessary.

Therefore, this research uses ICT-based multimedia learning in the Blended PjBL model, which combines projects given virtually or online to students with theories taught during face-to-face learning. It is a new learning concept where material can be delivered in class and online. Blended learning is defined as combining the advantages of e-learning, face-to-face, and practice (Matarirano et al., 2021; Omodan & Diko, 2021; Tsakeni, 2021) . Abdullah (2018) stated that this form of learning combines media, models, theories, face-to-face, and online methods. Hence, blended learning can be concluded to be a combination of all learning modes.

This research applied the concept that combines blended learning with PjBL, meaning the process was conducted face-to-face and online through LMS media. The concept is called the "Blended Project-Based Learning Model," which may allow students to improve their HOT abilities. Moreover, utilizing information technology in multimedia learning development is expected to be an innovation in teaching and learning.
Based on the preliminary results and previous research, this research aims to analyze the effectiveness of applying the blended PjBL with ICT-based multimedia learning on student learning outcomes using the LMS data analysis technique. The subsequent results can design interactive multimedia learning methods that can improve student activities and learning outcomes.

Theoretical Background

Engineering Drawings

Engineering drawings have more specific meanings and scopes in the engineering field and have been used to design machines, vehicles, or war strategies. This situation is visible from various artifacts of drawing results and equipment in museums, building reliefs, or other historical relics. Previously, drawings functioned only as thinking tools and concepts, so rules were not needed.

Subsequently, engineering drawings have developed concepts into functions "to convey information" and "way of thinking." A public standard was also created due to the need for a comfortable language. Generally, standards and rules are used to unify the perceptions and intentions of a draftsman and a product maker. Some currently in use include ANSI (American National Standard Institute), DIN (Deutsche Industrie Normen), ISO (International Organization of Standardization), JIS (Japanese Industrial Standard), NNI (Nederland Normalisatie Institute), and NIS (National Indonesian Standard).

Engineering drawing is similar to language and requires a set of 6 rules for proper use. Conversely, there are two basic rules in English, first, the 'word order,' which provides information about the subject and object, and second, spelling and information about the word itself, such as nouns and verbs. Generally, engineering drawings need to communicate legally binding information through various specifications. Therefore, several requirements should be met, namely (1) clarity, (2) completeness, (3) the ability to be duplicated. (4) non-dependence on a particular language, and (5) appropriateness with standards. Although different standards are applicable in each country, the 'highest' is the ISO, which applies worldwide. However, companies and industries have those specific to them.

Meanwhile, a projection drawing depicts a point, object, line, field, or view on a plane (Fakhri et al., 2019). Hence, it refers to a shadow coming from real or imaginary objects in the drawing field observed from certain points of view. Orthogonal projections have several characteristics. These are (1) they can provide precise and complete information of a 3D object, (2) the object is placed parallel to the projection plane, (3) cannot completely describe the object with only one projection. (4) Only a few areas are taken, and (5) combining the projection produces a clear drawing. The orthogonal projections for working drawings use horizontal and vertical planes (Kendal et al., 2020).

Quadrant I, or the European projection, is a drawing where the object is located between the observer and the plane. This projection-type appears as though the object was pushed into the plane (Fitria et al., 2019). Three areas are usually used during its demonstration: the front, top, and side, while the object is placed in quadrant I. Hence, the projection will occur on the horizontal, vertical, and front planes (see Figure 1).

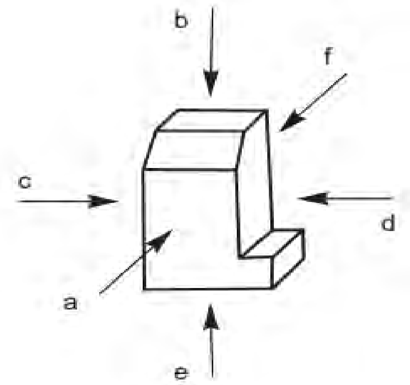

Figure 1. Designation of the Views

Quadrant III, or the American Projection, involves placing the object in front of the plane between the observer and the object. The object appears to be pulled into the plane during projection, so the sightline is drawn towards the projection plane (see Figure 2 and 3).

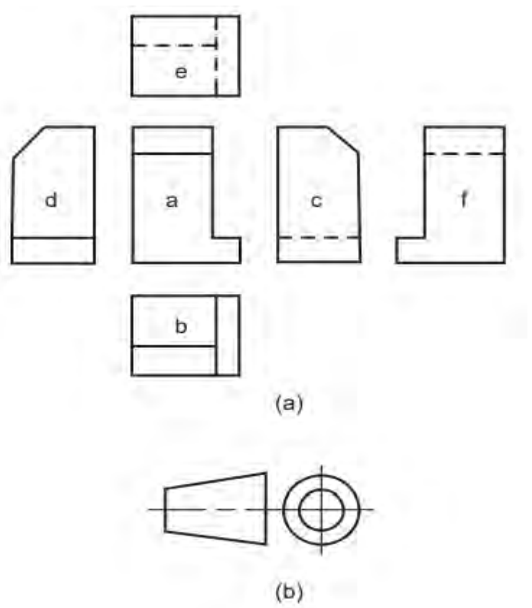

Figure 2. Relative Positions of Six Views in First Angle Projection

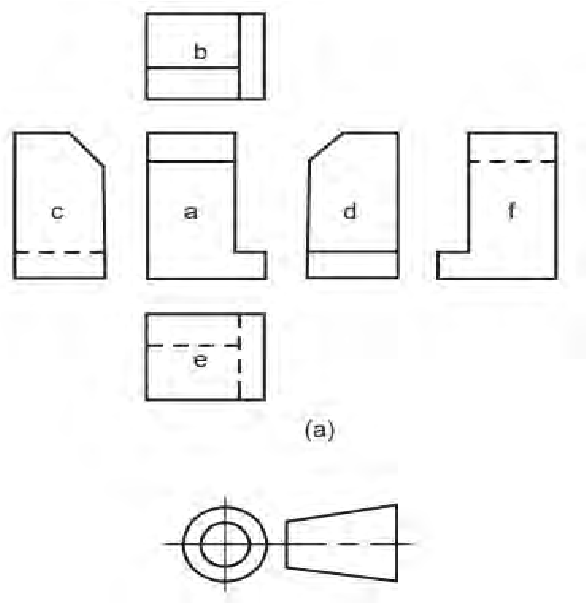

Figure 3. Relative Positions of Six Views in Third Angle Projection

The Blended Project-Based Learning Model

Blended learning requires widely accessible learning opportunities and resources. Etymologically, the term consists of two words, "blend," meaning "to mix to produce better quality" (Collins Dictionary), and "learning," which generally means "to study." Therefore, "blended learning" means combining one learning pattern with another. Tyley (2012) stated that blended learning refers to a course that combines face-to-face classroom instructions with online learning, thereby reducing classroom contact hours and sitting time.

The last point is an important distinction because enhancing regular face-to-face courses with online resources without changing the class contact hours is also possible." It is called hybrid learning and combines the characteristics of traditional schools with online learning benefits for personal delivery by providing different instructions for each group (Watson et al., 2020). This innovative concept includes the advantages of traditional and ICT-supported learning (Abass et al., 2021; Garcia, 2021; Monkeviciene et al., 2020; Ndibalema, 2021; Seage, & Türegün, 2020; Subedi & Subedi, 2020; Wahyudi, 2020; Wahyudi & Winanto, 2018). According to Carman (2002), there are five keys to applying blended learning: life events, independent learning, collaboration, assessment, performance, and supporting materials.

Meanwhile, blended PjBL is a model that allows students to manage online and offline learning of engineering drawing project works (Hasyim, 2020; Rachmah, 2019). It is student-centered and involves learning via a project activity. A project contains complex tasks based on challenging questions, problems, and engineering drawings, and requires students to design, solve problems, make decisions, investigate, and work independently. Performance assessment on PjBL can be conducted by calculating the individual's product quality, understanding of the content, and contribution to the ongoing project realization process. PjBL allows students to reflect on their ideas and opinions, decide the factors that affect their learning process and outcomes, and then present the final product.

This learning model can be used to condition active student-centered learning, facilitate a more interesting learning experience, and produce works based on real, contextual daily problems. It can emphasize science skills by observing, using tools and materials, interpreting, planning projects, applying concepts, asking questions, and enabling appropriate communication. Moreover, it develops students' creative thinking ability in designing and creating projects that can proffer systematic solutions to problems. Therefore, this model can develop HOT in implementing scientific (Observing, Associating, Trying, Discussing, and Communicating) and 21st-century learning (4Cs: Critical thinking, Collaboration, Creative, and Communication).

According to Lestari and Isnania (2019), the steps of the PjBL model are as follows:

1) Opening the lesson with challenging questions (start with the big question): Learning begins with a driving question that can assign students to execute an activity.
2) Planning the project (design a project plan): Planning is performed collaboratively between the students, who are expected to have a sense of ownership, and the lecturers.
3) Arranging a schedule of activities (create a schedule): Lecturers and students collaboratively arrange

activity schedules for completing projects. The time should be clear, and students may be directed to manage.

4) Supervising the project (monitor the students and project progress): Lecturers are responsible for monitoring the students' activities while completing the project. This step is performed by facilitating students during each process.

5) Assessing the resulting product (assess the outcome): The assessment is conducted to assist lecturers in measuring the achievement of standards and evaluating the student's progress.

6) Evaluating (evaluate the experience): At the end of the learning process, lecturers and students reflect on the activities and project results obtained.

Therefore, blended PjBL is more student-centered, as students are required to acquire and integrate new knowledge obtained from the results of projects assisted by lecturers as the facilitators.

Creative Thinking Ability

Creative thinking is an original and elaborate way of producing complex products. It is often referred to as divergent thinking because it begins with one problem but involves numerous solutions that can be applied extensively with many possibilities. Creative thinking can be defined as a whole series of cognitive activities individuals use according to certain objects, problems, and conditions. It also refers to various efforts towards events and problems based on individual capacities. Mahanal and Zubaidah (2017) stated that creative thinking is the ability to formulate new ideas that are surprising and valuable in numerous ways. It is related to novelty, the ability to create an entity, apply new forms of development, produce many imaginative abilities or transform an existing object into a new product (Kumdang et al., 2018; Sahida & Zarvianti, 2019). Furthermore, Munafiah et al. (2019) defined creative thinking as a unique form of self-expression.

Meanwhile, various indicators of creative thinking have been expressed by several experts. According to Joklitschke et al. (2018) and Zubaidah et al. (2017), creative thinking has five indicators, namely (1) fluency, defined as the ability to generate ideas, methods, suggestions, questions, and alternative answers fluently in a certain time. (2) Flexibility involves obtaining various ideas, answers, or questions from different points of view by changing the method of thinking and the approach used. (3) Originality, referring to the ability to create phrases, ways, or ideas to solve a problem in unusual and unique combinations of elements that other people do not visualize. (4) Elaboration means the ability to enrich, develop, add, describe, or specify details of objects, ideas, products, or situations to become more interesting. (5) Metaphorical thinking involves using comparisons or analogies to make new connections.

Students' different abilities require conditions involving learning experiences that develop their potential for creative thinking (Al-Husban, 2020; Kilinc et al., 2018; Yusnaeni et al., 2017). Since creative thinking can be included in learning, lecturers should implement the mandate for this development. This finding corresponds with the opinions of Zubaidah et al. (2017) and Nasir (2018), which stated that the lecturer is tasked with providing the best conditions for students to acquire relevant or important thinking abilities. Purnama (2020 and Ramdhani and Kiswanto (2020) stated that facing the challenges of the dynamic and uncertain modern life is necessary to develop creative thinking abilities in learning. These abilities are the basis of science (Asy'ari & Fitriani, 2017; Etherington, 2019; Zarah et al., 2021) and need to be developed through learning, especially engineering drawing.

Research Objective

The purpose of this research is to examine the effect of blended PjBL models and creative thinking ability on students' achievement of engineering drawing learning outcomes.

Method

Research Model

This research employed a quasi-experimental design to determine the effect of independent variables, i.e., the blended PjBL and blended learning models, alongside high and low creative thinking abilities, on the dependent variable, namely engineering drawing learning outcomes. Table 1 shows the 2 x 2 factorial experimental design.

Table 1. 2 x 2 Factorial Design

Creative Thinking (I)		Blended PjBL Model (A1)	Blended Learning (A2)
	High (B1)	A1 B1	A2 B1
	Low (B2)	A1 B2	A2 B2

Research Procedure

Before conducting the research, the lecturers assigned to teach the experimental group were trained on using the blended PjBL model for the drawing course in the mechanical engineering education department. Topics, teaching objectives, and learning media were provided for the eight weeks of treatment. The lecturer meant to instruct experimental group I about the textbook material on orthogonal drawings in the American and European projection systems was also given eight weeks of treatment. Meanwhile, the lecturers in both groups had the same topics and teaching objectives.

For the first week, the students in the two groups were faced with a creative thinking questionnaire to determine their ability levels and separate them into high and low categories. Then, the experimental group I followed a PjBL model for several weeks, while group II only used the blended learning model. The learning processes in the experimental group I were observed to examine the accuracy with which the prepared stages were followed. Also, group II was monitored four times to ensure the use of the blended learning model.

In experimental group I, the lecturers introduced the topic and explained the American and European projected drawing systems to the students. They followed the PjBL stages, including (1) contextually introducing the engineering drawing problems and (2) designing a project planning assignment of one to six views based on the stages. Furthermore, they obeyed the other steps by (3) arranging a schedule of student activities to be conducted according to the agreed project assignments, (4) observing and monitoring work based on the stages given through Edmodo, and (5) conducting an assessment of the learning process.

In addition, the lecturer guided students to identify and formulate related project assignments, design data collection instruments, analyze and collect the assignments. Then, they were asked to draw conclusions and present their work on the engineering drawings of American and European system projections with six complete views on the beam to the machine component media. The lecturers helped the students to revise, where necessary, and evaluate their understanding of the topics investigated during the group presentations. At the end of the lesson, they revised the learned topics. The procedure lasted for six weeks, was held three times per week, and was implemented online through a blended learning approach on the Google Classroom application.

Also, the topic was introduced and discussed by the lecturers using a textbook and online methods based on the blended learning approach in experimental group II. The students' levels of understanding were evaluated by asking questions before the classes ended. This procedure lasted for six weeks, holding thrice a week. Hence, the topic and duration in both groups were the same.

Research Sample

The population used in this research comprised first-semester students in the mechanical engineering education (S1) and the automotive engineering education (S1) study programs in the mechanical engineering department, engineering faculty, UNIMED, Indonesia. After the homogeneity test was conducted, class A was assigned as the experimental group I to evaluate the blended PjBL model. Conversely, class B students were designated to group II and examined using the blended learning model. The sample consisted of 80 students, equally divided into two parts, where 40 had high creative thinking ability, while the other half was low. As shown in Table 2, the groups involved 20 students with high and low creative thinking abilities each.

Table 2. Research Sample based on the Place and Type of Treatment

Blended Learning Model Creative Thinking Ability	Class A PjBL-Based Blended Learning Model	Class B Blended Learning Model	N
High	20	20	40
Low	20	20	40
Total	40	40	80

This research was conducted from August - November 2020, and the engineering drawing courses taught included orthogonal, axonometric, multiple views, American and European systems, and working projections. The American and European system projection drawings comprised a front view, alongside two, three, four, five, and six views.

Research Instruments

This research used a post-test to measure the engineering students' drawing learning outcomes and creative thinking abilities. The pre-test and final test consisted of 30 multiple-choice questions each. Two experienced engineering drawing lecturers, who had been teaching for over five years and were selected from other classes to avoid research bias, checked and validated the post-test questions and answers. Subsequently, the reliability coefficients for the multiple-choice questions were found to be 0.86 (KR-21) and 0.87 (KR-20), meaning the question were reliable.

The creative thinking ability questionnaire consisted of 30 Likert-type items adopted and modified the research objectives and ranged from 'strongly agree' (4 points) to 'strongly disagree' (1 point). Then, each student's total score was assumed to represent their interests. Before the actual data collection, a trial was conducted using 20 students from the mechanical engineering study program in the engineering faculty of UNIMED, Indonesia. This trial showed that the blended learning model and data collection instrument were understandable. The questionnaire attained a Cronbach's Alpha 0.745, higher than the acceptable value of 0.60 proposed by Sekaran and Bougie (2013). Then, the obtained data were analyzed using the two-way Analysis of Variance (ANOVA).

Data Analysis

According to Chu and Chang (2017), a two-way ANOVA is used to test the effect of the main factors and interactions in a 2x2 experimental factorial design. Subsequently, this was performed by classifying the variables into two approaches, namely the blended PjBL and ordinary blended learning models. The moderator variables were also categorized into low and high creative thinking abilities. Then, the statistical analysis requirements were examined for normality and homogeneity using the One-Sample Kolmogorov-Smirnov Test and Levene's Test of Equality of Error Variances, respectively. Supposing these results indicated an interaction between the independent and dependent variables, a posthoc analysis of variance using Tukey's test or Tukey's Honestly Significant Difference (HSD) was employed for in-depth testing of the research hypothesis.

Results and Discussion

The hypotheses in this research are the following:

(1) There is a significant difference between the average values of engineering drawing outcomes of the two learning approaches.

(2) There is an interaction between the influence of the blended learning model in the achievement of engineering drawing learning outcomes and the students' creative thinking abilities.

(3) The learning outcomes of the students who have higher creative thinking abilities and are taught using the blended PjBL are greater than those that applied the ordinary blended learning model.

(4) The learning outcomes of engineering drawing students with lower creative thinking abilities taught using the blended PjBL are lower than using the ordinary blended learning model.

Data analysis was performed using the Statistical Package for Social Sciences (SPSS) 25.0TM.

Table 3 shows the statistical analysis results confirmed by normality and homogeneity tests using the One-Sample Kolmogorov-Smirnov Test and Levene's Test of Equality of Error Variances, respectively.

Table 3. Normality and Homogeneity Test Results

Data Group	Normality		Homogeneity	
Final test	N	Sig.	Levene Test Score	Sig.
	80	0.261	0.803	0.863

As shown in Table 3, the research data were normally distributed, and all variants were homogeneous ($p > 0.05$). Table 4 shows the statistics description about the scores in the models.

Table 4. Statistics Description

Learning Model	Critical Thinking Ability	Mean	Std. Deviation	N
Blended PjBL Model	High Creative Thinking Ability	85.05	2.982	20
	Low Creative Thinking Ability	81.55	3.517	20
	Total	83.30	3.674	40
Blended Model	High Creative Thinking Ability	81.50	3.069	20
	Low Creative Thinking Ability	78.50	3.395	20
	Total	80.00	3.537	40
Total	High Creative Thinking Ability	83.28	3.486	40
	Low Creative Thinking Ability	80.02	3.745	40
	Total	81.65	3.949	80

The two-way ANOVA results are presented in Table 5.

Table 5. Two-Way ANOVA Results

Source	Type III Sum of Squares	Df	Mean Square	F	Sig.
Corrected Model	430.300[a]	3	143.433	13.594	.000
Intercept	533337.800	1	533337.800	50547.042	.000
Model	217.800	1	217.800	20.642	.000
Thinking	211.250	1	211.250	20.021	.000
Model * Thinking	1.250	1	1.250	.118	.732
Error	801.900	76	10.551		
Total	534570.000	80			
Corrected Total	1232.200	79			

a. R Squared = .349 (Adjusted R Squared = .324)

Table 5 shows that the first and second research hypotheses were rejected. Hence no further tests were conducted.

A significant difference between the average values of both models' engineering drawing learning outcomes can offer a suitable approach for improving students' outcomes. Subsequently, this research obtained average scores of 81.05 and 80.00 for the blended PjBL and the ordinary blended model, respectively. These results correspond with the statement that the blended PjBL model improves students' engineering drawing learning outcomes (Afifah & Wahyudi, 2019; Priono et al., 2019; Susilawati et al., 2020). Hence, the significant difference between the students' achievement levels may be due to the learning model. This finding supports the views of Pengabdian et al. (2012) and Sucipto (2017), which argued that blended PjBL is efficient in improving academic understanding and student learning outcomes of engineering drawing.

Meanwhile, the blended PjBL model did not affect the interaction between the ordinary blended model and the students' creative thinking ability. The blended PjBL model facilitates the students' achievement and is better than the ordinary strategy (Ekayati, 2018; Triyanto & Prabowo, 2020; Usman, 2019). However, students with low creative thinking abilities showed poorer learning outcomes with the blended PjBL compared to the ordinary blended model. This finding corresponds with research by Ayu and Tri (2019) and Ariyantini (2017), which implied interaction between the influence of blended learning strategies and creative thinking ability on students' engineering drawing learning outcomes.

The effectiveness of the blended PjBL model approach is related to students' characteristics. Therefore, lecturers need to apply this fact in determining the best model to facilitate their learning. In this case, the average student learning outcomes of the engineering drawing competence were higher with the blended PjBL than the ordinary blended learning model. In addition, students with high creative thinking abilities that employed the blended PjBL model had a higher average learning outcome of 85.05 than those in the ordinary blended learning group, who had a score of 81.50. This result means that the active model, i.e., the cooperative approach and PjBL is more suitable for students with high creative thinking abilities during the learning process (Antika & Nawawi, 2017; Fatmawati, 2011; Sari & Angreni, 2018).

The characteristics of students with high creative thinking abilities include self-motivation, optimism, independence, high ability, empathy, personal goals, and responsibility (Syaparuddin & Elihami, 2017). Applying learning motivation for success and individual responsibility is important to support the effectiveness of the blended PjBL model, as these two factors encourage students to help each other during learning. However, the absence of these two factors results in the lack of interest to improve their learning outcomes (Nasution, 2018; Pilotti & Al Mubarak, 2021; Tarbutton, 2018). This finding is in line with research by Lailiana and Handayani (2017) and Hapsari (2017), which stated that two factors needed to obtain academic achievement are group goals or motivation for success and individual responsibility.

Fourth, students with low creative thinking abilities taught using the blended PjBL model had a lower average value of learning outcomes than the ordinary blended model. Generally, the ordinary model is more effective for such individuals because it does not require teamwork, gives students responsibility for learning, and is challenging in learning engineering drawing (Ariyantini, 2017; Winaryati, 2018; Yusuf Sukman, 2017). This approach will allow these students to follow the learning process facilitated by the lecturer easily. Hence, the blended PjBL model can be concluded to be ineffective for students with low creative thinking abilities (Adisendjaja & Sanjaya, 2021; Susilowati & Dewantara, 2021).

In addition, students with low creative thinking abilities avoid taking active responsibility for their learning and show less confidence in completing tasks. According to Kurniawan et al. (2016), Yulianto (2015), Kusuma and Muttaqin (2019), and Waluya and Wiyono (2015), students quickly learn the basic skill of creating orthogonal drawings through various types of tasks based on the lecturer's directions and explanations in the ordinary blended model. This result supports the studies by Yustina et al. (2020), Wahyudi and Winanto (2018), Yustina et al. (2020), and Garrison and Kanuka (2004), which affirmed that blended learning is beneficial for students that possess low self-confidence and skill in completing their assignments because the use of applications has not been properly mastered.

Based on the results, blended PjBL and the ordinary blended learning models can significantly influence the engineering drawing learning outcomes of students. Also, the blended PjBL model seems to greatly affect students (Kurniawan et al., 2016; Kusuma & Muttaqin, 2019; Waluya & Wiyono, 2015; Yulianto, 2015).
The interaction between the effect of the blended PjBL model on the learning outcomes of engineering drawing and the students' creative thinking abilities revealed that this strategy is more effective for individuals with high-creative thinking abilities. However, the ordinary blended model without the project-based learning approach is more efficient for students with low emotional intelligence.

Conclusion

Consequently, this research recommends the application of blended PjBL for teaching engineering drawing, especially orthogonal projection material in the American and European systems, with several views to improve student learning outcomes. Enhancing students' learning outcomes in engineering drawing can help them achieve a high quality of life and knowledge in their field, solve social problems, develop their interests and talents, and adapt to the necessary science and technology development in the 21st century. However, their creative thinking ability needs to be improved to ensure the PjBL strategy is applied effectively. Since this research was limited to engineering drawings for orthogonal projections in the American and European systems with six compound views conducted during the first semester, further research needs to be performed on different subjects. They can focus on other learning outcomes, such as machine elements, engineering mechanics, machining, forming, and welding technology.

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References

Abass, O. A., Arowolo, O. A., & Igwe, E. N. (2021). Towards Enhancing Service Delivery in Higher Education Institutions via Knowledge Management Technologies and Blended E-Learning. *International Journal on Studies in Education (IJonSE), 3*(1), 10-21.

Abdullah, W. (2018). Model Blended Learning dalam Meningkatkan Efektifitas Pembelajaran. *Fikrotuna*, *7*(1), 855–866. https://doi.org/10.32806/jf.v7i1.3169

Adisendjaja, Y. H., & Sanjaya, Y. (2021). Keterampilan berpikir kreatif mahasiswa calon guru *Abstrak*. *9 (1)*, 98–106.

Afifah, E. P. & Wahyudi, Y. S. (2019). Efektivitas Problem Based Learning Dan Problem Solving Terhadap Kemampuan Berpikir Kritis Siswa Kelas V Dalam Pembelajaran Matematika Universitas Kristen Satya Wacana Pendahuluan Kurikulum yang berlaku di Indonesia sekarang ini adalah kurikulum 2013 . Kur. *Journal of Mathematics Education, Science and Technology*, *4*(1), 95–107.

Alfajri, S., & Nasution, I. N. (2016). Menggunakan Metode Manual dan Digital. *Jurnal Education Buuilding*, *2*, 30-40.

Al-Husban, N.A. (2020). Critical Thinking Skills in Asynchronous Discussion Forums: A Case Study. *International Journal of Technology in Education (IJTE), 3*(2), 82-91.

Antika, R. N., & Nawawi, S. (2017). Pengaruh Model Project Based Learning Pada Mata Kuliah Seminar Terhadap Keterampilan Berpikir Kreatif Mahasiswa. *Jurnal Pendidikan Biologi Indonesia*, *3*(1), 73.

Ariyantini, M. D. (2017). *Digital Repository Repository Universitas Universitas Jember Jember.* Staphylococcus aureus:Skripsi.

Asy'ari, M., & Fitriani, H. (2017). Literatur Reviu Keterampilan Proses Sains sebagai Dasar Pengembangan Keterampilan Berpikir Tingkat Tinggi. *Prisma Sains: Jurnal Pengkajian Ilmu Dan Pembelajaran Matematika Dan IPA IKIP Mataram*, *5*(1), 1. https://doi.org/10.33394/j-ps.v5i1.1114

Ayu, R., & Tri, A. (2019). Analisis Kemampuan Berpikir Kreatif Peserta Didik Melalui Penerapan Blended Project Based Learning. *Analisis Kemampuan Berpikir Kreatif Peserta Didik Melalui Penerapan Blended Project Based Learning*, *13*(2), 2437–2446.

Azizah, I. N., & Widjajanti, D. B. (2019). Keefektifan pembelajaran berbasis proyek ditinjau dari prestasi belajar, kemampuan berpikir kritis, dan kepercayaan diri siswa. *Jurnal Riset Pendidikan Matematika*, *6*(2), 233–243. https://doi.org/10.21831/jrpm.v6i2.15927

Budiman, H. (2017). Peran Teknologi Informasi Dan Komunikasi Dalam Pendidikan. *Al-Tadzkiyyah: Jurnal Pendidikan Islam*, *8*(1), 31. https://doi.org/10.24042/atjpi.v8i1.2095

Carman, J. M. (2002). Blended learning design: Five key ingredients. *Learning*, *11*. https://doi.org/10.1109/CSSE.2008.198

Chu, P. H. & Chang, Y. (2017). John W, Creswell, Research Design: Qualitative, Quantitative, and Mixed Methods Approaches. *Journal of Social and Administrative Sciences*, *4*(June), 3–5.

Etherington, M. (2019). The Challenge with Educational Transformation. *Journal of Culture and Values in Education*, *2*(1), 96-112. https://doi.org/10.46303/jcve.02.01.8

Fakhri, F., Body, R., & Apdeni, R. (2019). Pengembangan Media Pembelajaran Berbasis Animasi Pada Mata Kuliah Gambar Teknik Jurusan Teknik Sipil Universitas Negeri Padang. *Jurnal Teknik*, *5*(4), 1–6.

Fatmawati, M. B. (2011). Pembelajaran Berbasis Proyek Untuk Meningkatkan Keterampilan Berpikir Kreatif Mahasiswa. *Jurnal Pengajaran Matematika Dan Ilmu Pengetahuan Alam*, *16*(2), 85.

Fitria, N. Z., Damayanti, T. N., & Ramadan, D. N. (2019). Proyeksi Bangun Ruang Orthogonal Menggunakan Augmented Reality Sebagai Media Pembelajaran Pada Mata Kuliah Bengkel Mekanikal Dan Elektrikal. *Ie-Proceeding of Applied Science*, *5*(2), 1722–1731.

Garcia, R. (2021). Factors That Influence Students' Learning Progress in the Science Spiral Progression Curriculum. *Journal Of Curriculum Studies Research*, *3*(2), 79-99. https://doi.org/10.46303/jcsr.2020.5

Garrison, D. R., & Kanuka, H. (2004). Blended learning: Uncovering its transformative potential in higher education. *Internet and Higher Education*, *7*(2), 95–105. https://doi.org/10.1016/j.iheduc.2004.02.001

Hapsari, E. (2017). Penggunaan Metode Pembelajaran Kooperatif Student Team Achievement Division (STAD) dengan Motivasi Berprestasi pada Mahasiswa Statistika Praktikum Fakultas Psikologi. *Experientia: Jurnal Psikologi Indonesia*, *5*(1), 31–44. https://doi.org/10.1234/1550

Hasyim, M. (2020). Pengembangan Multimedia Pembelajaran Statistika Berbasis ICT dengan Model Blended Project Based Learning. *Jurnal Cendekia : Jurnal Pendidikan Matematika*, *4*(2), 1083–1097.

Joklitschke, J., Rott, B., & Schindler, M. (2018). Theories About Mathematical Creati Vit Y in Contemporary Research : a Literature Review. *Proceedings of the 42nd Conference of the International Group for the Psychology of Mathematics Education*, *3*(July), 171–178.

Junaidi, J. (2019). Peran Media Pembelajaran Dalam Proses Belajar Mengajar. *Diklat Review : Jurnal Manajemen Pendidikan Dan Pelatihan*, *3*(1), 45–56. https://doi.org/10.35446/diklatreview.v3i1.349

Kalimullina, O., Tarman, B. & Stepanova, I. (2021). Education in the Context of Digitalization and Culture: Evolution of the Teacher's Role, Pre-pandemic Overview. *Journal of Ethnic and Cultural Studies*, *8*(1), 226-238. DOI: http://dx.doi.org/10.29333/ejecs/629

Kendal, S. M. K. N., Sutjipto, A., Kendal, S. M. K. N., Bogosari, J. R., Pendidik, A., & Alppi, I. (2020). Peningkatan Aktivitas Dan Hasil Belajar Proyeksi Orthogonal Dengan Model Student Teams Achievement Division Pada Peserta Didik X Tkr 1 Smk Negeri 5 Kendal. *Internasional Jurnal Riset Pembelajaran (IJRP), 1*(2), 89–100.

Keskin, C., Akcay, H., & Kapici, H. O. (2020). The Effects of Environmental Science e-Projects on Middle School Students' Behaviors and Attitudes. *International Journal of Technology in Education and Science (IJTES), 4*(2), 160-167.

Kilinc, E., Tarman, B. & Aydin, H. (2018). Examining Turkish Social Studies Teachers' Beliefs About Barriers toTechnology Integration. *TechTrends, 62***,** 221–223 (2018). https://doi.org/10.1007/s11528-018-0280-y

Kumdang, P., Kijkuakul, S., & Chaiyasith, W. C. (2018). An Action Research on Enhancing Grade 10 Student Creative Thinking Ability using Argument-driven Inquiry Model in the Topic of Chemical Environment. *Journal of Science Learning*, *2*(1), 9. https://doi.org/10.17509/jsl.v2i1.11995

Kurniawan, A. S., Khumaedi, M., & Sulisty, S. M. (2016). Penerapan Video CAD (Computer Aided Design) untuk Meningkatkan Hasil Belajar Menggambar Proyeksi Dengan Sistem Amerika dan Sistem Eropa. *Journal of Mechanical Engineering Learning*, *1*(1), 28–41.

Kusuma, Y. A., & Muttaqin, A. Z. (2019). Pengembangan Gambar Perspektif Melalui Pendekatan Gambar Teknik di SMAN XYZ Madiun. *Jurnal Penelitian Dan Pengabdian Kepada Masyarakat UNSIQ*, *6*(2), 54–59. https://doi.org/10.32699/ppkm.v6i2.603

Lailiana, N. A., & Handayani, A. (2017). Motivasi Berprestasi Ditinjau Dari Komitmen Terhadap Tugas Pada Mahasiswa. *The 1st Education and Language International Conference Proceedings Center for International Language Development of Unissula*, 89–96.

Lestari, & Isnania, R. J. (2019). Komparasi Model Pembelajaran Problem Based Learning dan Project Based Learning Terhadap Hasil Belajar Siswa Pada Materi Perangkat Keras Jaringan Internet Kelas IX SMP Negeri 5 Sungai Kakap Kabupaten Kubu Raya. *Efektor*, *6*(Issue 2, 2019), 127–135.

Linda, R. F. C., Widodo, S., Karimah, N., & Ngazizah, N. (2019). Penerapan Project Based Learning Pada Praktikum Mahasiswa PGSD Semester 2 untuk Meningkatkan Kreativitas dan Pemecahan Masalah. *University Research Colloqium*, 214–222.

Mahanal, S., & Zubaidah, S. (2017). Model Pembelajaran Ricosre yang Berpotensi Memberdayakan Keterampilan Berpikir Kreatif. *Jurnal Pendidikan: Teori, Penelitian, Dan Pengembangan*, *2*(5), 676–685. http://journal.um.ac.id/index.php/jptpp/article/view/9180

Manshur, F. M. (2020). Typical Literary Works of Pesantren on Righteousness Teaching within Cultural Transformation. *Journal of Social Studies Education Research, 11*(4), 114-148.

Matarirano, O., Gqokonqana, O., & Yeboah, A. (2021). Students' Responses to Multi-Modal Emergency Remote Learning During COVID-19 in a South African Higher Institution. *Research in Social Sciences and Technology*, *6*(2), 199-218. https://doi.org/10.46303/ressat.2021.19

Mesin, J. T., Teknik, F., & Semarang, U. N. (2015). *Melalui Model Pembelajaran Langsung*.

Monkeviciene, O., Autukeviciene, B., Kaminskiene, L. & Monkevicius, J. (2020). Impact of innovative STEAM education practices on teacher professional development and 3-6 year old children's competence development. *Journal of Social Studies Education Research, 11*(4), 1--27.

Muna, W., & Hadisi, L. (2015). Pengelolaan Teknologi Informasi Dalam Menciptakan Model Inovasi Pembelajaran (E-learning). *Jurnal Al-Ta'dib*, *8*(1), 1–24.

Munafiah, S., Rochmad, R., & Dwijanto, D. (2019). Disposisi Matematis pada Pembelajaran Creative Problem Solving dalam Upaya Meningkatkan Kemampuan Berpikir Kreatif Matematis. In *Prosiding Seminar Nasional Pascasarjana (PROSNAMPAS), 2*(1), 819-823.

Mursid, R. (2016). Pengaruh Model Pembelajaran Berbasis Konstruktivistik dan Kemampuan Spatial Visualization Terhadap Kompetensi Menggambar Proyeksi Orthogonal. *JTP - Jurnal Teknologi Pendidikan*, *18*(3), 215–229. https://doi.org/10.21009/jtp1803.6

Mursid, R., & Yulia, E. (2016). Pengembangan pembelajaran dalam teknologi pendidikan di era ri 4.0. *Jurnal Ilmiah Mahasiswa Pendidikan Kimia*, *1*(3), 35–42.

Nasir, M. (2018). Influence of Project-Based Learning Model that Aided Matrix Laboratory toward Creative Thinking Ability Viewed from College Student's Science Generic Ability. *Indonesian Journal of Science and Education*, *2*(2), 161. https://doi.org/10.31002/ijose.v2i2.779

Nasution, W. N. (2018). The Effects Of Inquiry-Based Learning Approach And Emotional Intelligence On Students' Science Achievement Levels. *Journal of Turkish Science Education*, *15*(4), 104–115.

Ndibalema, P. (2021). Online Assessment in the Era of Digital Natives in Higher Education Institutions. *International Journal of Technology in Education (IJTE), 4*(3), 443-463. https://doi.org/10.46328/ijte.89

Oky Purmadi, T., & Dwi Handayani, K. (2018). Penerapan Metode Tutor Sebaya Dengan Media Sketchup Pada Materi Proyeksi Ortogonal Kelas X Di Smk Negeri 1 Sidoarjo. *Jurnal Kajian Pendidikan Teknik Bangunan*, *4*(1), 1–7.

Omodan, B., & Diko, N. (2021). Editorial: Education and the Quest for Educating in the Current and the Post-COVID-19 Era. *Research in Social Sciences and Technology*, *6*(2), i-iii.

Panjaitan, K., Saragih, A. H., & Purba, S. (2020). Pengembangan Media Pembelajaran Berbasis Generic Green Ability in Project Based Learning Pada Menggambar Teknik Berbantuan Cad. *Jurnal Teknologi Informasi & Komunikasi Dalam Pendidikan*, *7*(2), 203. https://doi.org/10.24114/jtikp.v7i2.23247

Pengabdian, P. D. A. N., Rahmawaty, P., Si, M., Respati, D., Sumunar, S., & Si, M. (2012). *Prosiding Seminar Nasional Prosiding Seminar Nasional* (Vol. 2, Issue January).

Pilotti, M., & Al Mubarak, H. (2021). Systematic versus informal application of culturally relevant pedagogy: Are performance outcomes different? A study of college students. *Journal of Culture and Values in Education*, *4*(2), 14-26. https://doi.org/10.46303/jcve.2021.1

Prajanto, A. (2020). Project Based Learningsebagai Model Pembelajaran Risk Based Auditdengan Media Aplikasi Audit Tool Linked Archive System(Atlas). *Urnal Akuntansi, Keuangan Dan Auditing*, *1*(1), 18–28.

Priono, A. I., Purnawan, P., & Komaro, M. (2019). Pengaruh Penerapan Model Pembelajaran Blended Learning Terhadap Hasil Belajar Menggambar 2 Dimensi Menggunakan Computer Aided Design. *Journal of Mechanical Engineering Education*, *5*(2), 129. https://doi.org/10.17509/jmee.v5i2.15179

Purnama, C. S. (2020). *Pemikiran Soedjatmoko tentang Pendidikan dan Relevansinya pada Abad Ke-21 di Indonesia*. *3*(58), 185–197.

Rachmah, H. (2019). Blended Learning: Memudahkan Atau Menyulitkan? *Prosiding Seminar Nasional Fakultas Ilmu Sosial Universitas Negeri Medan*, *3*, 673–679. http://semnasfis.unimed.ac.id2549-435x

Ramdhani, R. N., & Kiswanto, A. (2020). Urgensi Adaptabilitas dan Resiliensi Karier pada Masa Pandemi. *Indonesian Journal of Educational Counseling*, *4*(2), 95–106. https://doi.org/10.30653/001.202042.135

Rini Ekayati. (2018). Implementasi Metode Blended Learning Berbasis. *Jurnal EduTech Vol.*, *4*(2), 50–56.

Sahida, D., & Zarvianti, E. (2019). Development of Problem Based Learning (PBL) practicum guide to improve student Creative Thinking Ability (CTS) in basic physics subject. *Journal of Educational and Learning Studies*, *2*(1), 39. https://doi.org/10.32698/0492

Sari, R. T., & Angreni, S. (2018). Penerapan Model Pembelajaran Project Based Learning (PjBL) Upaya Peningkatan Kreativitas Mahasiswa. *Jurnal Varidika*, *30*(1), 79–83.

Seage, S.J., & Türegün, M. (2020). The Effects of Blended Learning on STEM Achievement of Elementary School Students. *International Journal of Research in Education and Science (IJRES), 6*(1), 133-140.

Sekaran, U. & Bougie, R. (2013). *Research Methods for Business: A Ability-Building Approach* (6th Edition (ed.)). Wiley.

Subedi, D., & Subedi, R. (2020). Practicing Self Learning of ICT for Resilience Amidst the COVID-19 Outbreak: Experiences from Kathmandu Valley. *Research in Educational Policy and Management*, *2*(2), 78-96. https://doi.org/10.46303/repam.2020.5

Sucipto, S. (2017). Peningkatan Self Regulated Learning Mahasiswa Di Era Digital Melalui Pembelajaran Blended Learning. *Soulmath*, *5*(1), 31. https://doi.org/10.25139/sm.v5i1.455

Surani, D. (2019). Studi Literatur: Peran Teknologi Pendidikan dalam Pendidikan 4.0. *Prosiding Seminar Nasional Pendidikan FKIP*, *2*(1), 456–469.

Susilawati, S., Yasin, A. F., & Hambali, M. (2020). Model Pembelajaran Blended Learning Untuk Meningkatkan Kualitas Belajar Mahasiswa Universitas Islam Negeri Maulana Malik Ibrahim Malang. *Edumaspul: Jurnal Pendidikan*, *4*(1), 329–341. https://ummaspul.e-journal.id/maspuljr/article/view/381

Susilowati, E., & Dewantara, D. (2021). Pengaruh blended learning terhadap keterampilan berpikir kritis dan ketrampilan berpikir kreatif. *Prosiding Seminar Nasional Lingkungan Lahan Basah*, *6*(2), 1–5.

Syaparuddin, S., & Elihami, E. (2017). Peningkatan Kecerdasan Emosional (Eq) Dan Kecerdasan Spiritual (Sq) Siswa Sekolah Dasar Sd Negeri 4 Bilokka Sebagai Upaya Meningkatkan Kualitas Diri Dalam Proses Pembelajaran PKn. *Jurnal Pendidikan Guru Sekolah Dasar*, *1*(2), 1–19.

Tadeu, P., Fernandez Batanero, J., & Tarman, B. (2019). ICT in a Global World. *Research in Social Sciences and Technology*, *4*(2), i-ii. https://doi.org/10.46303/ressat.04.02.ed

Tarbutton, T. (2018). Leveraging 21st century learning & technology to create caring diverse classroom cultures. *Multicultural Education*, *25*(2), 4–6.

Triyanto, S. A., & Prabowo, C. A. (2020). Efektivitas Blended-Problem Based Learning dengan Lesson Study Terhadap Hasil Belajar Effectiveness of Blended-Problem Based Learning with Lesson Study toward Learning Outcomes. *Bioedukasi: Jurnal Pendidikan Biologi*, *13*(1), 42–48.

Tsakeni, M. (2021). Transition to online learning by a teacher education program with limited 4IR affordances. *Research in Social Sciences and Technology*, *6*(2), 129-147.

Tyley, S. (2012). Blended learning. *Fire Risk Management*, September, 26–30. https://doi.org/10.4018/ijwltt.20211101.oa13

Usman, U. (2019). Komunikasi Pendidikan Berbasis Blended Learning Dalam Membentuk Kemandirian Belajar. *Jurnal Jurnalisa*, *4*(1), 136–150. https://doi.org/10.24252/jurnalisa.v4i1.5626

Wahyudi, W. (2020). The effectiveness of sharing blended project based learning (SBPBL) model implementation in operating system course. *International Journal of Emerging Technologies in Learning*, *15*(5), 202–211. https://doi.org/10.3991/IJET.V15I05.11266

Wahyudi, W., & Winanto, A. (2018). Development of Project-based Blended Learning (PjB2L) Model To Increase Pre-Service Primary Teacher Creativity. *Journal of Educational Science and Technology (EST)*, *4*(2), 91. https://doi.org/10.26858/est.v4i2.5563

Waluya, S., & Wiyono, A. (2015). Pengaruh media pembelajaran menggunakan program sketchup terhadap kemampuan menggambar proyeksi prtogonal siswa di smk negeri 2 Surabaya. *Jurnal Kajian Pendidikan Teknik Bangunan (JKPTB)*, *3*(3), 57–74.

Watson, J., Powell, A., Staley, P., Patrick, S., Horn, M., Fetzer, L., Hibbard, L., Oglesby, J., Verma, S., Education, M., C, T. O. C.-I. N. B., Kuehn, B. L., Ed, D., Archibald, D., Barbour, M. K., Leary, H., Wilson, E. V., & Ostashewski, N. (2020). Teacher education and K-12 online learning. *INACOL, The International Association for K–12 Online Learning*, *July*, 1–20.

White, C. (2020). Wielding Social Media in the Cyber-Arena: Globalism, Nationalism, and Civic Education. Research in Social Sciences and Technology, 5(1), 1-21. https://doi.org/10.46303/ressat.05.01.1

Williams, T., McIntosh, R., & Russell, W. (2021). Equity in Distance Education During COVID-19. *Research in Social Sciences and Technology*, *6*(1), 1-24. https://doi.org/10.46303/ressat.2021.1

Winaryati, E. (2018). Penilaian Kompetensi Siswa Abad 21. *Seminar Nasional Edusainstek FMIPA UNISMUS 2018*, *6*(1), 6–19. https://jurnal.unimus.ac.id/index.php/psn12012010/article/viewFile/4070/3782

Yulianto, S. (2015). *Penerapan Metode Pembelajaran Problem Based Learning untuk Meningkatkan Prestasi Belajar Siswa pada Mata Pelajaran Gambar Teknik di SMK Negeri 2 Yogyakarta*.

Yusnaeni, Y., Corebima, A. D., Susilo, H., & Zubaidah, S. (2017). Creative thinking of low academic student undergoing search solve create and share learning integrated with metacognitive strategy. *International Journal of Instruction*, *10*(2), 245–262. https://doi.org/10.12973/iji.2017.10216a

Yustina, Syafii, W., & Vebrianto, R. (2020). The effects of blended learning and project-based learning on pre-service biology teachers' creative thinking ability through online learning in the COVID-19 pandemic. *Jurnal Pendidikan IPA Indonesia*. https://doi.org/10.15294/jpii.v9i3.24706

Yusuf Sukman, J. (2017). Model Evaluasi Program Dalam Penelitian Evaluasi. *Jurnal Ilmiah Penjas, 4*(1), 9-15.

Zarah, J., No, V., No, J. B., Kasihan, K., & Yogyakarta, D. I. (2021). Posisi Keterampilan Berpikir Kritis Dan Keterampilan Berpikir [The Position of Critical Thinking and Creative Thinking in Science]. Jurnal Zarah, *9*(1), 8–14.

Zubaidah, S., Fuad, N. M., Mahanal, S., & Suarsini, E. (2017). Improving creative thinking ability of students through Differentiated Science Inquiry integrated with mind map. *Journal of Turkish Science Education*, *14*(4), 77–91. https://doi.org/10.12973/tused.10214a.

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