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The Effect of Learning Methods and Class Levels on Improving Creative Thinking in Aviation Vocational: 2x3 Factorial Anova Analysis

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ABSTRACT

Creative thinking is crucial in aviation vocational education to tackle dynamic industry challenges, but it is often hindered by overly structured educational approaches. This study evaluates the impact of learning methods and class levels on creative thinking enhancement, aiming to improve learning effectiveness in vocational education. Conducted at the Surabaya Aviation Polytechnic with a sample of 144 students selected through multiple-stage random Sampling, data analysis was performed using 2x3 Factorial ANOVA. The results reveal that Problem-Based Learning (PBL) is significantly more effective in enhancing creative thinking compared to conventional methods in aviation vocational education. Class levels (Semester I, II, III) do not significantly influence creative thinking improvement, indicating that longer learning experiences do not automatically boost creativity. Furthermore, no significant interaction was found between learning methods and class levels in affecting creative thinking enhancement

INTRODUCTION

The ability to think creatively is a skill important in education vocational, especially in field flights, which require the ability to adapt and innovate. In the industry of continuous flight development, professionals must be capable overcome various challenging technical and operational with solutions creative. According to Alam et al. (2023), thinking creatively is the process of generating new ideas that are relevant and useful, which is very important because it pushes innovation and efficiency. Vocational education that is capable grow skills This will produce graduates who are not only Ready to work but also ready to face changes and challenges in the world of work.

However, the development of skills thinks creative in education vocation no easy. One of the challenge mains is the approach to education that tends to focus on mastery skills solely, often ignoring development skills think level tall like creativity. According to Armadan (2023), an approach of too much education structured and dominated by teaching based on knowledge can hinder the development creativity of in participant education. In the field of flight specifically Polytechnic Surabaya Flights, which are very prioritised safety and precision, challenges the bigger because approaching too much learning rigid can hinder initiative and thinking creative.

The learning method's own role is crucial in influencing the ability to think creative participants educate. Conventional methods are often used in education vocation generally emphasize teaching directly and repetitively, which tends to be more effective in teaching basic and knowledge factual. However, the method This often criticized Because not to push participants educate think creatively or solve problems in any way independently (Ersa et al., 2023). On the other hand, Problem-Based Learning (PBL) has been identified as an effective method For stimulating thinking and creativity with participants educated in situation breakdown realistic problems, so that they are more involved in a way active in the learning process (Chan, 2013).

Even though Thus, both methods have Their own Advantages and disadvantages conventional methods are more structured and easily implemented, but tend to limit the creativity of participants. On the other hand, PBL is more challenging and requires more power, good from aspect time and also power trained instructors, however own potential big in increase creativity and skills breakdown problem participants educate Anazifa & Djukri (2017). Therefore that's important To evaluate how far the method of learning This effective in increasing the ability to think creatively, especially in the context of education vocation flight.

With the use of analysis Anova 2x3 factorial, the research Aims To test the influence of method learning to improve think creative, knowing influence levels class to improve think creative and analyze the interaction between method learning and levels class in influence ability think creative participant educate. Thus, research This expected to contribute theoretically to the development method of more learning effective in education vocation as well as give implications practical for managers and educators in education vocation flight in an effort to increase the quality graduate of participant students.

METHODS

Study This was implemented in Vocational Education Flight Polytechnic Surabaya flights even semester with amount sample study is 144 people using a stage Random Sampling technique which is divided over 2 study programs technique Air Navigation and Aircraft Engineering. Types of research are experiment pseudo (True Experiment) with treatment design by level 2 x 3, analysis variance use Anova 2x3 factorial using device SPSS 22 software. Variables free is method learning consists of conventional as control aimed at 72 students in the Air Navigation Engineering Study Program Semesters I, II, and III and the Problem-Based Learning (PBL) method as class experiments aimed at 72 students of the Aircraft Engineering Study Program Semesters I, II and III, the variables bound is results score ability think creative students

in class physics. To collect capability data think creatively that is use a questionnaire ability think in the meantime instrument test motivation Study mathematics use a questionnaire. The ability to think creatively is measured with involving 4 indicators namely (Munandar, 2009): 1) Original Thinking; 2) Fluent Thinking; 3) Flexible Thinking; 4) Elaboration Ability.

The relationship between variables that have been presented, can be described in the form table as follows.

Table 1. Design a Diagram of Relationships Between Variables

Class Level	**Learning Method (Thinking Score) Creative)**	
	Control (Conventional-X_1)	**Experiment (PBL- X_2)**
Semester I (A_1)	X_1, A_1	X_2, A_1
Semester II (A_2)	X_1, A_2	X_2, A_2
Semester III (A_3)	X_1, A_3	X_2, A_3

Information:

X 1: Ability score think a creative student with method Study conventional

X 2: Ability score think a creative student with method PBL learning

A 1: Ability score think a creative student with levels Semester I Class

A 2: Ability score think a creative student with levels Semester II class

A 3: Ability score think a creative student with levels Semester III class

X 1, A 1: Interaction between score ability to think creatively with method Study conventional and first-semester students

X 1, A 2: Interaction between score ability to think creatively with method Study conventional and second-semester students

X 1, A 3: Interaction between score ability to think creatively with method Study conventional and third-semester students

X 2, A 1: Interaction between score ability to think creatively with method PBL learning and 1st-semester students

X 2, A 2: Interaction between score ability to think creatively with method PBL learning and second-semester students

X 2, A 3: Interaction between score ability to think creatively with method PBL learning and semester III students

Thus, the hypothesis proposed in the research This in analysis Anova The factorial of 2x3 is as follows.

H 1: There is an influence method learning (Conventional and PBL) towards thinking creatively in vocational flight

H 2: There is an influence levels class (Semester I, II, III) against thinking creatively in vocational flight

H 2: There is an influence interaction method learning (Conventional and PBL) and Class Level (Semester I, II, III) towards thinking creative

RESULTS AND DISCUSSION

Before doing an ANOVA analysis, the researcher needs to conduct validity and reliability tests moreover first. A validity test is one of the steps important in the development process or use of instrument measurements like questionnaires or tests. Generally, the researcher will use Pearson correlation as a validity test (Sürücü & Maslakci, 2020). After the coefficient Pearson correlation was calculated, the results must rated its suitability in the show reliability instrument. If you want to know how significant the correlation of the results, can use table distribution Pearson correlation, sometimes called " r table ", or perform statistical

tests. The r table refers to a table containing values threshold critical For coefficient Pearson correlation at the level significance certain, usually measured at the level significance of 0.05. The results of the validity test are presented in the table under This.

Table 2. Validity and Reliability Test

Aspect Items Think Creative	r count	r table	Cronbach's Alpha	Information
Original_thinking	0.76	0.1637	0.762	Valid and Reliable
Fluent_thinking	0.788			Valid and Reliable
Flexible_thinking	0.816			Valid and Reliable
Elaboration_ability	0.691			Valid and Reliable

Obtained results correlation Pearson (r- count) in table 3. which then compared to with mark threshold critical that exists in r- table. with degrees free N-2 = 144-2=142 is 0.762 for set whether results correlation the significant or no. Considering mark Pearson correlation (r- count) is more big from r- table, then all over question study must considered Valid. Reliability test done after validity test finished. Very important For put questionnaires and tests through testing reliability before use it in research and development. Measurement repetitive to variable or the same question item must produce consistent results, and this is it which is assessed its reliability (Sürücü & Maslakci, 2020). Cronbach's alpha is usually used For evaluate reliability; this is size internal consistency of a tool measure, with higher alpha value tall show greater reliability large. Cronbach's alpha values are generally interpreted If alpha value > 0.70, instrument considered own good reliability. The Cronbach's alpha value (Table 2) throughout aspect think creative (Original Thinking, Fluent Thinking, Flexible Thinking, and Elaboration Ability) > 0.7. So, fourth aspect study from think creative stated reliable.

Assumptions Classic

Normality Test

One of the most basic tests in analysis regression is a normality test. So that this This can retained, residue or errors generated by the regression model must follow normal distribution. The Kolmogorov Smirnov test is one of the method For inspect normal condition.

Table 3. Kolmogorov Smirnov Normality Test

One-Sample Kolmogorov-Smirnov Test

	Standardized Residual for Creative Thinking Score

N		144
Normal Parameters [a,b]	Mean	.0000
	Std. Deviation	.98236
Most Extreme Differences	Absolute	.129
	Positive	.109
	Negative	-.129
Test Statistics		3.129
Asymp . Sig. (2-tailed)		.073 [c]

Researcher can conclude that residue normally distributed because the p-value (Asymp. Sig 2-tailed) is 0.073 from the normality test more big from level the significance that has been set (0.05) in table 3.

Homogeneity Test

Assumptions furthermore is a homogeneity test in which do testing Anova 2x3 factorial, researcher need ensure data variants already The same or homogeneous. In the study this is the output of levene's test This used For know is each variant from variable dependent is The same or homogeneous.

Table 4. Levene's Homogeneity Test

Levene's Test of Equality of Error Variances [a]

Dependent Variables: Creative_Thinking_Score

F	df1	df2	Sig.
.564	5	138	.728

Based on the output of table 4. Shows mark significance (sig.) of 0.728 > 0.05. This means that the variance score questionnaire from think creative is The same or homogeneous. With Thus, the requirements for the Anova test The 2x3 factorial is fulfilled.

Anova Test 2x3 Factorial

As for the results from theft Anova 2x3 factorial as following.

Table 5. Calculation Results Anova 2x3 Factorial

Source Variance	Amount Square (JK)	Degrees Freedom (dk)	Mean Square	F- count	P-value (Sig.)
Learning Method (*X*)	47,851	1	47,851	8,830	.003
Level (*A*)	4,400	2	2,200	.406	.667
Interaction of Learning Methods and Class Levels (*XA*)	.107	2	.053	.010	.990
Error (*e*)	747,813	138	5.419		
Total	**22581.000**	**144**			

Based on results Table 5 shows the existence influence think creative, indicating that there is influence significant from method learning to improvement think creative in education vocation flight (H1). This is shown by the F- count value of 8,830 with a p-value of 0.003, which is more small from 0.05, so that hypothesis zero (H0) which states No There is influence method learning to think creative can rejected. This means that method learning, good That Conventional and Problem-Based Learning (PBL), provide different impacts in increase ability think creative student.

On the other hand, no there is influence significant from levels class (H2) against think creative in vocation flights, as shown by the F-count value of 0.406 and a p-value of 0.667 which is greater big from 0.05. In addition, no There is interaction significant between method learning and levels class to improve think creative (H3), with F-value is 0.010 and p-value is 0.990. This shows that influence method of learning to think creatively No influenced by level class students, as well as on the contrary.

Table 6. Estimation of Marginal Mean between Learning Methods

Learner_Model	Mean	Std. Error	95% Confidence Interval	
			Lower Bound	Upper Bound
Control (Conventional)	11,717	.274	11,174	12,259
Experiment (PBL)	12,870	.274	12,327	13,413

Based on table results average comparison of thinking creative between two group method learning, namely Control (method) conventional) and Experimental (PBL), it can be seen that group Experiment have average thinking more creative high (Mean = 12,870) compared to with group Control (Mean = 11.717). This mean difference show that method learning more PBL based effective in increase ability think creative student compared to method learning conventional. In addition, the 95% confidence interval for group Experiment is in the range of 12,327 to 13,413, which is more tall compared to with group intervals Controls that are in the range of 11,174 to 12,259.

This result strengthen interpretation from H1 which states existence influence significant method learning to think creative in education vocation flight. PBL method in consistent show higher average value high, which indicates that a more approach interactive and based problem can stimulate creativity student with more Good compared to method conventional. This is important For under consideration in development curriculum in education vocation flights , especially in effort increase ability think creative student.

Discussion

Research result This disclose that there is influence significant from method learning to improvement think creative in education vocation flight, where the method learning based on Problem-Based Learning (PBL) is proven more effective compared to method conventional. Findings This in line with Ali & Hartono (2024)that state that PBL facilitates development skills think critical and creative through approach breakdown authentic problems. PBL allows student For involved in a way active in the learning process, encourage they For think out of the box, so that generate creative ideas that are not unexpected. This is also supported by research Artika et al. (2023)which shows that PBL is significant increase ability think creative in students in various discipline knowledge.

On the other hand, research this also shows that levels class (Semester I, II, III) no own influence significant to improvement think creative in students vocation flight. This is indicates that ability think creative No in a way automatic increase along with additional semesters or levels class. Research This contradictory with view traditional which assumes that experience longer study will in a way automatic increase ability think creative. According to Anggreani (2019), development ability think creative more depends on the quality and type experience Study than duration or levels class. This result emphasize importance notice method learning that is applied in every levels class For maximize potential creative student.

More next, results study This show that No There is significant interaction between method learning and levels class to improvement think creative. That is, effectiveness method learning in increase think creative No influenced by level class students. Findings This support view that PBL as method learning universal and effective applied in various levels class without looking at the semester. Research by Pratiwi et al. (2023)also shows that PBL can applied in a way effective on various levels education, with consistent impact to improvement skills think creative.

With Thus, the findings This confirm importance election method appropriate learning, such as PBL, for support development think creative in students vocation flight. Although levels class No in a way direct influence ability think creative, implementation method innovative and challenging learning in a way cognitive in every levels still required For maximize potential creative students. These results also strengthen importance evaluation sustainability to effective method learning used, use ensure that every student get optimal opportunity for develop ability think creative.

CONCLUSION

Based on the results of 2x3 factorial ANOVA analysis, research concludes that method learning's own influence is significant to improvement think creativity in education vocation flight, with the Problem-Based Learning (PBL) method proven more effective compared to method conventional. Level class, however, does not own significant influence, as well as No There is interaction between method learning and levels class to think creative. This result show that implementation method appropriate learning, such as PBL, is more determine in develop ability think creative compared to with level maturity academic students represented by level class.

Implications from findings This emphasize importance focus on design method learning that can stimulate creativity students, especially in education vocations that require skills think creative For solve problems practical. The implementation of PBL is necessary prioritized in curriculum vocation flight without look at levels class, because its effectiveness universal in nature. Recommendations For study furthermore covers exploration more carry on about other possible

variables to moderate influence method learning to think creative, such as motivation Study or environment learning, for get better understanding comprehensive about supporting factors development creativity student in context education vocation.

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