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EFFECT OF INQUIRY CREATIVE PROCESS LEARNING MODELS ON IMPROVING THE CRITICAL THINKING ABILITY OF PROSPECTIVE SCIENCE TEACHERS

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ABSTRACT: *Critical thinking has become a very important part as one of the goals of learning at the level of higher education in Indonesia and globally, and learning based on inquiry activities is recommended as a teaching foundation for training learners' critical thinking ability. Teaching inventions towards critical thinking must be trained to prospective teacher for better education in the future. This study aims to determine the effect of the Inquiry Creative Learning (ICP) learning model on improving the critical thinking ability of prospective science teachers. This research is an experimental study with the design of "one group pretest-posttest design". The subject of implementation as a research sample were 20 prospective science teacher who is currently studying at the Faculty of Teacher Training and Education (FKIP), Mataram University, Indonesia. The data of critical thinking ability were analyzed descriptively and statistically, in which homogeneity test, normality test, and t-test were conducted. The results showed that the ICP learning model had an effect on improving critical thinking ability of prospective science teachers.*

Keywords: *ICP Learning Model, Critical Thinking Ability.*

INTRODUCTION

One of the factors that causes the low quality of learning is the learning process that does not encourage students to think critically. Critical thinking has become a major trend and focus in learning, even curriculum authorities in some developed countries have included the critical thinking ability in their curriculum as a learning objective and one of the essential skills in the 21st century (Prayogi, Yuanita, & Wasis, 2017; Prayogi, et. al., 2019). Critical thinking is a reasonable and reflective thinking that is focused on deciding what to believe or do (Ennis, 2015). According to Lai (2011) who has conducted a review of a number of literature and expert opinions about critical thinking, drawing conclusions that critical thinking can be seen in three main approaches in its definition, namely the philosophical approach, cognitive psychological approach, and educational approach. Critical thinking in a philosophical approach emphasizes the quality and characteristics of a critical thinker. In the cognitive psychological approach, critical thinking places more emphasis on real action and behavior that can be demonstrated by a critical thinker, so that by definition there is a list of critical thinking ability. Finally as an educational approach, critical thinking is emphasized more as a process of thinking at a higher level or what is referred to as "higher order thinking skills".

The critical thinking ability is a dimension of cognitive processes which needed to solve 21st century problems and is a direction for the development of learning globally (Birgili, 2015). In addition, critical thinking has become the goal

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of learning at the higher education level in Indonesia, and efforts to improve the critical thinking ability of prospective teacher are pursued to achieve national education goals. In the context of teaching science, mastery of science material requires the ability to think logically and critically, therefore the model applied should facilitate the learners' thinking activities. Learning critical thinking requires a holistic approach and involves a set of appropriate learning models (Thompson, 2011). One model that can be integrated in teaching science, is a model based on inquiry activities (Wenning, 2011). Some previous researchers also recommend inquiry as a teaching foundation for practicing critical thinking skills (Prayogi, Yuanita, & Wasis, 2018).

Recently, Wahyudi, et. al. (2018) developed the Inquiry Creative Process (ICP) learning model to train the critical thinking ability of prospective teacher. ICP is a learning model that integrates the activity of scientific inquiry with scientific creativity. According to Wahyudi, et. al. (2019), creative processes or also called scientific creativity have the potential to train learners' critical thinking ability. The ICP learning model consist of 5 (five) steps/phases of learning, namely: a) problem preparation and identification (problem finding); b) formulating hypotheses (creating hyphotheses); c) creatively experiment designing; d) science creatively problem solving; and e) creatively product design.

Hypothetical framework Inquiry Creative Process (ICP) learning model refers to the findings of Wahyudi, et. al. (2018). First learning phase (problem preparation and identification-problem finding), lecturer behaviors are prepare learners to learn and convey learning objectives; instructing learners to find as many problems as possible related to learning mater, and they choose one core problem to be tested; and instructing learners to formulate the problem to be tested. Second learning phase (formulating hypotheses-creating hyphotheses), lecturer behaviors are instructing learners to formulate hypotheses according to the chosen problem. Third learning phase (creatively experiment designing), lecturer behaviors are instructing learners to identify the variables in the hypothesis to be tested; defining the variables operationally; and arranging the steps of testing the hypothesis in the form of creative experiment procedures. Fourth learning phase (science creatively problem solving), lecturer behaviors are instructing learners to implement the experimental steps that have been prepared; check the accuracy of the implementation of experimental steps that have been done; evaluate the results of experiments based on hypotheses that have been previously formulated; and conclude the results of experiments. Sixth learning phase (creatively product design), lecturer behaviors are instructing learners to make resumes of experimental results that include detailed explanations with the support of concepts from various relevant sources.

The results of the validation through the focuss-group-discussion activity showed that the ICP learning model had valid criteria to train the critical thinking ability of prospective teacher. Furthermore, research needs to be conducted on how the effect of the ICP learning model on improving the critical thinking ability of prospective science teacher.

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METHODS

This research is an experimental research that aims to determine the effect of inquiry creative process learning models on the improving critical thinking ability of prospective science teachers. The one group pretest-posttest design conducted in this study (Fraenkel, Wallen, & Hyun, 2012).

Table 1. Research Design.

Group	Pretest	Treatment	Posttest
P	O_1	X	O_2

The sample in this study was taken with purposive sampling technique with the criteria of prospective science teachers who were taking fundamental physics courses as many as 20 prospective science teachers in the Faculty of Teacher Training and Education, Mataram University, Indonesia.

The indicators of critical thinking ability measured in this study, namely: analysis, inference, evaluation, and decision making. Critical thinking ability of prospective science teachers are measured using the critical thinking ability test instrument. The essay test is adjusted to the critical thinking indicator, which is given to the sample group as a pretest and posttest. The scoring technique for critical thinking ability is adapted from the Ennis-Weir Critical Thinking Essay Test where the highest score is +3 and the lowest is -1. The number of questions as many as 8 (eight) items follow the indicator of critical thinking ability, so the maximum score is +24 and the minimum score is -8. The conversion of scores into categorized qualitative data adapted from Prayogi, et. al. (2019) is presented in Table 2.

Table 2. Five Scale Quantitative Data Conversion with 8 Items Test.

Interval Score	*Range*	*Category*
$X > X_i + 1.8$ Sbi	$X > 17.6$	Very Critically
$X_i + 0.6$ Sbi $< X \leq X_i + 1.8$ Sbi	$11.2 < X \leq 17.6$	Critically
$X_i - 0.6$ Sbi $< X \leq X_i + 0.6$ Sbi	$4.8 < X \leq 11.2$	Critically Enough
$X_i - 1.8$ Sbi $< X \leq X_i - 0.6$ Sbi	$-1.6 < X \leq 4.8$	Less Critically
$X \leq X_i - 1.8$ Sbi	$X \leq -1.6$	Not Critically

Anotation: X (Empirical Score), X_i (Ideal Average Score), Sbi (Ideal Standard Deviation).

The score increased of critical thinking ability were analyzed using the N-gain equation (Hake, 1999) with the criteria for changing scores (N-gain); high (> 0,70), moderate (0,30-0,70), and low (< 0,30). Data on critical thinking ability were analyzed descriptively and statistically, homogeneity test, normality test, and t-tests were conducted. The hypothesis tested in this study is an increase in critical thinking ability of prospective science teachers between pretest and posttest, which shows the effect of learning with the given ICP model. All statistical data analysis uses Statistical Package for Social Science (SPSS) 23.0 software tools.

RESULTS AND DISCUSSION

The measurement results of critical thinking ability of prospective science teachers are provided in Table 3 and Figure 1. The results of the homogeneity test of the sample variance and normality are presented in Table 4, and the results of the t test are presented in Table 5.

Table 3. Measurement Results of Critical Thinking Ability.

CTs Interval	*Criteria*	*Pretest*		*Posttest*		*N-gain*	*Criteria*
		Freq.	*Mean*	*Freq.*	*Mean*		
X >17.6	VC	0	-2.40	6	16.6	0.71	High
11.2 < X ≤ 17.6	C	0	(NC)	14	(C)		
4.8 < X ≤ 11.2	CE	0		0			
-1.6 < X ≤ 4.8	LC	6		0			
X ≤ -1.6	NC	14		0			
Amount		**20**		**20**			

Anotation: VC (Very Critically), C (Critically), CE (Critically Enough), LC (Less Critically), NC (Not Critically).

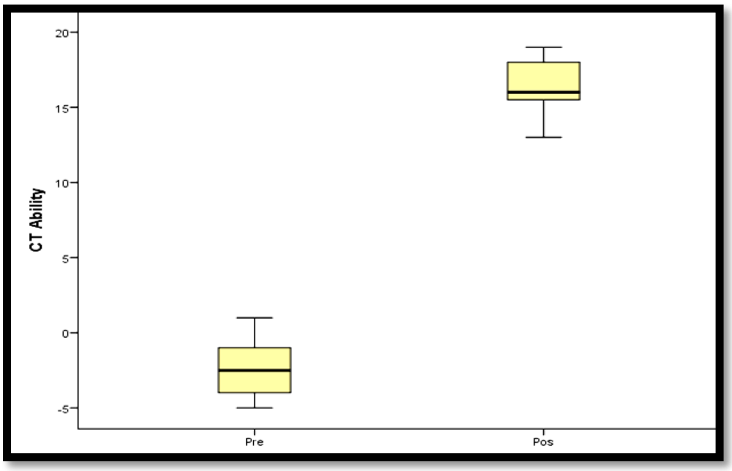

Figure 1. Measurement Result of Critical Thinking Ability between Pretest and Posttest.

Table 4. The Results of Homogeneity and Normality Test.

Data	**Group**	**Homogeneity Test**			**Normality Test**		
		Levene Test	**dF**	**Sig.**	**Kol-Smir. Test**	**N**	**Sig.**
Pretest-Posttest	PST	0.209	38	0.650	0.098	20	0.200

Table 5. The Results of t-Test (Independent Samples Test).

	Group	**t-Test for Equality of Means**		
		t	**df**	**Sig.**
Pretest-Postest (Equal var. ass.)	PPT	-31.996	19	0.000

Measurement results of critical thinking ability shown that the mean score of it on pretest consist of -2,40 with the criteria of "not critically" and posttest consist of 16,6 with the criteria of "critically" (Table 3), and N-gain value of 0,71 with the "high" criteria. These results indicate that there is an increase in the critical thinking ability of prospective science teachers between pretest and posttest, descriptively this result implies that there is an effect of learning given to the improvement of prospective science teachers' critical thinking ability, in this

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study is the implementation of the ICP learning model. The statistical analysis was also conducted to evaluate the effect of the ICP learning model on prospective science teachers' critical thinking ability, with predetermined hypothesis testing criteria.

The homogeneity test, normality test, and t-test were conducted. Tables 4 and 5 present the results of the variance homogeneity test using the Levene's test and the normality test using the Kolmogorov-Smirnov normality test showing that the variance of homogeneous, and the data normally distributed with a significance value of both are greater than alpha testing (0,05). Table 5 presents the results of the t test which show that the significance value of the test (0,000) is smaller than the alpha of the test (0,05), thus the hypothesis H_0 is rejected and H_1 is accepted, meaning that there is an increase in prospective science teachers' critical thinking ability between the pretest score and the posttest score after implementing the ICP learning model. These results are evidence that there is an effect of learning using the ICP model on increasing the critical thinking ability of prospective science teachers'.

The results of studies that have been presented are inseparable from the learning process given, in which in the ICP learning model the prospective science teachers' are transplanted to be able to think critically through the process and also the inquiry activity itself. The findings in this study also provide empirical evidence that scientific creativity in inquiry activities has an impact on improving the critical thinking ability of prospective science teachers. In this study, scientific creativity in question are problem finding, creating hyphotheses, creatively experimental designing, science creatively problem solving, and creatively product design. Improving the critical thinking ability through the ICP learning model cannot be separated from the interventions of each phase carried out during the learning process in the ICP model where the learning phase consistently trains critical thinking ability. Creative problem solving which is dimension of scientific creativity, its have correlation in the context to practice critical thinking (Samani, et. al., 2019).

The cognitive dimension of creative thinking correlates with several dimensions in critical thinking, this is very clear when learners think in the context of problem solving. When learners think in certain contexts (critical thinking), they use various thought processes (creative thinking). The nature of critical thinking is related to creative abilities during problem discovery and problem solving (Koray & Köksal, 2009). The ability to find creative problems is defined as a kind of intellectual trait or ability that is demonstrated in the process of generating and expressing new questions that are found in a way that is unique, new, and useful, using existing context and experience. Furthermore, when the problem is being faced, a hypothesis is needed to determine the most appropriate way to solve the problem, which will automatically strengthen to think critically. Creative product design is a part of scientific creativity in which students are required to be able to design scientific products as a result of scientific creativity (Hu & Adey, 2010), these points are important findings in terms of developing the critical thinking ability of prospective science teachers.

CONCLUSIONS

The results showed that the ICP learning model had an effect on improving the critical thinking ability of prospective science teachers. An important finding in this study is that the processes of scientific creativity in inquiry activities that are intensively trained have an effect on improving the critical thinking ability. The implication of this finding is that the ICP learning model can be an alternative model implemented in learning who specifically practice critical thinking ability. The researcher recommends further research to explore the effects of the ICP learning model not only on aspects of critical thinking ability but also the disposition of critical thinking.

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TITLE AND ABSTRACT

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LEARNING MODELS TO OVERCOME THE WEAKNESS OF CRITICAL THINKING ABILITY IN PROSPECTIVE SCIENCE TEACHERS

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Abstract

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Key words: *ICP learning model, critical thinking ability*.

INTRODUCTION

One of the factors that causes the low quality of learning is the learning process that does not encourage students to think critically. Critical thinking has become a major trend and focus in learning, even curriculum authorities in some developed countries have included the critical thinking ability in their curriculum as a learning objective and one of the essential skills in the 21st century (Prayogi, Yuanita, & Wasis, 2017; Prayogi, et al., 2019). Critical thinking is a reasonable and reflective thinking that is focused on deciding what to believe or do (Ennis, 2011). According to Lai (2011) who has conducted a review of a number of literature and expert opinions about critical thinking, drawing conclusions that critical thinking can be seen in three main approaches in its definition, namely the philosophical approach, cognitive psychological approach, and educational approach. Critical thinking in a philosophical approach emphasizes the quality and characteristics of a critical thinker. In the cognitive psychological approach, critical thinking places more emphasis on real action and behavior that can be demonstrated by a critical thinker, so that by definition there is a list of critical thinking ability. Finally as an educational approach, critical thinking is emphasized more as a process of thinking at a higher level or what is referred to as "higher order thinking skills."

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critically, therefore the model applied should facilitate the learners' thinking activities. Learning critical thinking requires a holistic approach and involves a set of appropriate learning models (Thompson, 2011). One model that can be integrated in teaching science, is a model based on inquiry activities (Wenning, 2015). Some previous researchers also recommend inquiry as a teaching foundation for practicing critical thinking skills (Prayogi, Yuanita, & Wasis, 2018).

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Hypothetical framework Inquiry Creative Process (ICP) learning model refers to the findings of Wahyudi et al (2018) as described in Table 1.

Table 1. Hypothetical framework of ICP learning model.

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Learning phases	*Learning process (lecturer behavior)*
1. Problem preparation and identification (problem finding)	• Prepare learners to learn and convey learning objectives. • Instructing learners to find as many problems as possible related to learning mater, and they choose one core problem to be tested. • Instructing learners to formulate the problem to be tested.
2. Formulating hypotheses (creating hyphotheses)	• Instructing learners to formulate hypotheses according to the chosen problem.
3. Creatively experiment designing	• Instructing learners to identify the variables in the hypothesis to be tested, defining the variables operationally, and arranging the steps of testing the hypothesis in the form of creative experiment procedures.
4. Science creatively problem solving	• Instructing learners to implement the experimental steps that have been prepared, check the accuracy of the implementation of experimental steps that have been done, evaluate the results of experiments based on hypotheses that have been previously formulated, and conclude the results of experiments.
5. Creatively product design	• Instructing learners to make resumes of experimental results that include detailed explanations with the support of concepts from various relevant sources.

The results of the validation through the focuss-group-discussion activity showed that the ICP learning model had valid criteria to train the critical thinking ability of prospective teacher. Furthermore, research needs to be conducted on how the effect of the ICP learning model on improving the critical thinking ability of prospective science teacher. The specific purpose of this study is to explore the effect of Inquiry Creative Process (ICP) learning models on improving the critical thinking ability of prospective science teachers.

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METHODS

This research is an experimental research that aims to determine the effect of Inquiry Creative Process learning models on the improving critical thinking ability of prospective science teachers. The one group pretest-posttest design conducted in this study (Fraenkel, Wallen, & Hyun, 2012).

Group	***Pretest***	***Treatment***	***Posttest***
P	O_1	*X*	O_2

The sample in this study was taken with purposive sampling technique with the criteria of prospective science teachers who were taking fundamental physics courses as many as 20 prospective science teachers in the Faculty of Teacher Training and Education, University of Mataram - Indonesia.

The indicators of critical thinking ability measured in this study, namely: analysis, inference, evaluation, and decision making. Critical thinking ability of prospective science teachers are measured using the critical thinking ability test instrument. The essay test is adjusted to the critical thinking indicator, which is given to the sample group as a pretest and posttest. The scoring technique for critical thinking ability is adapted from the Ennis-Weir Critical Thinking Essay Test where the highest score is +3 and the lowest is -1. The number of questions as many as 8 (eight) items follow the indicator of critical thinking ability, so the maximum score is +24 and the minimum score is -8. The conversion of scores into categorized qualitative data adapted from Prayogi et al (2018) is presented in Table 2.

Table 2. Five scale quantitative data conversion with 8 items test

Interval score	*Range*	*Category*
$X > X_i + 1{,}8\ Sbi$	$X > 17{,}6$	Very critically
$X_i + 0{,}6\ Sbi < X \leq X_i + 1{,}8\ Sbi$	$11{,}2 < X \leq 17{,}6$	Critically
$X_i - 0{,}6\ Sbi < X \leq X_i + 0{,}6\ Sbi$	$4{,}8 < X \leq 11{,}2$	Critically enough
$X_i - 1{,}8\ Sbi < X \leq X_i - 0{,}6\ Sbi$	$-1{,}6 < X \leq 4{,}8$	Less critically
$X \leq X_i - 1{,}8\ Sbi$	$X \leq -1{,}6$	Not critically

anotation***:*** *X (empiricalscore),* X_i *(Ideal average score), Sbi (Ideal standard deviation)*

The score increased of critical thinking ability were analyzed using the N-gain equation (Hake, 1999) with the criteria for changing scores (N-gain); high (> 0.70), moderate (0.30 - 0.70), and low (<0.30). Data on critical thinking ability were analyzed descriptively and statistically, homogeneity test, normality test, and t-tests were conducted. The hypothesis tested in this study is an increase in critical thinking ability of prospective science teachers between pretest and posttest, which shows the effect of learning with the given ICP model. All statistical data analysis uses Statistical Package for Social Science (SPSS) 23.0 software tools.

RESULTS AND DISCUSSION

The measurement results of critical thinking ability of prospective science teachers are provided in Table 3 and Figure 1. The results of the homogeneity test of the sample variance and normality are presented in Table 4, and the results of the t test are presented in Table 5.

Table 3. Measurement results of critical thinking ability

CTs interval	*Criteria*	*Pre test*		*Post test*		*N-gain*	*Criteria*
		Freq.	*Mean*	*Freq.*	*Mean*		
X > 17,6	VC	0	-2.40	6	16.6	0.71	High
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4,8 < X ≤ 11,2	CE	0		0			
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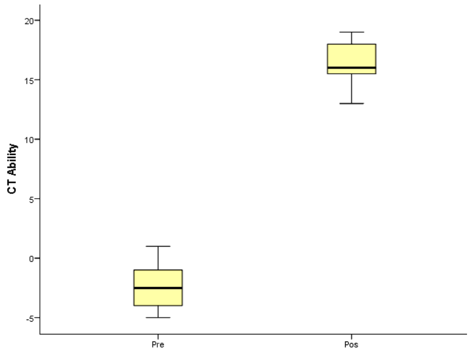

Figure 1. Measurement result of critical thinking ability between pretest and posttest

Table 4. The results of homogeneity and normality test

Data	*Group*	*Homogeneity test*			*Normality test*		
		Levene test	*dF*	*Sig.*	*Kol-Smir. test*	*N*	*Sig.*
Pretest-Posttest	PST	0.209	38	0.650	0.098	20	0.200

Table 5. The results of t-test (independent samples test)

	Group	*t-test for equality of means*		
		t	*df*	*Sig.*
Pretest-postest (equal var. assum.)	PPT	-31.996	19	0.000

Measurement results of critical thinking ability shown that the mean score of it on pretest consist of -2.40 with the criteria of “not critically” and posttest consist of 16.6 with the criteria of “critically” (Table 3), and N-gain value of 0.71 with the “high” criteria. These results indicate that there is an increase in the critical thinking ability of prospective science teachers between pretest and posttest, descriptively this result implies that there is an effect of learning given to the improvement of prospective science teachers’ critical thinking ability, in this study is the implementation of the ICP learning model. The statistical analysis was also conducted to evaluate the effect of the ICP learning model on prospective science teachers’ critical thinking ability, with predetermined hypothesis testing criteria. The homogeneity test, normality test, and t-test were conducted. Tables 4 and 5 present the results of the variance homogeneity test using the Levene's test and the normality test using the Kolmogorov-Smirnov normality test showing that the variance of homogeneous, and the data normally distributed with a significance value of both are greater than alpha testing (0.05). Table 5 presents the results of the t test which show that the significance value of the test (0.000) is smaller than the alpha of the test (0.05), thus the hypothesis H_0 is rejected and H_1 is accepted, meaning that there is an increase in prospective science teachers' critical thinking ability between the pretest score and the posttest score after implementing the ICP learning model. These results are evidence that there is an effect of learning using the ICP model on increasing the critical thinking ability of prospective science teachers'.

The results of studies that have been presented are inseparable from the learning process given, in which in the ICP learning model the prospective science teachers' are transplanted to be able to think critically through the process and also the inquiry activity itself. The findings in this study also provide empirical evidence that scientific creativity in inquiry activities has an impact on improving the critical thinking ability of prospective science teachers. In this study, scientific creativity in question are problem finding, creating hyphotheses, creatively experimental designing, science creatively problem solving, and creatively product design. Improving the critical thinking ability through the ICP learning model cannot be separated from the interventions of each phase carried out during the learning process in the ICP model where the learning phase consistently trains critical thinking ability. Creative problem solving which is dimension of scientific creativity, its have correlation in the context to practice critical thinking.

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The cognitive dimension of creative thinking correlates with several dimensions in critical thinking, this is very clear when learners think in the context of problem solving. When learners think in certain contexts (critical thinking), they use various thought processes (creative thinking). The nature of critical thinking is related to creative abilities during problem discovery and problem solving (Koray & Köksal, 2009). The ability to find creative problems is defined as a kind of intellectual trait or ability that is demonstrated in the process of generating and expressing new questions that are found in a way that is unique, new, and useful, using existing context and experience. Furthermore, when the problem is being faced, a hypothesis is needed to determine the most appropriate way to solve the problem, which will automatically strengthen to think critically (Alberta Education, 2010). Creative product design is a part of scientific creativity in which students are required to be able to design scientific products as a result of scientific creativity (Hu & Adey, 2010), these points are important findings in terms of developing the critical thinking ability of prospective science teachers.

CONCLUSIONS

The results showed that the ICP learning model had an effect on improving the critical thinking ability of prospective science teachers. An important finding in this study is that the processes of scientific creativity in inquiry activities that are intensively trained have an effect on improving the critical thinking ability. The implication of this finding is that the ICP learning model can be an alternative model implemented in learning who specifically practice critical thinking ability. The researcher recommends further research to explore the effects of the ICP learning model not only on aspects of critical thinking ability but also the disposition of critical thinking.

ACKNOWLEDGEMENTS

The researcher would like to thank those who have contributed in this study, especially to fellow researchers, the subject of model implementation, and Mataram University as the institution that has funded the research.

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EFFECT OF INQUIRY CREATIVE PROCESS LEARNING MODELS ON IMPROVING THE CRITICAL THINKING ABILITY OF PROSPECTIVE SCIENCE TEACHERS

Ni Nyoman Sri Putu Verawati[1], Wahyudi[2], Syahrial Ayub[3], Wiwin Putriawati[4], & Saiful Prayogi[5]

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ABSTRACT*:* *Critical thinking has become a very important part as one of the goals of learning at the level of higher education in Indonesia and globally, and learning based on inquiry activities is recommended as a teaching foundation for training learners' critical thinking ability. Teaching inventions towards critical thinking must be trained to prospective teacher for better education in the future. This study aims to determine the effect of the Inquiry Creative Learning (ICP) learning model on improving the critical thinking ability of prospective science teachers. This research is an experimental study with the design of "one group pretest-posttest design." The subject of implementation as a research sample were 20 prospective science teacher who is currently studying at the Faculty of Teacher Training and Education (FKIP), University of Mataram - Indonesia. The data of critical thinking ability were analyzed descriptively and statistically, in which homogeneity test, normality test, and t-test were conducted. The results showed that the ICP learning model had an effect on improving critical thinking ability of prospective science teachers.*
Key words: *ICP learning model, critical thinking ability.*

INTRODUCTION

One of the factors that causes the low quality of learning is the learning process that does not encourage students to think critically. Critical thinking has become a major trend and focus in learning, even curriculum authorities in some developed countries have included the critical thinking ability in their curriculum as a learning objective and one of the essential skills in the 21st century (Prayogi, Yuanita, & Wasis, 2017; Prayogi, et al., 2019). Critical thinking is a reasonable and reflective thinking that is focused on deciding what to believe or do (Ennis, 2011). According to Lai (2011) who has conducted a review of a number of literature and expert opinions about critical thinking, drawing conclusions that critical thinking can be seen in three main approaches in its definition, namely the philosophical approach, cognitive psychological approach, and educational approach. Critical thinking in a philosophical approach emphasizes the quality and characteristics of a critical thinker. In the cognitive psychological approach, critical thinking places more emphasis on real action and behavior that can be demonstrated by a critical thinker, so that by definition there is a list of critical thinking ability. Finally as an educational approach, critical thinking is emphasized more as a process of thinking at a higher level or what is referred to as "higher order thinking skills."

The critical thinking ability is a dimension of cognitive processes which needed to solve 21st century problems and is a direction for the development of learning globally (Birgili, 2015). In addition, critical thinking has become the goal of learning at the higher education level in Indonesia, and efforts to improve the critical thinking ability of prospective teacher are pursued to achieve national education goals. In the context of teaching science, mastery of science material requires the ability to think logically and critically, therefore the model applied should facilitate the learners' thinking activities. Learning critical thinking requires a holistic approach and involves a set of appropriate learning models (Thompson, 2011). One model that can be integrated in teaching science, is a model based on inquiry activities (Wenning, 2015). Some previous researchers also recommend inquiry as a teaching foundation for practicing critical thinking skills (Prayogi, Yuanita, & Wasis, 2018).

Recently, Wahyudi et al (2018) developed the Inquiry Creative Process (ICP) learning model to train the critical thinking ability of prospective teacher. ICP is a learning model that integrates the activity of scientific inquiry with scientific creativity. According to Wahyudi et al (2019), creative processes or also called scientific creativity have the potential to train learners' critical thinking ability. The ICP learning model consist of 5 (five) steps/phases of learning, namely: a) problem preparation and identification (problem finding); b) formulating hypotheses (creating hyphotheses); c) creatively experiment designing; d) science creatively problem solving; and e) creatively product design.

Hypothetical framework Inquiry Creative Process (ICP) learning model refers to the findings of Wahyudi et al (2018). First learning phase (problem preparation and identification - problem finding), lecturer behaviors are prepare learners to learn and convey learning objectives; instructing learners to find as many problems as possible related to learning mater, and they choose one core problem to be tested; and instructing learners to formulate the problem to be tested. Second learning phase (formulating hypotheses - creating hyphotheses), lecturer behaviors are instructing learners to formulate hypotheses according to the chosen problem. Third learning phase (creatively experiment designing), lecturer behaviors are instructing learners to identify the variables in the hypothesis to be tested; defining the variables operationally; and arranging the steps of testing the hypothesis in the form of creative experiment procedures. Fourth learning phase (science creatively problem solving), lecturer behaviors are instructing learners to implement the experimental steps that have been prepared; check the accuracy of the implementation of experimental steps that have been done; evaluate the results of experiments based on hypotheses that have been previously formulated; and conclude the results of experiments. Sixth learning phase (creatively product design), lecturer behaviors are instructing learners to make resumes of experimental results that include detailed explanations with the support of concepts from various relevant sources.

The results of the validation through the focuss-group-discussion activity showed that the ICP learning model had valid criteria to train the critical thinking ability of prospective teacher. Furthermore, research needs to be conducted on how the effect of the ICP learning model on improving the critical thinking ability of prospective science teacher.

METHODS

This research is an experimental research that aims to determine the effect of Inquiry Creative Process learning models on the improving critical thinking ability of prospective science teachers. The one group pretest-posttest design conducted in this study (Fraenkel, Wallen, & Hyun, 2012).

Table 1. Research design

Group	*Pretest*	*Treatment*	*Posttest*
P	O_1	*X*	O_2

The sample in this study was taken with purposive sampling technique with the criteria of prospective science teachers who were taking fundamental physics courses as many as 20 prospective science teachers in the Faculty of Teacher Training and Education, University of Mataram - Indonesia.

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were conducted. The hypothesis tested in this study is an increase in critical thinking ability of prospective science teachers between pretest and posttest, which shows the effect of learning with the given ICP model. All statistical data analysis uses Statistical Package for Social Science (SPSS) 23.0 software tools.

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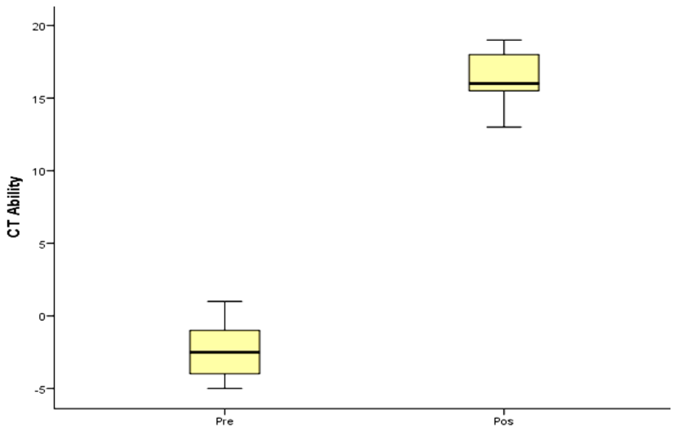

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Table 5. The results of t-test (independent samples test)

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The cognitive dimension of creative thinking correlates with several dimensions in critical thinking, this is very clear when learners think in the context of problem solving. When learners think in certain contexts (critical thinking), they use various thought processes (creative thinking). The nature of critical thinking is related to creative abilities during problem discovery and problem solving (Koray & Köksal, 2009). The ability to find creative problems is defined as a kind of intellectual trait or ability that is demonstrated in the process of generating and expressing new questions that are found in a way that is unique, new, and useful, using existing context and experience. Furthermore, when the problem is being faced, a hypothesis is needed to determine the most appropriate way to solve the problem, which will automatically strengthen to think critically (Alberta Education, 2010). Creative product design is a part of scientific creativity in which students are required to be able to design scientific products as a result of scientific creativity (Hu & Adey, 2010), these points are important findings in terms of developing the critical thinking ability of prospective science teachers.

CONCLUSIONS

The results showed that the ICP learning model had an effect on improving the critical thinking ability of prospective science teachers. An important finding in this study is that the processes of scientific creativity in inquiry activities that are intensively trained have an effect on improving the critical thinking ability. The implication of this finding is that the ICP learning model can be an alternative model implemented in learning who specifically practice critical thinking ability. The researcher recommends further research to explore the effects of the ICP learning model not only on aspects of critical thinking ability but also the disposition of critical thinking.

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