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The Effectiveness of reflective-inquiry learning model to improve preservice-teachers' critical thinking ability viewed from cognitive style

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Abstract. This study aims to explore the effectiveness of Reflective-Inquiry Learning (RIL) model to improve the critical thinking ability of preservice-teachers viewed from cognitive style. Quasi-experimental research using one sample group was conducted in this study. The research sample consisted of 24 (twenty-four) preservice-teachers consisting of 14 (fourteen) males and 10 (ten) females. They are preservice-teachers (PTs) in the physics education study program – Universitas Pendidikan Mandalika (Undikma). Measurement of cognitive style using GEFT to classify the sample group into the field dependent (FD) and field independent (FI) cognitive style. Pre-test and post-test to measure the critical thinking ability of preservice-teachers. Data were analysed descriptively and statistically, where the n-gain test, normality test, and t-test (pair-t test) were conducted. The results of the study have shown that the RIL model is effective in improving the critical thinking ability of preservice-teachers in both the field dependent (FD) and field independent (FI) cognitive style. The results of further studies are described in this article.

1. Introduction

Critical thinking has an important role for the future of students in modern society, and critical thinking supports the work ability of students in the future [1]. Optimizing of student's critical thinking is when they study in the university level, because at universities students are faced with more complex problems that require the critical thinking [2]. In addition, developing students' critical thinking is one form of support for their academic freedom [3]. In a theoretical context, critical thinking is defined as reasonable and reflective thinking that focuses on deciding what to believe or do [4, 5]. Recently the conduction of training critical thinking is aimed at preservice-teachers, because the role of future teachers is the backbone of the quality of learning and education. In addition, preservice-teachers who have the ability to think critically in time will be able to train it at students at the primary and secondary education level when they become teachers [6, 7, 8, 9].

The development of critical thinking has entered the policy realm to improvement the quality of education and learning, this is marked by curriculum reforms in several developed countries that direct learning to achieve critical thinking goals [10]. However, in its implementation inconsistencies often occur, and in fact there are still many learning processes that are oriented towards develop and test learners' memory so that students' thinking abilities are reduced and only understood as the ability



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to remember [11]. Learning design where one of them is setting the right learning model is needed to teach critical thinking [12]. Some previous studies recommend inquiry learning as the foundation of teaching towards increasing critical thinking skills, because basically inquiry teaching focuses on how students can think [13]. To achieve the goal of teaching towards more effective critical thinking, the inquiry learning model needs to be integrated and intervened by reflective processes in its teaching. This is in line with the critical thinking concept which is a form of reflective thinking [14].

Recently an inquiry model has been developed which is intervened by a reflective process called the Reflective-Inquiry Learning (RIL) Model with 6 (six) learning phases, namely orientation, problem presentation, hypothesis formulation, hypothesis testing, formulation of explanation, and reflection [15, 16]. Learning phases of RIL Model are presented in Table 1. The RIL Model was developed specifically to improve critical thinking ability of learners at the higher education. Reflective process interventions in it, such as the presentation of anomalous phenomena, monitoring, performance evaluation, and sustainable reflection that aims to improve critical thinking ability of learners. The hypothetical framework of RIL model was developed and this was validated through focus group discussion (FGD) activities involving 7 validators. The validation results show that the RIL model has been valid in the aspects of content validity and construct validity [15, 16]. Furthermore, this model needs to be implemented in the classroom and evaluated for its effectiveness to improve preservice-teachers' critical thinking ability viewed from cognitive style.

Table 1. Learning phases of RIL Model

Learning phase	Learning activities	Aspects of critical thinking that are trained
1. Orientation	<ul style="list-style-type: none"> • Preparing preservice-teacher to learning 	
2. Providing problems	<ul style="list-style-type: none"> • Presenting a cognitive-conflict with a phenomenon in everyday life that is authentic to the preservice-teachers and then asking for their responses. (<i>Preservice-teachers' monitoring process on each response</i>). • Take corrective action for each response from the preservice-teacher that is not in accordance with the context of the problem being studied. (<i>Preservice-teachers' control process</i>). 	<ul style="list-style-type: none"> • Cognitive-conflict is one of learning strategy that can train learners' critical thinking.
3. Formulating hypothesis	<ul style="list-style-type: none"> • Asking preservice-teachers to formulate the hypotheses according to the problem and show a strong correlation of both. (<i>Preservice-teachers' performance evaluation</i>). 	<ul style="list-style-type: none"> • Aspects of science process skills, including formulating hypotheses and testing them through experimental mechanisms are precursors that bridge the acquisition of critical thinking to the learner.
4. Examining hypothesis	<ul style="list-style-type: none"> • Asking preservice-teachers to testing the hypotheses that they have stated through experimental activities, and write down the experimental data. (<i>Preservice-teachers' control process and performance evaluation</i>). 	
5. Formulating explanation	<ul style="list-style-type: none"> • Asking the preservice-teacher to prepare a detailed explanation of the experimental data and make a generalization. (<i>Preservice-teachers' control process</i>). 	<ul style="list-style-type: none"> • Compiling an explanation is an important aspect of critical thinking skills.
6. Reflection	<ul style="list-style-type: none"> • Involving the preservice-teacher to reflect on the learning process that has been passed and to open space for discussion if there are problems in the learning process. (<i>Preservice-teachers' continuous reflection</i>). 	<ul style="list-style-type: none"> • Thinking about what has been thought through the learning process is a form of self-regulation and this is a strengthening aspect of critical thinking.

Previous studies have shown that critical thinking is related to the cognitive style of learners, in the context of how learners retain information in their thought processes affecting their activities [17]. Individual cognitive styles are generally divided into two groups of cognitive styles, namely field-dependent (FD) and field-independent (FI) cognitive styles [18]. This study aims to evaluate the effectiveness of the RIL model in improving preservice-teacher's critical thinking ability viewed from cognitive style. The term ability is used in this study to clarify aspects of critical thinking as cognitive skills [4, 5] which includes four main aspects of ability namely analysis, inference, evaluation, and decision making [11].

2. Method

Quasi-experimental research using one sample group was conducted in this study. The research sample consisted of 24 (twenty-four) preservice-teachers consisting of 14 (fourteen) male and 10 (ten) female. They are preservice-teachers (PTs) in the physics education study program – Universitas Pendidikan Mandalika (Undikma). The sample was then given The Group Embedded Figures Test (GEFT), this measurement aims to grouping them into FD and FI cognitive styles. GEFT contains 18 (eighteen) item questions in the form of a figure test. GEFT score with two criteria, namely true (score 1) and false (score 0), the interpretation of the total score of each individual if the score is 0-11 then it is stated in the FD cognitive style category and the score 12-18 is stated in the FI cognitive style category. After GEFT, the sample is given a pretest, followed by a learning treatment using the RIL Model, and finally a posttest. Each pretest and posttest used critical thinking ability test which consisted of 8 (eight) item questions. The critical thinking ability score of each individual was analyzed on a range of five scales, the highest with a score of +3 (plus three) and the lowest with a score of -1 (minus one). Furthermore, the critical thinking scores (CTs) of each individual were interpreted as very critically ($CTs > 17.6$), critically ($11.2 < CTs \leq 17.6$), quite critically ($4.8 < CTs \leq 11.2$), less critically ($-1.6 < CTs \leq 4.8$), and not critically ($CTs \leq -1.6$) [11]. Analysis of the increase in critical thinking scores using the n-gain equation. Descriptively and statistically data analysis of critical thinking ability were presented in this study, including the pair-t test preceded by the normality test assisted by SPSS 23.0.

3. Results and Discussion

The descriptively analysis results show that as many as 13 (thirteen) preservice-teachers fall into the category of FD cognitive style and as many as 11 (eleven) with FI cognitive style. Before learning using the RIL Model, when the pretest was obtained by preservice-teachers with the criteria of "less critically" in general for both cognitive styles (pretest score of 0.87), and after the implementation of the RIL model in the classroom, this criteria changed to "critically" when posttest (posttest score of 16.25), with the criteria for changing the score (n gain score) of 0.64 (moderate). The average score of the measurement of critical thinking ability before and after the implementation of the RIL model for each cognitive style of FD and FI is shown in Table 2 and Figure 1.

Table 2. Critical thinking measurement results for each cognitive style

Cognitive style	Number of PTs	Pre-test		Post-test		n-gain	Criteria
		CTs average	Criteria	CTs average	Criteria		
FD	13	0.84	less critically	16.23	critically	0.62	moderate
FI	11	0.91	less critically	16.27	critically	0.66	moderate
Average		0.87	less critically	16.25	critically	0.64	moderate

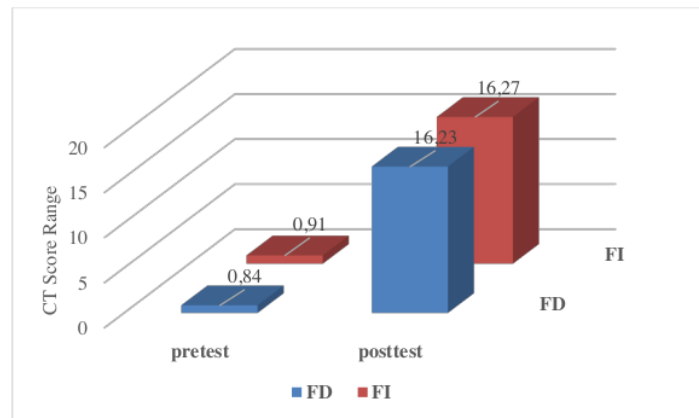


Figure 1. The result of critical thinking measurement for each cognitive style

The difference in the acquisition of critical thinking ability scores was statistically tested using the t-test (pair-t test). In this study, the normality test as a prerequisite test showed that the data variants were not normally distributed with a significance value (p value) (0.003) smaller than the alpha test (0.05). Therefore, the pair-t test uses the Wilcoxon test. The Wilcoxon test results are presented in Table 3.

Table 3. The result of pair t-test using Wilcoxon among pre-test and post-test score

Pretest-posttest group	N	Mean rank	Sum of rank	Z	Sig.
Negative Ranks	0	0.00	0.00	-4.296	0.000
Positive Ranks	24	12.50	300.00		
Ties	0				
Total	24				

Negative ranks, positive ranks, and ties show that there is no decrease in the pretest to posttest scores of all members of the study sample, meaning that 24 (twenty four) sample members have increased their critical thinking scores from pretest to posttest. The results also show that sig. (0.000) is smaller than the alpha testing (0.05), which means that there is a difference in the critical thinking ability scores of the preservice-teachers between the pretest and posttest. Elaboration of the results in this study, it can be stated that the RIL model is effective in improving the critical thinking ability of preservice-teachers in both of FD and FI cognitive style.

These results are slightly different from the findings of previous researchers [20, 21] which state that students with the FI cognitive style tend to be stronger and better at using critical thinking than FD. In this study, as a fact that the critical thinking ability of preservice-teachers with FD and FI cognitive styles, both can be improved by induction of teaching using the RIL model. This result is inseparable from the uniqueness of the RIL model, one of which is the strengthening of the reflection aspects of each phase of teaching [15]. Within the broader teaching construct, the reflection process as a form of information feedback to students that can be used to improve the quality of desired learning outcomes and their performance in the learning process itself [22], in the context of this study is critical thinking. The feedback mode as a reflection process has a positive impact on learners' success in learning [23].

The process of reflection in the RIL model requires students to be responsible, open-minded and curious for the knowledge they have or are exploring. The forms of reflection process interventions in inquiry learning that support critical thinking of preservice-teacher's students are process of monitoring, control process, performance evaluation, and sustainable reflection, and these are intervened and integrated in the RIL model with the teaching phase starting from orientation, problem presentation, hypothesis formulation, hypothesis testing, explanation formulation, and reflection [16]. Reflective practice in the learning process using the RIL model becomes a strength in improving critical thinking. Not only in the context of critical thinking, reflective practice also becomes the foundation of the

learning process for developing understanding and improving expected learning outcomes [24]. To achieve meaningful learning, the reflective process requires a contextual learning anchor [24], and through an investigation process [25], in this study the contextual anchor and the investigation process are carried out through inquiry activities.

The findings in this study answer the concern in the learning process, that not all thinking processes arise when learners solve problems [26] which causes learners' thinking abilities to be relatively low [27]. However, the aspects of continuous reflection that are conducted in the teaching of inquiry have been able to improve learners' thinking abilities in solving problems, which in turn has an impact on better learning outcomes.

4. Conclusion

The results of this study have shown that the RIL model is effective in improving the critical thinking ability of preservice-teachers in both the field dependent (FD) and field independent (FI) cognitive style groups. The recommended findings in this study are that the RIL model can be broadly implemented in the learning process with the specific aim of increasing the critical thinking ability of preservice-teachers.

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