

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

N N S P Verawati^{1*}, Hikmawati² and S Prayogi³

^{1,2}Physics Education Department, Universitas Mataram, Jl. Majapahit No 62, Mataram, Indonesia 83125.

³Physics Education Department, Universitas Pendidikan Mandalika, Jl. Pemuda No 59A, Mataram, Indonesia 83126

Email*: veyra@unram.ic.id

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 efforts to develop and test learners' memory so that students' thinking abilities are reduced and only understood as the ability



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

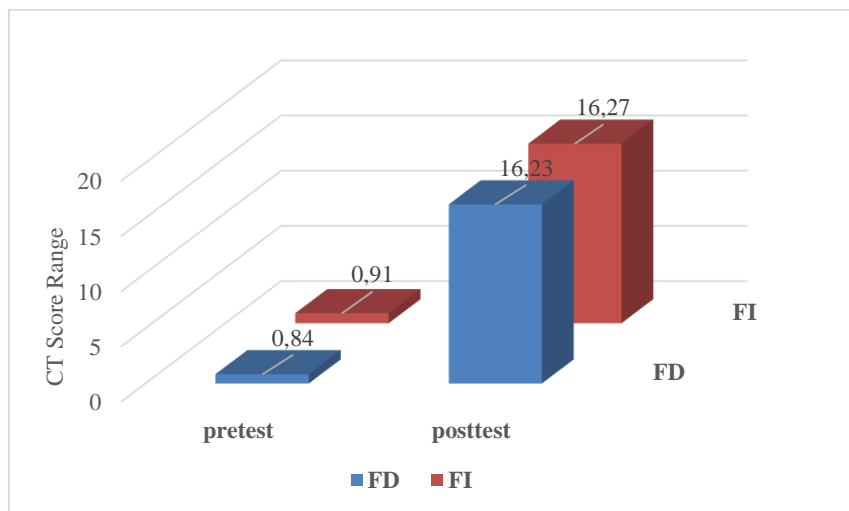


Figure 1. The result of critical thinking measurement for each cognitive style

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.

Acknowledgments

This research is a part of the University Flagship Research which is supported and funded by the Government of the Republic of Indonesia. The researcher is grateful to those who have contributed in supporting this research which we cannot mention one by one, starting from Mataram University, research partners, the subject of model implementation as research samples, and others. Hopefully this study will be useful for the advancement of education and learning, especially in Indonesia.

References

- [1] Barnett R 2011 *Being a University* (Abingdon: Routledge)
- [2] Davies M and Barnett R 2015 *The Palgrave Handbook of Critical Thinking in Higher Education* (New York: Palgrave Macmillan)
- [3] Macfarlane B (2017) *Freedom to Learn - The Threat to Student Academic Freedom and Why It Needs to be Reclaimed* (London: Routledge)
- [4] Ennis R H 2011 Critical thinking: Reflection and perspective part II *Inquiry: Crit. Thin. Across the Discipl.* **26** 2, 5-19
- [5] Ennis R H (2013). Critical thinking across the curriculum: The wisdom CTAC Program *Inquiry: Crit. Thin. Across the Discipl.* **28** 2, 25-45
- [6] Prayogi S, Yuanita L and Wasis 2018 Critical-Inquiry-Based-Learning: A model of learning to promote critical thinking among prospective teachers of physic *J. Turkish Sci. Edu.* **15** 1 43-56
- [7] Prayogi S, Yuanita L and Wasis 2017 Critical-Inquiry-Based-Learning: Model of learning to promote critical thinking ability of pre-service teachers *J. Phys. Conf. Ser.* **947** 1-6
- [8] Wahyudi, Verawati N N S P, Ayub S and Prayogi S 2018 Development of inquiry-creative-process learning model to promote critical thinking ability of physics prospective teachers *J. Phys. Conf. Ser.* **1108** 1-6
- [9] Wahyudi, Verawati N N S P, Ayub S and Prayogi S 2019 The effect of scientific creativity in inquiry learning to promote critical thinking ability of prospective teacher *Int. J. Emer. Tech. Lear.* **14** 14 122
- [10] Verawati N N S P, Prayogi S, Gummah S, Muliadi A and Yusup M Y 2019 The effect of conflict-cognitive strategy in inquiry learning towards pre-service teachers' critical thinking ability *J. Pend. IPA Indonesia* **8** 4 529
- [11] Prayogi S and Verawati N N S P 2020 The effect of conflict cognitive strategy in inquiry-based learning on preservice teachers' critical thinking ability *J. Edu. Cul. Psych. Stud. (ECPS)* **21** 1 27

- [12] Prayogi S, Muhali, Yuliyanti S, Asy'ari M, Azmi I and Verawati N N S P 2019 The effect of presenting anomalous data on improving student's critical thinking ability *Int. J. Emer. Tech. Lear.* **14** 133
- [13] Arends R 2012 *Learning to Teach* Ninth Edition (New York: McGraw-Hill)
- [14] Rodgers C 2002 Defining reflection: Another look at John Dewey and reflective thinking *Teac. Coll. Rec.* **104** 842.
- [15] Verawati N N S P, Hikmawati and Prayogi S 2019 Conceptual framework of reflective-inquiry learning model to promote critical thinking ability of preservice physics teachers *J. Phys. Conf. Series* **1397** 1
- [16] Verawati N N S P and Hikmawati 2019 Validitas model inkuiri yang diintervensi proses reflektif untuk melatih kemampuan berpikir kritis mahasiswa calon guru *Prisma Sains: J. Peng. Ilmu dan Pemb. Mat. dan IPA IKIP Mataram* **7** 1 38
- [17] Wright R A and McCurdy B L 2011 Class-wide positive behavior support and group contingencies *J. Pos. Beha. Inter.* **14** 3 173
- [18] Witkin H A, Moore C A, Goodenough D and Cox P W 1977 Field-dependent and independent cognitive style and their educational implication *Rev. Edu. Res.* **47** 1 1
- [19] Witkin H A, Oltman P K and Raskin E 1971 *Manual Embedded Figure Test, Children Embedded Figure Test, Grup Embedded Figure Test* (California: Consulting Psychology Press, Inc)
- [20] Kholid M N, Hamida P S, Pradana L N and Maharani S 2020 Students' critical thinking depends on their cognitive style *Int. J. Sci. Tech. Res.* **9** 1 1045
- [21] Listiagfiroh W and Ellianawati 2019 Problem based learning: Practicing students' critical thinking skills with cognitive style dependent fields and independent fields *J. Pen. dan Peng. Pend. Fis.*, **5** 2 169
- [22] Ross J A, Rolheiser C and Gray A H 2002 Influences on student cognitions about evaluation *Asses. Edu. Princ. Pol. Prac.* **9** 1 81
- [23] Agricola B T, Prins F J and Sluijsmans D M A 2020 Impact of feedback request forms and verbal feedback on higher education students' feedback perception, self-efficacy, and motivation *Asses. Edu. Princ. Pol. Prac.* **27** 1, 6
- [24] Loughran J J 2002 Effective reflective practice: In search of meaning in learning about teaching *J. Teac. Edu.* **53** 1 33
- [25] Smyth W J 1992 Teachers' work and the politics of reflection *Am. Edu. Res. J.* **29** 2, 267-300.
- [26] Ariefia H E, As'ari A R and Susanto H 2016 Proses berpikir siswa dalam menyelesaikan permasalahan pada materi trigonometri *J. Pemb. Mat.* **3** 58
- [27] Primasatya N 2016 Analisis kemampuan berpikir matematis calon guru sekolah dasar dalam menyelesaikan masalah matematika *J. Pend. Mat.* **2** 50

Tulis

Kotak Masuk 348

Berbintang

Ditunda

Terkirim

Draf 5

Selengkapnya

Meet

Rapat baru

Rapat saya Baru

Hangout



veyra



Tidak ada chat terbaru

[Mulai yang baru](#)

[MISEIC2020] Submission Upload Ack



Enny Susiyawati <miseic@unesa.ac.id>

kepada saya

Inggris

Indonesia

[Terjemahkan pesan](#)

Ni Nyoman Sri Putu Verawati:

Thank you for uploading your presentation, "The Effectiveness o Reflective-Inquiry Learning Model to Improve Preservice Teache Thinking Ability Viewed from Cognitive Style" to MISEIC. With th conference management system that we are using, you will be a its progress through the editorial process by logging in to the cor web site:

Submission URL:

<http://miseic.conference.unesa.ac.id/index.php/ocs/miseic2020/a>

Username: veyra

If you have any questions, please contact me. Thank you for con conference as a venue for your work.

Enny Susiyawati

MISEIC

MISEIC Committee 2020

<http://miseic.conference.unesa.ac.id/ocs/index.php/ocs/miseic20>



[HOME](#) [ABOUT](#) [USER HOME](#) [SEARCH](#) [CURRENT CONFERENCES](#)
[ARCHIVE](#) [ANNOUNCEMENTS](#) [SUBMISSION STATISTICS](#)

Home > User > Author > Submissions > #2636 > **Summary**

#2636 Summary

SUMMARY [REVIEW](#)

Submission

Authors	Ni Nyoman Sri Putu Verawati
Title	The Effectiveness of Reflective-Inquiry Learning Model to Improve Preservice Teachers' Critical Thinking Ability Viewed from Cognitive Style
Original file	2636-3671-2-SM.DOCX 2020-07-26
Supp. files	2636-3571-2-SP.DOC 2020-06-10
Submitter	Ni Nyoman Sri Putu Verawati
Date submitted	July 26, 2020 - 08:33 AM
Track	Science Education
Director	miseic 2020 (Director)

Status

Status	Paper In Review
Initiated	2020-07-26
Last modified	2020-07-26

Submission Metadata

Authors

Name	Ni Nyoman Sri Putu Verawati
URL	https://scholar.google.co.id/citations?user=N5amy0AAAAJ&hl=en&authuser=4
Affiliation	Universitas Mataram
Country	Indonesia
Bio statement	Department of Physics Education, Universitas Mataram, INDONESIA

Principal contact for editorial correspondence.

Title and Abstract

Title	The Effectiveness of Reflective-Inquiry Learning Model to Improve Preservice Teachers' Critical Thinking Ability Viewed from Cognitive Style
-------	--

Abstract	This study aims to explore the effectiveness of the Reflective-Inquiry Learning (RIL) model to improve critical thinking ability of prospective teacher students in terms of cognitive style. The RIL
----------	---

Registration

Aim & Scope

Editorial Board

Online Submissions

Abstracting and Indexing

PROCEEDING
2019

USER

You are logged in as...

veyra

- [My Profile](#)
- [Log Out](#)

model is an inquiry learning model that is intervened by reflective processes in the learning phases. The RIL model has been declared valid for the purpose of increasing learners' critical thinking ability at the higher education level, furthermore this model needs to be implemented in the classroom to evaluate its effectiveness in increasing learners' critical thinking ability in this study viewed from cognitive style.

This study is a quasi-experimental study, where one-group pretest posttest design is conducted. The sequence of this research process, namely sample selection, measurement of cognitive style using the Group Embedded Figures Test (GEFT), pretest, treatment (learning with RIL model), posttest, and finally analysis of results. The research sample involved 24 preservice teachers (PTs) in the physics education department - Mandalika University of Education (Undikma). Measurement of cognitive style using GEFT as many as 18 test items (figure test) to identify the sample group into the cognitive style of field dependent (FD) and field independent (FI). Pretest and posttest to measure the critical thinking ability of the sample, where the instrument used was in the form of essay questions consisting of 8 items. The GEFT score uses true-false criteria, if the correct answer is given a score of 1 and if wrong is given a score of 0. The individual GEFT score is interpreted into two categories, FD cognitive style if the score from 0 to 11, and the FI cognitive style if the scores from 12 to 18. Critical thinking ability scores of each individual are analyzed using a multilevel scale (five scales) with the lowest score -1 (minus one) and the highest +3 (plus three). Furthermore, the critical thinking scores (CTs) of each PTs are interpreted into the categories: very critically (CTs > 17.6), critically (11.2 < CTs ≤ 17.6), quite critically (4.8 < CTs ≤ 11.2), less critically (-1.6 < CTs ≤ 4.8), and uncritically (CTs ≤ -1.6). The effectiveness of the RIL model to improve critical thinking ability of PTs is characterized by an increase in the critical thinking ability scores. Analysis of increasing scores using the n-gain equation. Data analysis of critical thinking ability is done descriptively and statistically, where the normality test and t-test (pait-t test) are conducted.

The results of the study show that as many as 13 PTs are categorized into the FD cognitive style and 11 categorized into the FI cognitive style. The average pretest score of the two cognitive style groups (FD and FI) was 0.87 with the criteria of "less critically", and after the implementation of the RIL model, the average score of the posttest was 16.25 with the criteria of "critically," and the n-gain of 0.64 with criteria "moderate." The average score of the measurement of the critical thinking ability of PTs before and after the implementation of the RIL model for each of the FD and FI cognitive styles is shown in Table 1.

Table 1. Average scores from the measurement of critical thinking ability of PTs for each of FD and FI cognitive style

Cognitive style

Number of PTs

Pretest

Posttest

n-gain

Criteria

CT score average

Criteria

CT score 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

Differences in critical thinking ability scores were statistically tested using the t-test (pair-t test), where the normality test of the data as a prerequisite test was carried out. The results of the normality test showed that the data variant was not normally distributed (the significance value of 0.003 was smaller than alpha testing). Because the data are not normally distributed, the pair-t test uses the Wilcoxon test. Paired t-test results showed that the significance value (0.000) was smaller than alpha testing (0.05), meaning that there were differences in the scores of PTs critical thinking ability between pretest and posttest.

Elaboration of the results in this study, it can be concluded that the RIL model is effective to improve critical thinking ability of preservice teachers both in groups with cognitive styles of field dependant (FD) and field independent (FI). The author recommends for further research that it is necessary to implement the RIL model on a broader subject.

Indexing

Keywords Reflective-Inquiry learning model; critical thinking ability; cognitive style
 Language en

Supporting Agencies

Agencies —

Organized by

Universitas Negeri Surabaya
 C12 Building, Science Department, Faculty of Mathematics and Natural Sciences,
 Universitas Negeri Surabaya
 Ketintang Campus, Ketintang St., Surabaya, INDONESIA



The 4th Mathematics Informatics Science Education
International Conference
Surabaya, October 3rd, 2020 (online)
Website: <http://miseic.unesa.ac.id/>
Email: miseic@unesa.ac.id

Date: September 1st, 2020

Delay Announcement

Dear authors,

Due to unforeseen circumstances, we have to announce that the notification of full paper acceptance will be postponed. The notification of full paper acceptance will be sent directly to your email no later than September 11, 2020. We apologize for this inconvenience and thank you for your patience and understanding.

For authors who have made payment for registration, please use the following link to upload your proof of payment. The information and documentation that you included in the link will be checked by our team for verification.

<http://s.id/receiptmiseic2020>

Should you have any questions related to the delay and payment, please do not hesitate to contact us.

Thank You.
Best regards,



Enny Susiyawati, Ph.D.
MISEIC 2020 Chairperson



The Effectiveness of Reflective-Inquiry Learning Model to Improve Preservice-Teachers' Critical Thinking Ability Viewed from Cognitive Style

Ni Nyoman Sri Putu Verawati³, Hikmawati², Saiful Prayogi³

^{1,2}Physics Education Department, Universitas Mataram, Jl. Majapahit No 62, Mataram, Indonesia 83125.

³Physics Education Department, Universitas Pendidikan Mandalika, Jl. Pemuda No 59A, Mataram, Indonesia 83126

veyra@unram.ic.id

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. This study is a quasi-experimental research, where the one-group pretest posttest design is conducted. As many as 24 preservice-teachers (14 male and 10 female) as research samples, they are preservice-teachers (PTs) in the physics education department - Mandalika University of Education (Undikma). Measurement of cognitive style using GEFT as many as 18 test items (figure test) to identify the sample group into the field dependent (FD) and field independent (FI) cognitive style. Pretest and posttest to measure the critical thinking ability of preservice-teachers, where the critical thinking ability test instrument is in the form of essay questions. Data were analyzed 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 critical thinking in students is when they study at the university level, because at universities students are faced with more complex problems that require 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 improve the quality of learning and education, 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 efforts to develop and test learners

Commented [HOHs1]: This article is very interesting and easy to understand.

Commented [HOHs2]: How many essay test items are employed? add information here

'memory so that students' thinking abilities are reduced and only understood as the ability to remember [11]. Teaching critical thinking requires a holistic approach and must involve a set of appropriate and goal-oriented learning models that enable students to manipulate their cognitive skills [12]. Some previous studies recommend inquiry 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 model needs to be intervened by reflective processes in its teaching. This is in line with the concept of critical thinking 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 learners' critical thinking ability at the higher education level. Reflective process interventions in it, such as the presentation of anomalous phenomena, monitoring, performance evaluation, and sustainable reflection that aims to improve learners' critical thinking ability. The hypothetical framework of the RIL model was developed and this was validated through 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. Furthermore, this model needs to be implemented in the classroom and evaluated for its effectiveness for the purpose of improving critical thinking ability, in this study viewed from cognitive style.

Table 1. Learning phases of RIL Model

Learning phase	Learning activities
1. Orientation	<ul style="list-style-type: none"> • Preparing preservice-teacher to learn and describe the process and learning objectives
2. Providing problems	<ul style="list-style-type: none"> • Presenting conflict-cognitive with authentic phenomena and requesting preservice-teachers' responses • Monitoring preservice-teachers' responses toward the provided phenomena (<i>monitoring process</i>). • Conducting correction if the preservice-teachers' responses are inappropriate with the context being studied (<i>control process</i>)
3. Formulating hypothesis	<ul style="list-style-type: none"> • Encouraging preservice-teachers to hypothesize problem situation stated initially • Examining the correlation between hypothesis and problem condition stated to be confirmed with each proposed hypothesis (<i>performance evaluation</i>)
4. Examining hypothesis	<ul style="list-style-type: none"> • Asking preservice-teacher to examine hypothesis through an experiment • Asking preservice-teacher to explain how they collect data to examine the hypothesis through experimental activities (<i>control process, performance evaluation</i>)
5. Formulating explanation	<ul style="list-style-type: none"> • Asking preservice-teacher to formulate explanations and making a generalization (<i>control process</i>) • Confirming each explanation arranged (<i>performance evaluation</i>)
6. Reflection	<ul style="list-style-type: none"> • Involving preservice-teacher to check the processes that they have done and identifying mistakes to be continuously corrected (<i>continuous reflection</i>).

Cognitive style in learning is important to consider, one's critical thinking ability is related to cognitive style possessed. The link, namely how individuals attain, retention, and produce information with a high level of consistency can affect individual behavior and activities directly or indirectly [17]. Individual

Commented [h3]: Is there any article that say so? If yes, authors need to quote it

Commented [h4]: Authors can add one more row, state critical thinking skills that can be train during each learning phase/activities

cognitive styles are categorized into field-dependent (FD) and field-independent (FI) cognitive styles [18]. This study aims to evaluate the effectiveness of the RIL model to improve the critical thinking ability of preservice-teachers viewed from cognitive style. The term ability is used in this study to clarify aspects of critical thinking as cognitive skills [4, 5] which include aspects of analysis, inference, evaluation, and decision making as indicators of critical thinking abilities [11].

2. Methods

This study is a quasi-experimental research, in which one-group pretest posttest design is conducted. The sequence of this research process, namely sample selection, measurement of cognitive style using The Group Embedded Figures Test (GEFT), pretest, treatment (learning with RIL models), posttest, and finally analysis of results. As many as 24 preservice-teachers (14 male and 10 female) as research samples, they are preservice-teachers (PTs) in the physics education department - Mandalika University of Education (Undikma).

Measurement of cognitive style using GEFT as many as 18 item items (figure test) to identify the sample group into the field dependent (FD) and independent field (FI) cognitive style [19]. Pretest and posttest to measure the critical thinking ability of the sample, where the instrument used was in the form of essay questions consisting of 8 items. The GEFT score uses true-false criteria, if the correct answer is given a score of 1 and if wrong is given a score of 0. The individual GEFT score is interpreted into two categories, FD cognitive style if the score acquisition from 0 to 11, and the FI cognitive style if score acquisition from 12 to 18.

The critical thinking ability score of each individual is analyzed using a multilevel scale (five scales) with the lowest score -1 (minus one) and the highest +3 (plus three). Furthermore, the critical thinking scores (CTs) of each preservice-teachers are interpreted into the very critical categories (CTs > 17.6), critical (11.2 < CTs ≤ 17.6), quite critical (4.8 < CTs ≤ 11.2), less critical (-1.6 < CTs ≤ 4.8), and uncritical (CTs ≤ -1.6) [11]. The effectiveness of the RIL model to improve the critical thinking ability of preservice-teachers is characterized by an increase in the critical thinking ability scores. Analysis of increasing scores using the n-gain equation. Data analysis on critical thinking ability is done descriptively and statistically, where the normality test and t-test (pair-t test) are conducted.

3. Results and Discussion

The results of the study show that as many as 13 preservice-teachers are categorized into the FD cognitive style and 11 categorized into the FI cognitive style. The average pretest score of the two cognitive style groups (FD and FI) was 0.87 with the criteria of "less critical", and after the implementation of the RIL model, the average score of the posttest was 16.25 with the criteria of "critical," and an n-gain of 0.64 with criteria "moderate." The average score of the measurements of the critical thinking ability of preservice-teachers before and after the implementation of the RIL model for each cognitive style of FD and FI is shown in Table 2.

Table 2. The average score from the measurement of the critical thinking ability of preservice-teachers for each cognitive style of FD and FI

Cognitive style	Number of PTs	Pretest		Posttest		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

Differences in critical thinking ability scores were statistically tested using the t-test (pair-t test), where the normality test of the data as a prerequisite test was carried out. The results of the normality test showed that the data variant was not normally distributed (the significance value of 0.003 was smaller

Commented [HOHs5]: The method used is very clear, and has described what the researcher did in the current study

Commented [h6]: Authors can add bar chart to present the result

than alpha testing). Because the data is not normally distributed, the paired t-test uses the Wilcoxon test. Paired t-test results are shown in Table 3.

Table 3. The result of pair t-test using Wilcoxon among pretest and posttest 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 score of the posttest of all sample members, meaning that as many as 24 sample members have increased critical thinking scores, and there is no equal score between the pretest and posttest of each sample member. Paired t-test results show that the significance value (0.000) is smaller than alpha testing (0.05), meaning that there are differences in the scores of critical thinking abilities of preservice-teachers between pretest and posttest. Elaboration of the results in this study, it can be stated that the RIL model is effective in increasing the critical thinking ability of preservice-teachers in both the FD and FI cognitive style groups.

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 curious, open-minded, and responsible for the knowledge they have or are exploring. The forms of reflection process interventions in inquiry teaching that support critical thinking of preservice-teachers students are process monitoring, process control, 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.

References

- [1] Barnett R 2011 *Being a University* (Abingdon: Routledge)
- [2] Davies M and Barnett R 2015 *The Palgrave Handbook of Critical Thinking in Higher Education* (New York: Palgrave Macmillan)
- [3] Macfarlane B (2017) *Freedom to Learn - The Threat to Student Academic Freedom and Why It Needs to be Reclaimed* (London: Routledge)
- [4] Ennis R H 2011 Critical thinking: Reflection and perspective part II *Inquiry: Crit. Thin. Across the Discipl.* **26** 2, 5-19.
- [5] Ennis R H 2013). Critical thinking across the curriculum: The wisdom CTAC Program *Inquiry: Crit. Thin. Across the Discipl.* **28** 2, 25-45.
- [6] Prayogi S, Yuanita L and Wasis 2018 Critical-Inquiry-Based-Learning: A model of learning to promote critical thinking among prospective teachers of physic *J. of Turkish Sci. Edu.* **15** 1, 43-56.
- [7] Prayogi S, Yuanita L and Wasis 2017 Critical-Inquiry-Based-Learning: Model of learning to promote critical thinking ability of pre-service teachers *J. of Phys.: Conf. Series* **947**, 1-6.
- [8] Wahyudi, Verawati N N S P, Ayub S and Prayogi S 2018 Development of inquiry-creative-process learning model to promote critical thinking ability of physics prospective teachers *J. of Phys.: Conf. Series* **1108**, 1-6.
- [9] Wahyudi, Verawati N N S P, Ayub S and Prayogi S 2019 The effect of scientific creativity in inquiry learning to promote critical thinking ability of prospective teacher *Int. J. of Emer. Tech. in Lear.* **14** 14, 122-131.
- [10] Verawati N N S P, Prayogi S, Gummah S, Muliadi A and Yusup M Y 2019 The effect of conflict-cognitive strategy in inquiry learning towards pre-service teachers' critical thinking ability *J. Pend. IPA Indonesia* **8** 4, 529-537.
- [11] Prayogi S and Verawati N N S P 2020 The effect of conflict cognitive strategy in inquiry-based learning on preservice teachers' critical thinking ability *J. of Edu. Cul. and Psych. Stud. (ECPS)* **21** 1, 27-41.
- [12] Prayogi S, Muhali, Yuliyanti S, Asy'ari M, Azmi I and Verawati N N S P 2019 The effect of presenting anomalous data on improving student's critical thinking ability *Int. J. of Emer. Tech. in Lear.* **14** 6, 133-137
- [13] Arends R 2012 *Learning to Teach* Ninth Edition (New York: McGraw-Hill)
- [14] Rodgers C 2002 Defining reflection: Another look at John Dewey and reflective thinking *Teac. Coll. Rec.* **104** 4, 842-866.
- [15] Verawati N N S P, Hikmawati and Prayogi S 2019 Conceptual framework of reflective-inquiry learning model to promote critical thinking ability of preservice physics teachers *J. of Phys.: Conf. Series* **1397**, 1-10.
- [16] Verawati N N S P and Hikmawati 2019 Validitas model inkuiri yang diintervensi proses reflektif untuk melatih kemampuan berpikir kritis mahasiswa calon guru *Prisma Sains: J. Peng. Ilmu dan Pemb. Mat. dan IPA IKIP Mataram* **7** 1, 38-47.
- [17] Wright R A and McCurdy B L 2011 Class-wide positive behavior support and group contingencies *J. of Pos. Beha. Inter.* **14** 3, 173-180.
- [18] Witkin H A, Moore C A, Goodenough D and Cox P W 1977 Field-dependent and independent cognitive style and their educational implication *Rev. of Edu. Res.* **47** 1, 1-64.
- [19] Witkin H A, Oltman P K and Raskin E 1971 *Manual Embedded Figure Test, Children Embedded Figure Test, Grup Embedded Figure Test* (California: Consulting Psychology Press, Inc)
- [20] Kholid M N, Hamida P S, Pradana L N and Maharani S 2020 Students' critical thinking depends on their cognitive style *Int. J. of Sci. & Tech. Res.* **9** 1, 1045-1049.
- [21] Listiagfiroh W and Ellianawati 2019 Problem based learning: Practicing students' critical thinking skills with cognitive style dependent fields and independent fields *J. Pen. dan Peng. Pend. Fis.*, **5** 2, 169-176.

Commented [HOHs7]: need to the re-checking and adjust to the format of IOP

- [22] Ross J A, Rolheiser C and Gray A H 2002 Influences on student cognitions about evaluation *Asses. in Edu.: Princ. Pol. & Prac.* **9** 1, 81-95.
- [23] Agricola B T, Prins F J and Sluijsmans D M A 2020 Impact of feedback request forms and verbal feedback on higher education students' feedback perception, self-efficacy, and motivation *Asses. in Edu.: Princ. Pol. & Prac.* **27** 1, 6-25.
- [24] Loughran J J 2002 Effective reflective practice: In search of meaning in learning about teaching *J. of Teac. Edu.* **53** 1, 33-43.
- [25] Smyth W J 1992 Teachers' work and the politics of reflection *Amer. Edu. Res. J.* **29** 2, 267-300.
- [26] Ariefia H E, As'ari A R and Susanto H 2016 Proses berpikir siswa dalam menyelesaikan permasalahan pada materi trigonometri *J. Pemb. Mat.* **3** 58
- [27] Primasatya N 2016 Analisis kemampuan berpikir matematis calon guru sekolah dasar dalam menyelesaikan masalah matematika *J. Pend. Mat.* **2** 50

Acknowledgments

This research is part of the University Flagship Research funded by the Government of the Republic of Indonesia. We thank those who have contributed in supporting this research, including research partners. We hope that this study will be beneficial for the advancement of education especially in Indonesia and globally.