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Universitas Negeri Surabaya, Surabaya, Indonesia
October 3rd, 2020

The conference is organized by

Universitas Negeri Surabaya

Website: http://www.unesa.ac.id/

4th Mathematics, Informatics, Science and Education International Conference

4th Mathematics, Informatics, Science and Education International Conference

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The 4th Mathematics, Informatics, Science and Education International Conference was successfully held on October 3, 2020 at Universitas Negeri Surabaya, Surabaya, East Java, Indonesia. This conference was organized by Universitas Negeri Surabaya. The 4th MISEIC was the first conference in the history of MISEIC which was completely conducted using a digital platform in line with the social distancing norms due to the COVID-19 breakout. The theme for the 4th MISEIC was "**Advancing Research on Mathematics, Informatics, Science and Education for Building a Better Society**". Using the theme, the 4th MISEIC invited scientists, education experts, practitioners, and students through this scientific forum to share their ideas, research findings, and issues about theoretical and practical knowledge in Mathematics, Informatics, Science, and STEM education. Their shared ideas were expected to have important contributions for building "a better society", such as solving problems caused by, but not limited to, the pandemic situations.

This year, MISEIC was held in the form of An International Joint Conference on Science, Technology, Art, and Humanities. The joint conference merged five Universitas Negeri Surabaya-organized conferences into one major event which was held on 3rd to 4th of October 2020. The joint conference included the 4th MISEIC, the 3rd International Conference on Vocation Education and Electrical Engineering (ICVEE), the 4th International Conference on Education Innovation (ICEI), the 2nd International Conference on Research and Academic Community Services (ICRACOS), and the 1st International Conference on Cultural Studies and Applied Linguistics (ICCSAL). The first day was dedicated to the conferences which have scopes focused on Science and Technology, namely MISEIC, ICVEE, and ICRACOS, whereas the second day represented Art and Humanities-focused conferences. In this joint conference, each individual conference was represented by one keynote and one or more speakers from overseas universities or institutions. However, the joint conference was organized only for the meeting day. Practically, each supporting conference had its own brochure, website, and article management system. The modification from an individual conference into the joint conference was conducted because of reallocation of academic budget to COVID-19 aids.

The joint conference was completely conducted online using Zoom as a platform. Similar to offline form, the online joint conference included plenary and roundtable sessions. In the plenary session, each keynote speaker delivered a talk directly on the Zoom within 30 minutes. This session was also broadcasted live via an official YouTube channel of Universitas Negeri Surabaya. Each talk was followed by live Question and Answer (Q&A) for 15 minutes. Participants were offered to deliver their questions to each keynote speaker using oral or written forms on the Zoom or via live chat on YouTube.

After one hour break, the roundtable sessions were conducted and organized by each individual supporting conference. For MISEIC, these roundtable sessions were preceded by a 20-minute live talk on the Zoom from an invited speaker. This session invited particularly all presenters and participants of the 4th MISEIC. The live Q&A for this forum was held using oral and written forms on the Zoom and lasted for 10 minutes. At the end of the session, each MISEIC presenter was assigned to a particular roundtable discussion room based on the ID shown in the Zoom. The committee provided 10 roundtable discussion rooms to accommodate all MISEIC's presenters. Each room consisted of one moderator, one IT technician, 8-9 presenters, and some participants. There were three sessions in each roundtable discussion room which lasted for 50 minutes for each session comprising of 25 minutes for presenters' video presentations and 25 minutes for live Q&A via Zoom. Preceding to the conference day, each MISEIC's presenter was required to submit a seven-minute video presentation to a link which was provided by the committee. The decision to use a video instead of a live presentation was taken in order to avoid delay during the presenters' presentation due to internet connection problems.

A total of 85 presenters participated and presented their video of oral presentations in the 4th MISEIC. This year, the 4th MISEIC received more than 85 papers from various topics including pure and applied mathematics, science and technology, computer science, and education in mathematics, science, and computer science. The selected papers are published in this proceeding.

We would like express our best gratitude to keynote and invited speakers for their invaluable contribution and worthwhile ideas shared in the conference. We would also thank to all authors for their contribution to this proceeding as well as our reviewers for their constructive comments and suggestions to improve the quality of the presented papers. The organizing and editorial committee of the 4th MISEIC hopes that the presented papers can serve a reference for the relevant topics and you can enjoy reading this volume of JPCS.

MATHEMATICS, INFORMATICS, SCIENCE, AND EDUCATION INTERNATIONAL CONFERENCE (MISEIC) 2020
October 3rd, 2020, Surabaya, Indonesia

Organized by: Universitas Negeri Surabaya

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International Joint Conference on Science, Technology, Art, and Humanities

Universitas Negeri Surabaya (Online Conference), October 3-4, 2020

MISEIC, as a part of the International Joint Conference on Science, Technology, Art, and Humanities, is an annual conference hosted by Faculty of Mathematics and Natural Sciences, Universitas Negeri Surabaya. The theme of MISEIC 2020 is "**Advancing Research on Mathematics, Informatics, Science, and Education for Building a Better Society**". Using the theme, MISEIC invites researchers and educators from the relevant fields to present their advance research findings that may have important contributions for building "a better society".

Keynote Speaker

Prof. Dr. Hadi Susanto
Professor of Mathematics
Khalifa University of Sciene and Technology, Abu Dhabi
The University of Essex, UK

Invited Speaker

Dr. Hammam Riza, M.Sc
Head of Agency for the Assesment and Application of Technology Indonesia

Another Keynote Speakers in International Join Conference Unesa

Prof. Takeshi Fukusako
Kumamoto University
Japan

Prof. Peter Charles Taylor
Murdoch University
Western Australia

Dr. George Jacobs
Center for a Responsible Future Singapore

Prof. Johan Pion
HAN University
Netherland

IMPORTANT DATES	BATCH I	BATCH II
Abstract Submission	June 6, 2020	June 30, 2020
Notification of Abstract Accept.	June 19, 2020	July 14, 2020
Full Paper Submission	Aug 7, 2020	Aug 14, 2020
Notification of Full Paper Accept.	Aug 26, 2020	Aug 30, 2020
Early Bird Payment		Aug 7, 2020
Payment Deadline		Sep 4, 2020
Full Paper Revision		Sep 10, 2020
Final Camera Ready & Copyright transfer		Sep 18, 2020
Conference Registration		Sep 27, 2020
Conference Day		Oct 3, 2020

FEES	EARLY BIRD	REGULAR
Indonesian Presenter	Rp. 500.000,-	Rp. 750.000,-
Indonesian Student Presenter	Rp. 350.000,-	Rp. 350.000,-
International Presenter	$50	$75
International Student Presenter	$35	$35
Publication fee (Indonesia)		Rp. 1.500.000,-
Publication fee (International)		$150

Pure and Applied Mathematics
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- Analysis,
- Combinatorics
- Dynamical System
- Industrial Mathematics
- Mathematical Physics
- Statistics, etc

Science and Technology
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- Earth and Space Sciences
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- Artificial Intelligence
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- Control and Robotics
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- Assessment and evaluation
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Contact

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The remaining paper will be offered to be published in our google scholar indexed proceeding and journal which are:

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Peer review declaration

Peer review declaration

All papers published in this volume of Journal of Physics: Conference Series have been peer reviewed through processes administered by the Editors. Reviews were conducted by expert referees to the professional and scientific standards expected of a proceedings journal published by IOP Publishing.

- **Type of peer review: Single-blind / Double-blind / Triple-blind / Open / Other (please describe)**
- The review process of all papers of MISEIC 2020 is conducted using single-blind peer review as the authors are able to see reviewers' comments and are still unable to know the reviewers' identities. This method ensures enough space for all reviewers to comment on all papers, and therefore, the quality of those can be guaranteed in terms of clarity and validity.

  ✓ **Conference submission management system:** The system for managing the paper submission in MISEIC 2020 is Open Conference System (OCS) at www.miseic.conference.unesa.ac.id. The authors need to register before use. They start submitting the abstract followed by uploading the full-paper.

-

  ✓ **Number of submissions received:** The total abstract received were 147 abstracts, but the total papers received were 87 papers.

-

  ✓ **Number of submissions sent for review:** The total papers sent for review were 87 papers.

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- **Number of submissions accepted:** The total submissions accepted were 71 papers, but only 47 of those are finally eligible to be submitted in IOP. The rest papers were published elsewhere or rejected. The rejection was caused by high similarity index, out of topic/scope, and authors' incapability to revise on schedule.

  ✓ **Acceptance Rate (Number of Submissions Accepted / Number of Submissions Received X 100):** The acceptance rate for MISEIC paper was 54%.

-

- **Average number of reviews per paper:** Each paper is reviewed twice. First, it is reviewed after the abstract is accepted. Second, the review is conducted after the authors revise their paper in accordance with the first reviewers' comments.

  ✓ **Total number of reviewers involved:** MISEIC involved twenty reviewers from six different disciplines, including Pure and Applied Mathematics, Mathematics Education, Science and Technology, Computer Science and Science Education.

- ✓ **Any additional info on review process:** The plagiarism checker software was applied twice, before and after review, to keep originality of ideas and sentences in all papers.

- ✓ **Contact person for queries:** Contact person: Aris Rudi Purnomo (Universitas Negeri Surabaya), email: arispurnomo@unesa.ac.id

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

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 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	• Preparing preservice-teacher to learning	
2. Providing problems	• Presenting a cognitive-conflict with a phenomenon in everyday life that is authentic to the preservice-teachers and then asking for their responses. (*Preservice-teachers' monitoring process on each response*). • Take corrective action for each response from the preservice-teacher that is not in accordance with the context of the problem being studied. (*Preservice-teachers' control process*).	• Cognitive-conflict is one of learning strategy that can train learners' critical thinking.
3. Formulating hypothesis	• Asking preservice-teachers to formulate the hypotheses according to the problem and show a strong correlation of both. (*Preservice-teachers' performance evaluation*).	• 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	• Asking preservice-teachers to testing the hypotheses that they have stated through experimental activities, and write down the experimental data. (*Preservice-teachers' control process and performance evaluation*).	
5. Formulating explanation	• Asking the preservice-teacher to prepare a detailed explanation of the experimental data and make a generalization. (*Preservice-teachers' control process*).	• Compiling an explanation is an important aspect of critical thinking skills.
6. Reflection	• 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. (*Preservice-teachers' continuous reflection*).	• 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 ≤ 17.6), quite critically (4.8 <CTs ≤ 11.2), less critically (-1.6 <CTs ≤ 4.8), and not critically (CTs ≤ -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

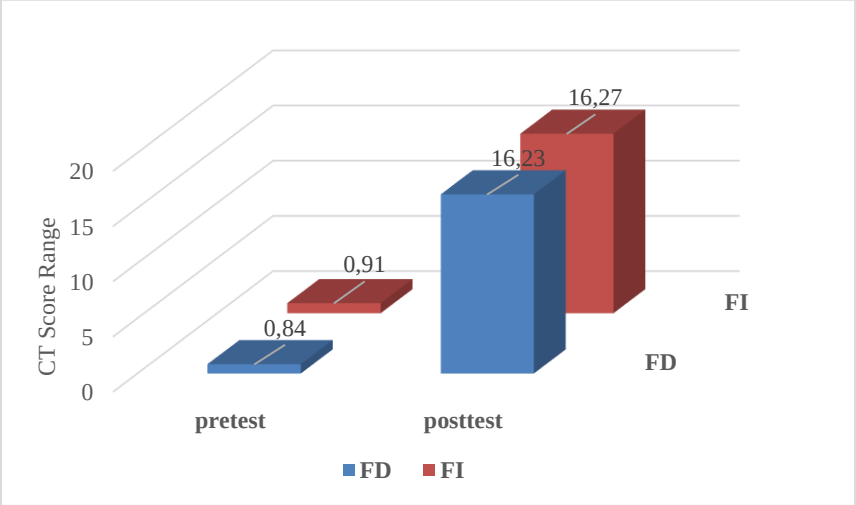

Figure 1. The result of critical thinking measurement for each cognitive style

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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