ICMSE International Conference on Mathematics and Science Education

International Conference on Science Education ICoSEd

Book of Program

Theme:

"Mathematics and Science Education Research for Sustainable Development"

Bandung, June 29th,2019

Sekolah Pascasarjana
Universitas Pendidikan Indonesia

Perkumpulan Pendidik
IPA Indonesia (PPII)

OPENING REMARKS ICoSEd 2019

The International Conference on Science Education organized by the Association of Indonesian Science Teachers (Perkumpulan Pendidik IPA Indonesia, PPII) has been carried out periodically. This year's activity is the second conference, and will be conducted in collaboration with the School of Postgraduate Studies UPI (SPs UPI) through an International Conference on Mathematics and Science Education (ICMScE). Through this joint conference, it is expected the increase of participation of seminar participants as well as build cohesiveness between science and mathematics educators widely.

On this occasion, our congratulations convey to the participants and presenters who will present the results of their research. Our thanks go to the keynotes that are willing to attend to share their experiences and insights. Our thanks also go to the PPII of the West Java Region, Master Program of Chemistry Education, Master Program of Science Education UNPAK, and the Postgraduate Program of UNPAK which has hosted and sponsored the conference.

Hopefully this conference will produce various ideas, innovations, and creativities in the fields of mathematics and science education towards Indonesia 4.0.

Congratulations,

Wassalammu'alaikum Warahmatullahi Wabarakatuh

Prof. Dr. Phil. Ari Widodo, M.Ed.
ICoSEd Chair

Bandung, June 29th, 2019

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The Conference Schedule

Time	Agenda	Room	PIC
07.00 – 08.00	Registration	Ballroom Hall Grand Mercure Hotel Bandung (Lobby Level)	Dr. Indarini Dwi P. Anisa Desti Herawati
08.00 -09.00	Opening Ceremony 1. Indonesian National Anthem (Conductor: Dr. Soja Siti Fatimah, M.Si.) 2. Pray 3. Speech from Chairman Committee (Dr. rer.nat Ahmad Mudzakir, M.Si.) 4. Speech from President of Association of Indonesian Science Educator (PPII) (Prof. Dr. Anna Permanasari, M.Si.) 5. Speech from Director of SPs and Chancellor of UPI	Ballroom Grand Mercure Bandung Setiabudi (Lobby Level)	**MC.** Dr. Siti Aisyah, Dr. Galuh Yuliani and Ikmanda, M.Pd. Dr. Dadang Jaenudin, M.Pd.
09.00 – 10.00	Keynote I: **Prof. Kin Eng Chin** (College of Education, Psychology and Social Work, Flinders University Australia) *How Humans Make Sense of Mathematics* **Prof. Sein Shin, PhD** (Chungbuk National University, South Korea) *Motivated Reasoning in Science & Science Education*	Ballroom Grand Mercure Bandung Setiabudi (Lobby Level)	**Moderator I:** Dr. Sufyani Prabawanto, M.Ed.
10.00 –10.30	Coffee Break		
10.30 – 12.00	Keynote II **Prof. Minsu Ha, PhD** (Division of Science Education, College of Education, Kangwon National University) *The development of assessment tool based Artificial Intelligence (AI) for open-ended question: The introduction of research trends and WA^{3}I project* **Prof. Jun-Ki Lee, PhD** **(**Chonbuk National University, Korea) *Complex Problems in Complex Problem Solving: Types, Levels, and Meaning in the Field of Science Education* **Prof. P. John Williams** (Director STEM Education Research Group, School of Education Curtin University | Australia) *Technology Education: a role in STEM.*	Ballroom Grand Mercure Bandung Setiabudi (Lobby Level)	**Moderator II:** Prof. Dr. Phil. Ari Widodo, M.Ed
12.00 -13.00	Lunch Break		
13.00 – 13.30	**Plenary Session** **Science Education:** Prof. Dr. phil. Ari Widodo, M.Ed.	Ballroom C (Lobby Level)	**Desti Herawati**
	Mathematics Education: Al Jupri, Ph.D.	Ballroom B (Lobby Level)	**Isnie Yusnitha, M. Sc.**

Time	Agenda	Room	PIC
	Designing symbol sense tasks: The case of quadratic equations		
	Physic Education: Dr. Parsaoran Siahaan, M.Pd. *Building metacognitive skills through ICARE Learning Model in Physics learning.*	Parahyangan 1-2 (Ground Level)	**Anisa Nurramadani, M.Pd.**
	Biology Education: Prof. Dr. Nuryani Rustaman, M.Pd *STEM-DSLM in Facilitating Students' Conceptual Change and Preventing Misconception in Life Sciences*	Mandalagiri 1-2 (2nd Level)	**Dr. Yayan Sanjaya**
	Chemistry Education: Prof. Dr. Liliasari, M.Pd *Innovative organic synthesis course for sustainable development in chemistry education to enhance students' critical thinking skill*	Mandalayang (2nd Level)	**Dr. Tuszie Widhiyanti**
13.30 – 13.50	Poster Session I	Ballroom	
13.50 - 14.40	Paralel Session I (17 rooms)	Room 1 - 17	
14.40 - 15.30	Paralel Session II (17 rooms)	Room 1 - 17	
15.30 - 15.50	Poster Session II	Ballroom	
15.50 - 16.50	ISHOMA		
16.50 - 17.15	Paralel Session III (17 rooms)	Room 1 - 17	
17.15 - 18.05	Paralel Session IV (17 rooms) & Closing and Certificate Distributions	Room 1 - 17	

SCHEDULE OF PRESENTATION

VENUE / MODERATOR																	PRESENTATION TIME
BALLROOM / I NYOMAN TRI UPAYOGI, M.Pd																	PRESENTATION TIME
POSTER SESSION I																	13.30 - 13.50
PARALLEL SESSION I & II																	
VENUE																	
No	Parallel-1	Parallel-2	Parallel-3	Parallel-4	Parallel-5	Parallel-6	Parallel-7	Parallel-8	Parallel-9	Parallel-10	Parallel-11	Parallel-12	Parallel-13	Parallel-14	Parallel-15	Parallel-16	Parallel-17	
	Mandalagiri 1	Mandalagiri 2	Mandalayang	Agrabinta	Siliwangi	Wastukencana	Ballroom A1	Ballroom A2	Ballroom B1	Ballroom B2	Ballroom C1	Ballroom C2	Parahyangan 1	Parahyangan 2	Punawarman	Jayagiri 1	Jayagiri 2	
	MODERATOR																	
	Yayan Sanjaya, M.Si., Ph.D	Dr. Hj. Widi Purwianingsih, M.Si.	Dr. Hernani, M.Si.	Dr. Al Azhari Masta, M.Si.	Lusia Narsia Amsad, M.Si	Eka Danti Agustiani, M.Pd	Ari Syahidul Shidiq, M.Pd	Maulidiya, M.Pd	Wulansary Kartika Hayati, W. P, M.Pd	Dr. Riandi, M.Si	Dr. Taufik Ramlan Ramalis, M.Si	Dr. Achmad Samsudin, M.Pd.	Sri Hartini, M.Si	Irma Rahma Suwarma, M.Pd.,Ph.D	Desti Herawati, M.Pd	Annisa Nurramadhani, M.Pd	Dr. Indarini Dwi Pursitasari, M.Si	PRESENTATION TIME
	BIO	BIO	CHEM	MAT	MAT	MAT	MAT	MAT	MAT	SAINS	SAINS	PHYS	PHYS	STEM	BIO & CH	PHYS	SAINS	
1	ABS-163	ABS-13	ABS-29	ABS-251	ABS-186	ABS-1	ABS-51	ABS-80	ABS-146	ABS-006	ABS-158	ABS-9	ABS-88	ABS-015	ABS-20	ABS-52	ABS-48	13.50 - 14.00
2	ABS-172	ABS-61	ABS-104	ABS-253	ABS-209	ABS-7	ABS-52	ABS-82	ABS-137	ABS-033	ABS-188	ABS-18	ABS-119	ABS-025	ABS-24	ABS-53	ABS-51	14.00 - 14.10
3	ABS-207	ABS-71	ABS-107	ABS-254	ABS-213	ABS-8	ABS-55	ABS-86	ABS-148	ABS-096	ABS-194	ABS-21	ABS-120	ABS-026	ABS-40	ABS-55	ABS-62	14.10 - 14.20
4	ABS-219	ABS-81	ABS-132	ABS-257	ABS-214	ABS-11	ABS-59	ABS-91	ABS-154	ABS-105	ABS-198	ABS-27	ABS-135	ABS-045	ABS-105	ABS-56	ABS-64	14.20 - 14.30
5	ABS-242	ABS-92	ABS-165	ABS-258	ABS-272	ABS-12	ABS-63	ABS-97	ABS-156	ABS-110	ABS-215	ABS-38	ABS-136	ABS-115	ABS-106	ABS-59	ABS-70	14.30 - 14.40
6	ABS-268	ABS-98	ABS-180	ABS-261	ABS-229	ABS-14	ABS-64	ABS-109	ABS-159	ABS-125	ABS-216	ABS-44	ABS-167	ABS-131	ABS-18	ABS-60	ABS-72	14.40 - 14.50
7	ABS-271	ABS-117	ABS-189	ABS-262	ABS-230	ABS-20	ABS-73	ABS-114	ABS-169	ABS-126	ABS-217	ABS-46	ABS-195	ABS-161	ABS-28	ABS-66	ABS-88	14.50 - 15.00
8	ABS-293	ABS-118	ABS-191	ABS-263	ABS-231	ABS-23	ABS-74	ABS-116	ABS-170	ABS-128	ABS-228	ABS-53	ABS-206	ABS-166	ABS-34	ABS-68	ABS-89	15.00 - 15.10
9	ABS-298	ABS-130	ABS-202	ABS-269	ABS-238	ABS-24	ABS-75	ABS-121	ABS-175	ABS-129	ABS-273	ABS-54	ABS-224	ABS-227	ABS-54	ABS-81	ABS-91	15.10 - 15.20
10	ABS-337	ABS-144	ABS-236	ABS-270	ABS-244	ABS-28	ABS-76	ABS-139	ABS-176	ABS-143	ABS-278	ABS-83	ABS-232	ABS-241	ABS-82	ABS-100	ABS-92	15.20 - 15.30
VENUE / MODERATOR																		PRESENTATION TIME
BALLROOM / I NYOMAN TRI UPAYOGI, M.Pd																		PRESENTATION TIME
POSTER SESSION II																		15.30 - 15.50
COFFEE BREAK																		15.50 - 16.15

Issues

Volume 1521, 2020

International Conference on Mathematics and Science Education 2019 (ICMScE 2019), ICMScE 2019, 29 June 2019, Bandung, Indonesia

Accepted papers received: 26 March 2020
Published online: 22 May 2020

Latest issues
(complete)

- Number 1, May 2020
  Preface
- Number 2, May 2020
  Physic Education
- Number 3, May 2020
  Mathematics Education
- Number 4, May 2020
  Science and STEM Education

JOURNAL LINKS

Journal home

Information for organizers

Table of contents

Volume 1521

2020

Previous issue Next issue

Mathematics Education

Accepted papers received: 26 March 2020
Published online: 22 May 2020

Open all abstracts

Mathematics Education

OPEN ACCESS 032019

The development of interactive mathematics learning media based on local wisdom and 21st century skills: social arithmetic concept

H Pujiastuti, R R Utami and R Haryadi

+ Open abstract View article PDF

OPEN ACCESS 032020

The role of agricultural contextual knowledge on the mathematical understanding of vocational students

A T Fatimah, W Wahyudin and S Prabawanto

+ Open abstract View article PDF

OPEN ACCESS 032021

Assessment problems of junior high school teachers in implementing 2013 Indonesian curriculum

S Morin, S Prabawanto and T Herman

+ Open abstract View article PDF

OPEN ACCESS 032022

Learning trajectory of modeling situation problems utilizing tables and diagrams for elementary school students

V Pratiwi, T Herman, D Suryadi, S Aryanto, Y Gumala, N Nurkaeti and L Farokhah

+ Open abstract View article PDF

OPEN ACCESS 032023

Analysis of students critical thinking ability in solving trigonometric problems

M E Nggaba

+ Open abstract View article PDF

OPEN ACCESS 032024

The analysis of reflective thinking ability in junior high school students

Rosmaya and SH Noer

+ Open abstract View article PDF

OPEN ACCESS 032025

Improving students mathematical higher order thinking through the implementation of the creative problem-solving model of High School Students

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Improving students mathematical higher order thinking through the implementation of the creative problem-solving model of High School Students

A Effendi and A T Fatimah

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Journal of Physics: Conference Series, Volume 1521, Mathematics Education

Citation A Effendi and A T Fatimah 2020 *J. Phys.: Conf. Ser.* **1521** 032025

DOI 10.1088/1742-6596/1521/3/032025

Abstract

This study aims to describe the increase in mathematical higher order thinking abilities of high school students through creative problem-solving learning models. This study was a quasi-experimental, with the design of the nonequivalentpretest-posttest control group in class X, the high school in Ciamis, Indonesia. The results of the study showed that there were differences in the comparison of the increase in students' higher order thinking abilitiess through creative learning models of problem-solving and direct learning. Students who achieve a high increase category are more in the creative problem-solving class compared to the direct learning class.

The advantages of creative problem-solving learning at the stage of expressing opinions. Students tend to express opinions openly so that many ideas emerge to choose effective strategies.

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← **Previous** article in issue

Next article in issue →

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Improving students mathematical higher order thinking through the implementation of the creative problem-solving model of High School Students

To cite this article: A Effendi and A T Fatimah 2020 *J. Phys.: Conf. Ser.* **1521** 032025

Improving students mathematical higher order thinking through the implementation of the creative problem-solving model of High School Students

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Abstract. This study aims to describe the increase in mathematical higher order thinking abilities of high school students through creative problem-solving learning models. This study was a quasi-experimental, with the design of the nonequivalentpretest-posttest control group in class X, the high school in Ciamis, Indonesia. The results of the study showed that there were differences in the comparison of the increase in students' higher order thinking abilitiess through creative learning models of problem-solving and direct learning. Students who achieve a high increase category are more in the creative problem-solving class compared to the direct learning class. The advantages of creative problem-solving learning at the stage of expressing opinions. Students tend to express opinions openly so that many ideas emerge to choose effective strategies.

1. Introduction

Thinking and thinking processest by students are very important to concern in the field of education. How to think, what to think, and how to use thinking to solve the problems into the curriculum design in education [1]. Development thinking of processes students need support from all parties, especially from teachers

Thinking is a subjective cognition from humans to solve problems [1]. The cognitive process taxonomy was proposed by Bloom, which was later revised by Anderson [2]. The revised Bloom Taxonomy includes remember, understand, apply, analyze, evaluate, and create. Remember, understand, and apply is claimed as a low-order thinking process while analyzing, evaluating, and creating is a higher order thinking process. The revision of Bloom's Taxonomy takes into account the latest advances in psychology education and potential applications in the curriculum and instruction (web). However, the implementation of taxonomy bloom differs from country to country. Most countries still apply a low cognitive process and ignore higher order cognitive processes [3].

Higher order thinking has characteristics that include creative thinking, critical thinking, and problem-solving abilities [4]. Branca stated that mathematical problem solving is one of the important goals in learning mathematics, called the heart of mathematics [5]. Problem-solving abilities also help students think analytically in making decisions and help improve critical thinking abilities in dealing with new situations [6,7].

During the learning process, the teacher can facilitate students to have higher order thinking abilities. Teachers can practice continuously higher order thinking strategies in the classroom by giving real-world problems, encouraging open class discussions, and encouraging inquiry-oriented experiments [8]. Learning efforts that encourage students to think higher order are among others by presenting the appropriate learning model.

In this study, we begin by claiming that the creative problem-solving model is a learning model that will encourage students' higher order thinking abilities. The main reason is that creative problem solving has learning steps that encourage students to optimize their cognitive processes. Creative problem solving relies on creating which is the highest category of cognitive processes. Creative problem solving refers to create, which is the highest cognitive process category. Create puts elements together to form a coherent and functional whole or reorganize elements into a new structure or patterns. In creating it is associated with three cognitive processes, namely generation, planning, and producing. Generation is a divergent phase that asks students to pay attention to the possible solutions of a task. If they get a solution opportunity, then a method in the form of an action plan will be selected and implemented. The process is identical to the criteria made by Krulik& Rudnick [9] in the order of creative thinking, namely synthesizing ideas, generating ideas, and applying these ideas.

Creative problem solving has three main steps, namely understanding problems, generating ideas, and planning actions [10,11]. Understanding the problem includes the stages of finding goals, finding data or facts, and finding problems as the target of questions. In generating ideas includes a decrease in choices to answer the open-ended problem. In this stage individuals produce many choices or ideas (thinking fluently), giving various possible choices (flexible thinking), new or unusual (original thinking) and refining or examining in detail the choices that (elaborative thinking). Being in planning actions includes the stages of finding solutions and Acceptance-finding. In this stage, the individual analyzes, refines or develops the appropriate choice of ideas. Then prepare a choice or alternative to increase support and value.

Pepkin stated that the four stages of learning are problem clarification, opinion disclosure, evaluation and selection, and implementation. Clarification of the problem is the stage of explaining to students about the problem situation. The goal is that students can understand the resolution as expected. Disclosure of opinion is to give freedom to students to express opinions about various kinds of problem-solving strategies. Evaluation and selection are the stages of group discussion. Students discuss opinions or strategies that are suitable for solving problems. Implementation is determining which strategies can be taken to solve the problem, then applying it to find a solution to the problem [12].

The importance of developing higher order thinking abilities of students encourages researchers to conduct an experiment, namely the implementation of creative problem-solving learning models to improve students' higher order thinking abilities. Therefore, this paper will describe an increase in students' higher order thinking abilities which are the effects of the creative problem-solving learning process. The higher order of thinking ability intended in this study is the ability to think of high school students in the process of analysis, evaluation, and creating in solving problems.

2. Methods

This research is a quasi-experimental study with the nonequivalentpretest-posttest control group design. The study population was grade X students of a public high school in Ciamis, Indonesia. The sample was chosen by purposive sampling technique for the experimental class and control class. Students in the experimental class obtain creative problem-solving learning, while the control class is direct learning (learning commonly used in math classes at the school).In this study, researchers used a creative problem-solving learning model with learning stages from Pepkin, namely the stages of CPL learning in this study were: (1) clarification of the problem; (2) disclosure of opinions; (3) evaluation and selection; (4) implementation [12]. On the other hand, direct learning through the stages of learning is (1) the teacher presents the subject matter; (2) give a sample question; (3) giving a problem exercise (4) asking some students to write the answers to the exercise on the board; (5) class discussion [13,14].

The topic given to students during this research is trigonometry. Trigonometry subtopics include angular size, trigonometric comparisons, trigonometric equations, trigonometric functions, trigonometric identities, sine and cosine rules, triangle area.

This study uses instruments, namely questions designed by researchers to facilitate the higher order thinking process of students. The problem is in the form of the word problem. Students solve problems by analyzing, evaluating, and creating. The instrument has been validated by experts and empirically. The results of the students' answers are scored based on rubric scoring based on aspects of analysis, evaluation, and creation. During the learning process, researchers observe students at each stage of the learning model activity.

Before trigonometry learning begins, we do the pretest and afterward the posttest. Data obtained from posttest will show students' higher order thinking abilities which are the effects of the learning process. Based on the pretest and posttest obtained N-Gain which showed an increase in students' higher order thinking abilities. We use statistical analysis to see a comparison of the increase in higher order thinking abilities of students in creative learning classes problem solving and direct learning. The stages of the analysis are data normality test, homogeneity test, and t-test or Mann Whitney.The order of significant is $\alpha = .05$ (two-tailed).

3. Result and Discussion

3.1. Result

The results of the research we obtained were data derived from students' pretest and posttest scores. We set scores on each item based on the rubric scoring that has been prepared to produce N-Gain. The data is processed and analyzed to compare the increase in higher order thinking abilities of students who get creative learning problem solving and direct learning. Table 1.below details the results of data processing.

Table 1. The Results of Statistical Tests of Hihger-Order Thinking

	Creative Problem Solving Class	Direct Learning Class
N	32	32
Mean	.56736	.41554
Std. Deviation	.203036	.207884
Sig. Test For Normality	.015	.200
Asymp. Sig. (2-tailed)	.003	

The increase in students' higherorder thinking abilitieswas then categorized into three criteria, namely high, medium, and low. Based on the percentage in Table 2. shows that students in the creative problem-solving class experience more improvement in higherorder thinking in the high category compared to students in the direct learning class. Conversely, in the medium and low increase category, the direct learning class has a large percentage compared to the creative problem-solving learning class.

Table 2. N-gain criteria

N-Gain Coefficient	**Criteria**	**Creative Problem Solving Class (%)**	**Direct Learning Class (%)**
$g \geq 0,7$	High	31,25	12,5
$0,3 \leq g < 0,7$	Middle	50	56,25
$g < 0,3$	Low	18,75	31,25

The observations during learning take place in creative problem-solving learning classes at each stage of learning are as follows: (1) Students are sometimes less careful in classifying problems, reading and understanding questions; (2) Students dare to express their opinions, ideas about strategies in solving problems. Students seemed enthusiastic about solving problems with their groups, even though in the beginning the students seemed confused. Students help each other, teach, exchange opinions, and collaborate; (3) In certain cases, students tend not to be able to describe or illustrate the problem into diagrams or sketches; (4) Students are sometimes hesitant in determining problem-solving strategies. Students' difficulties can slowly be overcome by scaffolding techniques.

3.2. Discussion

Creative problem solving is a learning model that represents a natural dimension of the process, not a forced effort. Creative problem solving is a dynamic approach. Students become more the ability because students have internal procedures that are more structured from the start. Through creative problem-solving learning, students can choose, develop ideas and thoughts. The description of creative problem solving learning is in line with the opinion of some previous researchers that mathematical problem solving as a learning approach describes learning which begins with the presentation of contextual problems which then through inductive reasoning students rediscover learned concepts and other mathematical abilities [5,15]. Contrary to teacher-centered learning. Students tend to adopt examples from the teacher so that their ideas and thoughts do not develop.

The problem clarification step is the initial stage that is very important for the next stage of learning. Weaknesses of students in understanding problem situations because of the situation (context) that is not yet known by students. Characteristics of institutions and cultures influence students' contextual knowledge, and vice versa [16]. However, contextual understanding is not enough to solve problems. Contextual understanding with mathematical conceptual and procedural knowledge will produce rules that are in accordance with the reality of the problem [17]. This stage is the analysis phase of Bloom's taxonomy.

The step of expressing an opinion is a step that is considered by the researcher as a step that supports the success of students in achieving an increase in higher order thinking. Students openly express ideas to get a variety of problem-solving strategies to support the next learning phase. At the evaluation step, they discuss to choose the most effective procedure. Furthermore, procedures that are claimed to be effective by students are implemented to solve problems. These stages require high-level thinking, namely evaluation, and creation. Students must have a lot of experience and then turn it into a process that can solve problems through thought processes [1].

4. Conclusion

Based on the results and discussion presented in the previous section, the implementation of the creative problem-solving learning model in this study can improve students' mathematical high-level thinking abilities. The advantage of implementing this model is that students tend to express opinions openly so that many ideas and thoughts emerge to choose effective strategies. However, further development of the problem clarification stage is needed, one of the ways is by applying to scaffold.

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Acknowledgements
We would like to thank the Ministry of Research, Technology and Higher Education for funding this research Improving students mathematical higher order thinking through the implementation of the creative problem-solving model of High School Students and all parties who have helped to realize this research.