

PAPER • OPEN ACCESS

Effectivity of the Mathematics Learning Model ICCACRE in Developing Mathematics Creativity of Junior High School Students

To cite this article: Alimuddin *et al* 2021 *J. Phys.: Conf. Ser.* **1899** 012129

View the [article online](#) for updates and enhancements.



The banner features a decorative top border with a repeating pattern of red, white, and blue diagonal stripes. On the left, the ECS logo is displayed in green and blue, followed by the text 'The Electrochemical Society' and 'Advancing solid state & electrochemical science & technology'. To the right of this text is a logo for the 18th IMCS meeting, consisting of a stylized 'E' and 'S' with '18th' below it. The main text of the banner reads '239th ECS Meeting with IMCS18', 'DIGITAL MEETING • May 30-June 3, 2021', and 'Live events daily • Free to register'. On the right side, there is a red button with the text 'Register now!'. The background of the banner is a collage of images: a person's face, a laptop, and abstract digital network patterns.

ECS The Electrochemical Society
Advancing solid state & electrochemical science & technology

239th ECS Meeting with IMCS18

DIGITAL MEETING • May 30-June 3, 2021

Live events daily • Free to register

Register now!

Effectivity of the Mathematics Learning Model ICCACRE in Developing Mathematics Creativity of Junior High School Students

Alimuddin^{1*}, Ruslan¹, Nashrullah¹

¹ Mathematics Education Department of Graduate School, Universitas Negeri Makassar. Jl Mallengkeri Raya, Parang Tambung, Tamalate, Makassar, Sulawesi Selatan, Indonesia 90224

*Email: alimuddin3112@gmail.com

Abstract. ICCACRE stands for Interaction, Connection, Collaboration, Application, Creativity, Reflection, and Extension. The seven words consecutively refer to the syntax of the mathematics learning model called ICCACRE. It is actually the result of the developmental research referring to the theory of development of Plomp. The theory contains five stages of development, Those are preliminary investigation, designing, realization, giving test evaluation and revision, and implementation. In the implementation or limited trial stage, it was conducted an experimental research to investigate the effectivity of the model in developing mathematics creativity of junior high school students. Students from class VIII-2 were selected as participants in this study based on the selection with cluster random sampling technique from all students class VIII of SMPN 27 Makassar for 2019-220. Mathematical creativity data were obtained using the mathematical creativity test developed by the researcher referring to the creative indicators: fluency, flexibility, and originality which was equipped with an assessment rubric. The collected data were analyzed with descriptive statistics to explore mathematical creativity in detail. Meanwhile, inferential analysis is used to see the effectiveness of the model in developing students' mathematical creativity. The results showed that the students' fluency was in the high category. Meanwhile, the flexibility and originality of students are included in the medium category. Normalized N-Gain mean. indicates that fluency and flexibility increase in high category. Is increasing originality in the medium category. Furthermore, the results of the inferential analysis show that the ICCACRE model is effective in developing the mathematics creativity of junior high school students.

1. Introduction

One type of high-order thinking that is currently receiving very wide attention among cognitive psychologists and is the goal of education in every country is creative thinking



skills [1]. Sternberg, Mumford & Gustafson, Runco, Fisher, Kitano, Torrance, Craft, Feldman & Benjamin said that there are three things that underlie this phenomenon, namely: 1) Everyone should have creative thinking skills in facing the 21st century, 2) Creative thinking skills can be developed through continuous practice, and 3) creativity is not only found in art disciplines, but also in other disciplines, including the discipline of mathematics known as mathematical creativity [2].

Mathematical creativity is defined differently by experts and a general definition of creativity is adopted. Generally, the experts are of the view that creative mathematical thinking is different from mathematical creativity. Creative thinking in mathematics is a mental activity that occurs in the human mind, those are: understanding / finding problems, formulating problems, developing knowledge that is already possessed from learning experiences, synthesizing knowledge with problems, viewing information from different points of view, predicting from limited information, formulate hypotheses based on observed phenomena and test hypotheses [3], Rhodes [4], [5], [6], [7], [8]. Meanwhile mathematical creativity is the product of mathematical thinking with fluent, flexible and original indicators. Fluent is the student's ability to come up with multiple ways / answers using the same concept. Being flexible is the student's ability to suggest different ways / answers using different concepts. Furthermore, the original ability of the students suggests ways / answers that are not common and new for deaf students [9], [10], [11].

To develop students' mathematical creativity skills through mathematics subjects, NACCCE, 1999, Jeffrey & Craft, 2004, Jeffrey & Craftsaid that teachers are required to be more creative in using or applying models, strategies, and learning methods that can encourage the development of student creativity. Learning that focuses on developing students 'imaginative, creating a dynamic atmosphere, providing space for students to innovate, facilitating students in exploring divergent thoughts will stimulate students' ability to find new ideas [2].

Learning theories related to mathematical creativity are the learning theory of cogivism, constructivism, Ausubel's theory of meaningful learning, and cooperative learning. Cogivism focuses on forming students' knowledge through mental processes, including information processing theory, hierarchy of thinking, as well as creative and critical thinking theories. Constructivism emphasizes the role of students in constructing material and solving problems, including problem posing, problem silving and open-ended problems. Ausubel theory privileges the formation of new knowledge by completing the knowledge schemes that students already have. The results of the elaboration of the learning theory form the basis for developing the Mathematics Learning Model ICCACRE (Introduction, Connection, Collaboration, Application, creativity, Reflection, and Extension) the author created through development research referring to Plomp's theory of development. The theory contains five stages of development. 1) initial investigation, 2) design, 3) realization, 4) test, evaluation, and revision, 5) implementation. This paper describes the results of experimental research with the aim of knowing the effectiveness of the application of the ICCACRE Mathematics Learning Model in developing students' mathematical creativity.

2. Method

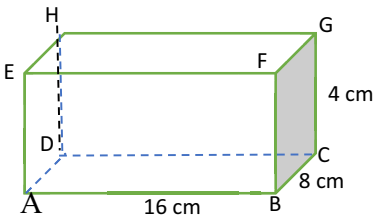
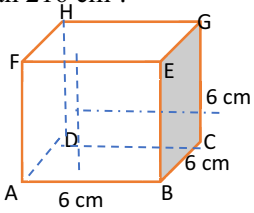
2.1. Research Context and Data Collection

Quasi-experimental research that is conducted requires only one treatment group to reveal the effectiveness of the learning ICCAARE in developing junior high school student creativity.

The research was conducted at SMPN 27 Makassar in the academic year of the even semester 2019-2020. Research procedure: 1) Selecting the research sample using purposive cluster random sampling technique and the selected class VIII-2, 2) Discussing with model teachers and observing with the aim of equalizing perceptions, 3) Giving a pretest of mathematical creativity to see students' initial abilities, 4) implementing learning ICCACRE for 6x3x40 minutes, and 5) Giving math creativity test

2.2. Research Instruments.

Table 1. The instrument is a modified version of the Siswono instrument, 2007

No	Information	Question
01.	<p>volume Balok dibawah ini adalah 512 cm^3</p> 	<p>Buatlah sebanyak mungkin bangun ruang bidang datar yang volumenya sama dengan volume balok disamping lengkap dengan gambar dan panjang rusuk-rusuknya. Dibolehkan menggabungkan beberapa bangun ruang sisi datar.</p>
02.	<p>Luas permukaan kubus dibawah ini adalah 216 cm^2.</p> 	<p>Buatlah sebanyak mungkin bangun ruang bidang datar yang luas permukaannya sama dengan luas permukaan kubus disamping lengkap dengan gambar dan panjang rusuk-rusuknya. Dibolehkan menggabungkan beberapa bangun ruang sisi datar.</p>

2.3. Data analysis

Descriptive statistical analysis (mean, standard deviation, and percentage) aims to describe in detail the mathematics creativity of students. While the normalized N-gain test aims to see the increase in students' mathematical creativity before and after being taught by the learning model ICCACRE.

$Ternormalisasi\ gain = \frac{Skor\ pos\ tes - Skor\ pre\ tes}{Skor\ maksimal - Skor\ pre\ tes}$ (Meltzer, 2002:1260). Kolmogorov-Smirnov one sample test with a significance level $\alpha = 0,05$ used to see whether the data is normal or not. Data is normally distributed if $p\text{-value} > 0,05$. Furthermore, the t-test used is one sample t-test with a significance level $\alpha = 0,05$ aims to test the hypothesis.

Table 2. Research criteria and hypothesis

Statistical Hypothesis	Mathematical Creativity Criteria	N-Gain criteria
$H_0: \mu g_1 \leq 0.3$ vs $H_1: \mu g_1 > 0.3$	81-100/very high	$\langle g \rangle \geq 0,7$ /high

$\mu g1$: average N-Gain	61-80/high	$0,3 < \langle g \rangle < 0,7$ /medium
$H_0: \mu_i \leq 56$ vs $H_1: \mu_i > 56$	41-60/medium	$\langle g \rangle < 0,3$ /low
μ_i : the average mathematical creativity of the i-th indicator	21-40/low	
	0-20/very low	
	[12]	[13]

3. Findings and Discussion

This study aims to determine the effectiveness of ICCACRE learning in developing students' mathematical creativity. The collected data were analyzed descriptively and informally. The results of the descriptive statistical analysis are shown in table 1.1. For the results of the inferential analysis are shown in the table 3.

Table 3. Recapitulation of Descriptive and Inferential Analysis Results

Indicator	Descriptive statistics					Inferential ($\alpha = 0,05$)		
	u.sam p.	Mea n	Modu s	Sd	Maks /min	N-Gain	$p - value$ $\mu g1$	$p - value$ μ_i
Fluency	35	72,5 2	72	5,0 3	84/46	0,67	0,004	0,003
Fleksibilit as	35	58,8 5	56	5,6 5	78/40	0,46	0,009	0,008
Originality	35	46,3 6	44	6,9 8	68/26	0,42	0,03	0,014

Table 3 shows that after ICCACRE learning, students' mathematical creativity on the Fluency indicator is in the high category. The highest score was in the very high category, while the lowest score of the students was in the medium category. N-gain indicates a moderate increase tends to be high. The flexibility indicator is in the medium category. The highest score was in the high category, while the lowest score of the students was in the medium category, the N-gain showed moderate improvement. Furthermore, the Originality indicator is in the medium category. The highest score is in the medium category which tends to be low, while the lowest score is in the low category. The N-gain indicates a moderate increase. The value distribution for the 3 indicators of mathematical creativity tends to the average value so that the average value for each indicator is not influenced by outlier data. Inferential statistics show that there is a significant increase in mathematical creativity after ICCACRE learning. Based on the results of statistical analysis, it was concluded that ICCACRE learning was effective in developing students' mathematical creativity. This is possible because the ICCACRE Learning provides free space for students to construct their new knowledge by using previously owned knowledge structures and linking it to new material with collaboration and communication. Open-ended problems encourage students to come up with different ideas that lead to the growth and development of students' divergent thinking skills. Although this research has not shown maximum results, especially on the indicators of novelty, the characteristics of student activity and the results obtained show a trend towards a better direction. To develop student creativity, it is not enough to do 6x3x40

minutes of learning, but it needs a continuous and long-lasting process. (Fisher (1990), Kitano (1986).

4. Conclusion

The ICCACRE Learning Model is one of the 21st century mathematics learning models that can be an alternative for teachers to develop students' mathematical creativity

Acknowledgement

All gratitude goes to the Chancellor and Chair of the Makassar State University LP2M who responded positively to this research, colleagues and students who have helped during the research process, and especially to DRPM Directorate General of Research and Development Strengthening who has funded this research.

References

- [1] Simonton, D. K. 2003. Scientific Creativity as Constrained Stochastic Behavior: The *Integration of Product, Person, and Process Perspectives*. *Psychological Bulletin*, 129: 475–494.
- [2] Alimuddin, 2012. *Proses Berpikir Kreatif Mahasiswa Calon Guru Kreatif Dalam Pemecahan Masalah Matematika Berdasarkan Gender*. Disertasi tidak diterbitkan. Program Pascasarjana Universitas Negeri Surabaya.
- [3] Semiawan, C. R., Putrawan, I M., & Setiawan, T. H. 1999. *Dimensi Kreatif dalam Filsafat Ilmu*. Bandung: Rosda Karya.
- [4] Fisher, R. 1990. *Teaching Children to Think*. Mayland Avenue: Simon and Schuster Education.
- [5] Costa, A. L. 1985. *Goal for a Critical Thinking Curriculum*. Dalam Costa, A.L. (Ed.) *Developing Minds: A Resource Book for Teaching Thinking* ASCD. Virginia: Alexandria
- [6] DeBono, E. 2007. *Revolusi Berpikir*. Bandung: PT. Mizan Pustaka.
- [7] Liliyasi, 2005. Membangun Keterampilan Berpikir Manusia Indonesia melalui Pendidikan Sains. *Pidato Pengukuhan Guru Besar Tetap dalam Ilmu Pendidikan IPA*. Bandung: Universitas Pendidikan Indonesia.
- [8] Carin, Arthur A., & Robert B. Sund. 1975. *Teaching Science through Discovery*. Ohio: Merrill Publishing Co.
- [9] Plucker, J. A., & Beghetto, R. A. 2004. Why Creativity is Domain General, Why It Looks Domain Specific, and Why the Distinction Does Not Matter. (Dalam Sternberg, R. J., Grigorenko, E. L. & Singer, J. L. (Eds.). *Creativity: From Potential to Realization* (pp. 153–168). Washington: American Psychological Association. Rineka Cipta.
- [10] Sriraman, B & Lee, K.H. 2011. The Elements of Creativity and Giftedness in Mathematics. *Sense Publishers*, 1-28. Netherlands.
- [11] Siswono, T. Y. E. 2007. *Penjenjangan Kemampuan Berpikir Kreatif dan Identifikasi Tahap Berpikir Kreatif Siswa dalam Memecahkan dan Mengajukan Masalah Matematika*. Disertasi tidak diterbitkan. Program Pascasarjana Universitas Negeri Surabaya.
- [12] Arikunto, S. 2010. *Prosedur Penelitian Suatu Pendekatan Praktik*. Jakarta: Astronomy, Iowa State University.

- [13] Meltzer, David E. 2002. Meltzer, David E. .2002. The Relationship Between Mathematics Preparation And conceptual learning gain in physics: A possible hidden Variable in Diagnostic pretest scores. Ames: Department of physics and Astronomy, Iowa State University.