



The Effect of Contextual Worksheets Assisted MEA Learning on Critical and Creative Thinking Ability

I Wayan Puja Astawa, I G A. Sri Kusuma Sari, I Gusti Putu Sudiarta*

Universitas Pendidikan Ganesha, Indonesia

* agungrikusumasari@gmail.com

© 2020 JIPM (Jurnal Ilmiah Pendidikan Matematika)

This is an open access article under the CC-BY-SA license (<https://creativecommons.org/licenses/by-sa/4.0/>) ISSN 2337-9049 (print), ISSN 2502-4671 (online)

Abstract: The ability to think critically and creatively is needed in solving math problems. Secondary school students in Indonesia still possess these two abilities according to the results of PISA research. Therefore, learning studies that influence these two abilities are still feasible to do. This study aims to examine the effect of MEA learning with contextual worksheets on the ability to think critically and creatively in solving math problems. The study was a quasi-experimental study using a post-test only control group design. The research population consisted of 137 class X students of SMK Kharisma Mengwi, Badung Regency, Bali for the 2019/2020 school year, which was spread into five classes with equivalent math abilities. A random sampling technique determined a sample of 2 classes. Data on the ability to think critically and creatively in solving mathematical problems were collected using a test in the form of a description. Data were analyzed using the MANOVA test. The results of the analysis show that MEA learning with contextual worksheets has a positive effect on the ability to think critically and creatively in solving math problems ($F = 90.018$; $p < 0.05$).

Keywords : MEA; Worksheets; contextual; critical thinking; creative thinking; problem-solving

Introduction

Thinking skills are one of the skills of students developed at school. Thinking is a mental activity to manipulate or manage and transform information into memory (Santrock, 2011). Thinking can be divided into critical thinking and creative thinking. Critical thinking is related to the ability to carry out assessments to make conclusions based on valid evidence (Costa & Kallick, 2008; Eggen, Wahono, & Kauchak, 2012). Meanwhile, creative thinking is related to the ability to find something new (Daryanto, 2009; Sudjana, 2009; Yeni, 2010; Yuniarta, Rusilowati, & Rohmad, 2012).

Critical and creative thinking is essential in problem-solving because according to Aljaberi & Gheith (2015). Problem-solving is one of the most important cognitive activities and

can be used by a person in various contexts related to the lifestyle of the information technology revolution and accelerating changes in aspects of life. The ability to solve math problems of students in Indonesia is still low. It can be seen in the 2018 PISA survey results (OECD, 2018). The achievement of Indonesian students in PISA is still weak in solving non-routine or high-level problems. The questions tested in PISA consist of 6 levels (level 1 is the lowest to level 6 is the highest).

Meanwhile, students in Indonesia are accustomed to routine problems at levels 1 and 2. Indonesia ranks 72 out of 78 countries with an average score of 378 for mathematics, with an average international score of 489. It shows that students' mathematical problem-solving abilities in Indonesia require special attention for repair. The results of other studies show that many students are less able to make reasonable solutions, both in mathematics and in different fields of study in everyday life (Boero & Dapueto, 2007; Ruseffendi, 1991).

Concerning aspects of mathematical problem-solving abilities, students are required to have the ability to think critically and creatively to understand, plan, and carry out solutions in solving mathematical problems. Critical thinking is a crucial ability for everyone who is used to solving life problems by thinking seriously, actively, carefully analyzing all the information they receive by including rational reasons to correct every action to be taken is correct (Liberna, 2012). In addition to critical thinking, the ability to think creatively is also essential in problem-solving.

The MEA learning model is a learning model for understanding, explaining, and communicating the concepts in a problem presentation through a mathematical modeling process (Permana, 2010; Chamberlin & Moon, 2008). The advantages of MEA learning in the learning process are that students can do/solve critical and creative thinking problems. Students participate more actively and can explore their ideas, and students who have low mathematical abilities can respond to problems in their way (Mahmuzah, 2015). Beside, MEA learning also has weaknesses. Such as students' difficulty in making meaningful problem-solving questions for students. Their difficulty in putting forward direct problems that can be understood by students and many students who have difficulty responding to problems given. Quickly students get bored because they get too difficult questions, less the fun of learning for students because of the difficulties they face, and the lack of time in learning (Rina, Rizky, & Nurfitriana, 2017). It requires innovation that can maximize the application of MEA learning. One of the media that is considered capable of overcoming the AEC learning's weaknesses is contextual worksheets. Contextual worksheets are a medium that can be used as a guide for students to investigate and find the material being studied and relate it to real-life situations to encourage students to apply it in their lives (Trianto, 2009; Sanjaya, 2013; Wardhani, Wiworo, Guntoro, & Sasongko, 2010). The author believes that contextual worksheets can help overcome the weaknesses of the AEC learning because contextual worksheets have the advantage of being able to direct students to think critically so that the time needed in problem-solving can be optimized. With contextual worksheets where questions lead to everyday life, students can find answers to why they have to study the material obtained in learning (Shoidah, Rachmadiarti, & Winarsih, 2012).

The use of worksheets allows teachers to teach more optimally because the stages of learning activities are directed according to the worksheets. Some of the functions of student worksheets include a tool or media to create an effective teaching and learning situation, complementing the student learning process to attract more student attention (Djamarah & Zain, 2000; Sanjaya, 2013). In writing contextual worksheets, there are several requirements in making so that these worksheets can be said to be good. Three conditions must be met in

writing worksheets so that the worksheets can be said to be good, including educational requirements, construction requirements, and techniques (Darmojo & Kaligis, 1992).

The MEA learning model effectively used in mathematics learning can be seen in the research conducted (Hanifah, 2015). In her study, the achievement and improvement of the mathematical representation ability of students who took the MEA learning with the scientific approach were better than students who took the learning with the scientific approach. There is a difference in the increase in students' mathematical representation ability who get MEA learning with a scientific approach with students who get learning with a scientific approach in terms of their initial mathematical abilities (high, medium, low). This article examines the effect of MEA learning with contextual worksheets, which is thought to improve students' critical and creative thinking skills in solving students' mathematics problems.

Method

This research is a quasi-experimental research with a population of all class X students of SMK Kharisma Mengwi, located in Badung district, Bali, in the 2019/2020 school year. The population numbered 137 students spread into five classes with equal mathematical abilities. This equivalence is obtained by testing equality based on mathematics's summative results in the previous semester. Sampling was done randomly (random) using a lottery system for all classes that became the population. From all classes, two classes were selected randomly as the research sample. After obtaining two classes, they are drawn again to determine one class to be the control class and the other to become the experimental class. From the draw's results, it was obtained that Class X TB2 was the experimental group, and Class X TB1 was the control group. The research design used was Posttest-Only control design. This design uses two groups, namely the experimental group and the control group. The experimental group is a class that is taught with MEA learning assisted by contextual worksheets, while the control group is a class that is taught using conventional learning.

The instrument used in this study was a mathematical problem-solving test in the form of a description. This test is used to measure the ability to think critically and creatively solve mathematical problems in the material series and number series. The scoring technique in this study used an analytical scoring rubric for each item. The maximum test score is obtained by adding up the maximum score for each item. The research instrument has met the validity and reliability requirements based on instrument testing. The content validity test was conducted with two experts, namely, a mathematics teacher at SMK Kharisma Mengwi and a lecturer for S2 Mathematics Education at the Ganesha University of Education. The test using the Gregory technique on both expert opinions resulted in valid test content. The construction validity and reliability tests were also carried out on class XI students of SMK Kharisma Mengwi. The construction validity test resulted in a coefficient of 1 and a reliability coefficient of 0.60. The data analysis technique used is Multivariate Analysis of Variance (MANOVA). It is preceded by prerequisite tests in the form of bivariate normal test, homogeneity test of variance-covariance matrix, and correlation test between dependent variables. Normal bivariate test with Mahalanobis distance plot with chi-squared quantile and its correlation, covariance variant matrix similarity test with Box M test, and correlation test between the two dependent variables critical thinking ability and creative thinking ability with moment product correlation test.

Result and Discussion

After conducting the research, the researcher obtained the data and then analyzed it. The results of the analysis are then summarized and concluded. The summary of the analysis results can be seen in Table 1. and Table 2. below.

Table 1. Summary of Analysis of Critical Thinking Ability in Problem Solving

Variable	Group	
	Experiment	Control
Sample	28	28
Mean	83	69

Table 2. Summary of Analysis of Creative Thinking Ability in Problem Solving

Variabel	Group	
	Experiment	Control
Sample	28	28
Mean	82	70

The table shows that the average critical thinking ability in the experimental class is 83 greater than the average critical thinking ability in the control class of 69. Likewise, the average creative thinking ability in the class experiment is 82 greater than the average. the average creative thinking ability in the class control is 70.

The prerequisite test shows that critical and creative thinking skills have a normal bivariate distribution in both the experimental and control groups. The Mahalanobis distance plot can be seen with the chi-square quantile that spreads close to the straight line, as shown in Figure 1 and Figure 2.

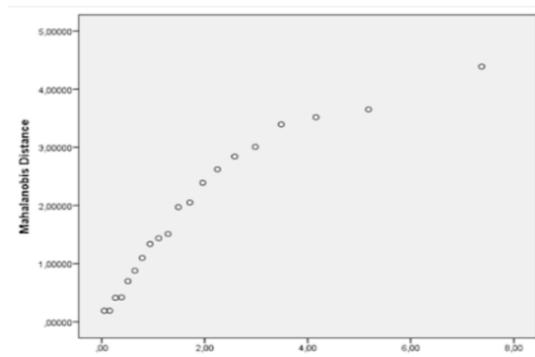


Figure 1. Mahalanobis Distance Plot of Critical and Creative Thinking Ability with Chi-Square Quantile in Experiment Group

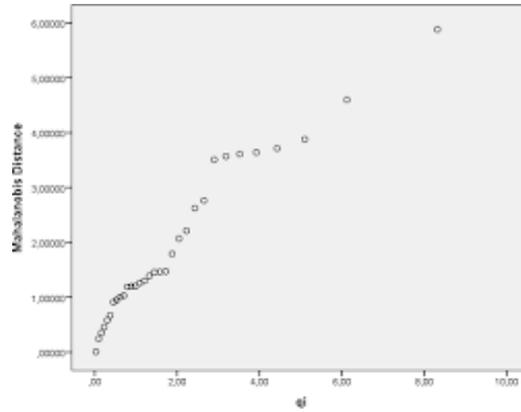


Figure 2. Mahalanobis Distance Plot of Critical and Creative Thinking Ability with Chi-Square Quantile in Control Group

Apart from using the Mahalanobis distance plot with the chi-squared quantile, the bivariate normal test was also tested by determining the significance of the product-moment correlation coefficient of both. The Mahalanobis distance correlation test results for critical and creative thinking skills with the chi-quadrante quantile can be seen in Table 3 and Table 4 below.

Table 3. Summary of Normal Bivariate Test Correlation in Experimental Group

		Mahalanobis Distance	Qi
Mahalanobis Distance	Pearson Correlation	1	.576*
	Sig. (2-tailed)		.000
	N	28	28
Qi	Pearson Correlation	.576*	1
	Sig. (2-tailed)	.000	
	N	28	28

Table 4. Summary of Normal Bivariate Test Correlation in Control Group

		Mahalanobis Distance	Qi
Mahalanobis Distance	Pearson Correlation	1	.695*
	Sig. (2-tailed)		.000
	N	28	28
Qi	Pearson Correlation	.695*	1
	Sig. (2-tailed)	.000	
	N	28	28

The correlation coefficient between the Mahalanobis distance of critical and creative thinking skills and the chi-square quantile in the experimental group was 0.576 ($p < 0.5$) and in the control group was 0.695 ($p < 0.05$). That shows a significant correlation between the Mahalanobis distance of critical and creative thinking skills and the chi-square quantile in the two groups. This result strengthens the distribution approaching the straight line depicted in Figure 1 and Figure 2. Thus; the ability to think critically and creatively has a bivariate normal distribution.

The similarity test of the variance-covariance matrix of critical thinking skills and creative thinking skills between the experimental and control groups resulted in a Box M value of 4.64 ($p > 0.05$), which means that the covariance variant matrix is homogeneous. The correlation test between the ability to think critically and creatively in the experimental group was 0.753. The control group was 0.735, both of which were in the range of 0.3 - 0.8, fulfilling the requirements for using MANOVA (Candiasa, 2010). Thus all the prerequisite tests for MANOVA are fulfilled.

The null hypothesis (H_0) tested in this study is as follows

$$H_0 : \begin{bmatrix} \mu_1 \\ \mu_3 \end{bmatrix} = \begin{bmatrix} \mu_2 \\ \mu_4 \end{bmatrix}$$

Note:

μ_1 : scores of students' critical thinking skills who take the MEA learning with contextual worksheets,

μ_2 : scores of students' critical thinking skills who follow conventional learning models,

μ_3 : scores of creative thinking abilities of students who take the MEA learning with contextual worksheets,

μ_4 : scores of students' creative thinking abilities who follow conventional learning models.

The result of analysis using MANOVA shows the value of $F = 90.018$ and has a significance of less than 0.05 ($p < 0.05$), which means the rejection of H_0 . These results indicate that MEA learning with contextual worksheets has a positive effect on the ability to think critically and creatively in solving math problems..

The MANOVA test results indicate that MEA learning assisted by contextual worksheets affects thinking critically and creatively in solving math problems. This result is inseparable from the advantages of MEA learning, namely real learning, which cannot be separated from students' daily lives. Students can construct knowledge from realistic problems. Students can create a pattern of documentation in their cognitive structure to position themselves in problem-solving. Students can identify, evaluate, and review their active mindset. Can develop students' critical thinking and creative skills in solving mathematical problems. Students can share with other students about problem-solving solutions. That results in students getting used to solving math problems in everyday life. The use of contextual worksheets supports the advantages of MEA learning. Worksheets is a tool commonly used by teachers to train students in solving math problems. There is much use of contextual worksheets. It can make it easier for students to construct knowledge of daily problems, create patterns in themselves to solve math problems, identify, evaluate, and review so that student worksheets can help students solve math problems in everyday life.

In addition to affecting problem-solving, MEA learning assisted by contextual worksheets can improve students' critical thinking skills in solving math problems. It can be seen in contextual worksheets, where students are invited to process a problem related to everyday life. With critical thinking in processing a problem, seeing patterns and shapes of student questions can solve these students' math problems.

The MEA learning assisted by contextual worksheets also affects the ability to think creatively in problem-solving. With MEA learning assisted by contextual worksheets, students are trained to think creatively, because the problems given in contextual worksheets are problems in everyday life so that students will solve the problems faced not only with the formulas that have been taught but in different ways so that students can solve the math problems it faces.

The MEA learning's weakness, as described earlier, can be overcome by using small groups to discuss problems in contextual worksheets so that students can discuss more effectively and efficiently. In these groups, students are directed to do practice questions following the instructions on the worksheets. Students will be more active in discussing students with other students and between students and teachers. It can be seen here that with the help of contextual worksheets, communication is formed in many directions so that the weaknesses of the MEA can be resolved. Other weaknesses of MEA learning, which sometimes require more time, can also be determined. With the help of contextual worksheets, student work is more focused so that the time needed to solve the problem is shorter.

The downside of further MEA learning is that students cannot know what may be vital for them to study, especially in areas with no previous experience. With the help of contextual worksheets, where questions are designed to lead to everyday problems, students can find out and understand why they are studying the material presented. By relating the problem to daily problems, they can solve the math problems they face in their everyday life.

When students have no interest or do not believe that the problem being studied is challenging to solve, they will feel reluctant to try. Contextual worksheets can overcome the weaknesses of this MEA learning because, with contextual worksheets that refer to questions or problems in everyday life, the questions in contextual worksheets will be more creative to stimulate students to work on contextual worksheets. Then the weaknesses of MEA learning, as revealed by knowledge (Rina, Rizky, & Nurfitriana, 2017), can be overcome with contextual worksheets.

The description above can illustrate that with contextual worksheets, assisted MEA learning can affect students' critical and creative thinking skills in problem-solving because students are allowed to analyze the problems they encounter themselves and discuss with their groups so as to generate critical and creative thinking in solving mathematical problems. Therefore, MEA learning with contextual worksheets can be used as a learning option to improve students' critical and creative thinking skills in solving students' mathematical problems. This finding is in line with the results of research conducted by Istianah (2013), which showed an increase in critical thinking skills due to MEA learning.

Conclusion

Based on the results of research and discussion, it can be concluded that learning by using MEA learning assisted by contextual worksheets can improve students' critical and creative thinking skills in solving students' mathematics problems. Recommendations for further research could be to develop learning media that support MEA, or more to analyze the extent to which MEA learning affects students' critical and creative thinking abilities.

References

- University Students Level of Metacognitive Thinking and their Ability to Solve Problems. *American International Journal of Contemporary Research*, 5(3), 121-134.
- Boero, P., & Dapueto, C. (2007). Problem Solving in mathematics education in Italy: Dreams and reality. *ZDM: the international journal on mathematics education*, 39(5), 383-393.
- Candiasa, I. M. (2010). *Statistik Univariat dan Bivariat disertai Aplikasi SPSS*. Singaraja: Penerbit Undiksha.
- Chamberlin, S. A., & Moon, S. M. (2008, November 24). *How does the Problem Based Learning Approach Compare to the Model Eliciting Activity Approach in Mathematics?* Retrieved July 1, 2019, from <http://www.cimt.org.uk/journal/index.htm>:<http://www.cimt.org.uk/journal/chamberlin.pdf>
- Costa, A., & Kallick, B. (2008). *Describing 16 Habits of Mind*. Retrieved June 10, 2019, from <http://www.habits-of-minds.net/16HOM2.pdf>
- Darmojo, H., & Kaligis, J. R. (1992). *Pendidikan IPA II*. Jakarta: Depdikbud, Dirjen Dikti Proyek Pembinaan Tenaga Kependidikan.
- Daryanto, .. (2009). *Panduan Proses Pembelajaran Kreatif dan Inovatif*. AV. Publisher, Jakarta.
- Djamarah, S., & Zain, A. (2000). *Strategi Belajar Mengajar*. Jakarta: Rineka Cipta.

Eggen, P., Wahono, S., & Kauchak, D. (2012). *Strategi dan Model Pembelajaran: Mengajarkan Konten dan Keterampilan Berpikir*. Jakarta: PT Indeks.

Hanifah. (2015). Penerapan Pembelajaran Model Eliciting Activities (MEA) dengan Pendekatan Sainifik untuk Meningkatkan Kemampuan Representasi Matematis Siswa. *KreanoJurnal Matematika Kreatif-Inovatif*, 6(2), 191-198.

Liberna, H. (2012). Peningkatan Kemampuan Berpikir Kritis Matematis Siswa Melalui Penggunaan Metode Improve Pada Materi Sistem Persamaan Linear Dua Variabel. *FORMATIF: Jurnal Ilmiah Pendidikan MIPA*, 2(3), 190-197.

Mahmuzah, R. (2015). Peningkatan Kemampuan Berpikir Kritis Matematis Siswa SMP melalui Pendekatan Problem Posing" *Jurnal Peluang*. *Jurnal Peluang*, 4(1), 64-72.

OECD. (2018). *Programme For International Student Assessment(PISA) result From PISA 2018*. <https://www.oecd.org/pisa/PISA-2018-Indonesia.pdf>.

Permana, Y. (2010). *Pengembangan Kemampuan Pemahaman, Komunikasi, dan Disposisi Matematis Siswa Sekolah Menengah Atas Melalui Model Eliciting Activities*. Bandung: Disertasi pada SPS UPI Bandung.

Rina, D. S., Rizky, E. U., & Nurfitriana, R. (2017). Keefektifan model eliciting activities (meas) Berbantu macromedia flash terhadap kemampuan Pemecahan masalah. *Jurnal Ilmiah Pendidikan Matematika*, 2(2), 170-175.

Ruseffendi, E. T. (1991). *Pengantar Matematika Modern dan Masa Kini untuk Guru dan PGSD D2 Seri Kelima*. Bandung: Tarito.

Sanjaya, W. (2013). *Penelitian Pendidikan Jenis, Metode dan Prosedur*. Jakarta: Kencana Predana Media Group.

Santrock, J. W. (2011). *Perkembangan Anak Edisi 7 Jilid 2. (Terjemahan: Sarah Genis B)*. Jakarta: Erlangga.

Shoidah, Z., Rachmadiarti, F., & Winarsih. (2012). Pengembangan LKS Berbasis Contextual Teaching and Learning Materi Hama dan Penyakit Tumbuhan. *Berkala Ilmiah Pendidikan Biologi (BioEdu)*, 1(3), 8-12.

Sudjana, N. (2009). *Penilaian Hasil Proses Belajar Mengajar*. Bandung: Remaja Rosdakarya.

Trianto. (2009). *Mendesain Model Pembelajaran Inovatif-Progresif*. Jakarta: Kencana Predana Media Group.

Wardhani, S., Wiworo, Guntoro, S. T., & Sasongko, H. W. (2010). *Pembelajaran Kemampuan Pemecahan Masalah matematika di SMP. PPPPTK Matematika*. Yogyakarta: PPPPTK Matematika,

Dirjen PMPTK Kemdiknas.

Yeni, R. (2010). *Strategi Pengembangan Kreativitas pada Anak Usia Taman Kanak-kanak*. Jakarta: Kencana.

Yunianta, T., Rusilowati, A., & Rohmad. (2012). Kemampuan Berpikir Kreatif Siswa Pada Implementasi Project Based Learning Dengan Peer And Self-Assessment. *Unnes Journal of Mathematics Education Research*, 1(2), 81-86.