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Promoting the Increase of Mathematical Representative Skill in Vocational Students through Blended Problem-Based Learning Sri Rahayu Setiyorini1 and Azalina Nurul Fajariah2 1 SMK. Karya Pembangunan Padalarang Jl. U Suryadi 17 Kertajaya Padalarang-Bandung Barat 2 SMP PGRI Pameungpeuk, Jl. Raya Pameungpeuk, Garut, Indonesia 1 sr.setiyorini@gmail.com, 2 azalina93nurul@gmail.com Received: XXXXX X, XXXX; Accepted: XXXXX X, XXXX Abstract Low mathematical representation skill causes the inability of vocational students solving problems creatively as demanded by industries.

Researches showed that blended problem-based learning (BL-PBL) combining online and offline learning to train students to independently solve problems was proven to increase mathematical skills in education levels other than vocational school. Therefore, this research aimed to evaluate BL-PBL effect to mathematical representation skill escalation in vocational high school.

Quantitative study with pre-test and post-test control group design was performed to two randomly-chosen classes over vocational schools in Kabupaten Bandung Barat, West Java, Indonesia. Samples were divided into two groups: experimental (BL-PBL method) and control (lecture method). Initial skill was determined by pre-test while learning outcome was determined using post-test. Data was analysed by t-test and two-way ANOVA with 0.05 significance level using IBM SPSS. Result showed the initial skill of two groups was similar.

After treatment, N-gain data uncovered a significant increase of representative skill in experimental group. While, two-way ANOVA test showed no interaction between learning model used and student grouping based on initial skill to representation skill. Finally, BL-PBL was proven to increase mathematical representation skill in vocational

students and, hence, is suggested to be implemented in vocational high school
Keywords: Blended learning, Problem-based learning, Representative skill How to Cite: Setiyorini, SR. & Fajariah, AN. (2019).

Promoting the Increase of Mathematical Representative Skill in Vocational Students through Blended Problem-Based Learning. JIML, X (X), XX-XX. _ _ INTRODUCTION Mathematical representation skill is the ability of interpreting someone's thought in the form of words, pictures, tables, graphs, concrete things, mathematical symbols, etc. to be used as a tool in problem solving (Syafri, 2017; Tandililing & Hartoyo, 2016).

Therefore, mathematical representation skill is important in promoting logical, systematical, critical, and creative thinking ability; as stated in the purpose of studying mathematics. In vocational high school (Sekolah Menengah Kejuruan – SMK), especially in technology and engineering expertise group, subjects such as technical drawing and energy conversion are highly correlated with mathematics. These subjects need mathematical representation skill to understand (Arifin & Ristadi, 2017; Warso, 2017).

However, data shows that mathematical representation skill of vocational high school students is low (Hasibuan, 2017; Indrati, 2017; Kusumawati, 2017; Maulydia, 2017; Tyas, 2016). This correlates with the inability of vocational students to solve mathematical problems (Armanto, Armanto, & Harahap, 2014; Asmara, 2016; Ramandani, Mahardika, & Supriadi, 2017; Syafri, 2017).

Adiastuty (2015) supported the findings by stating that the level of pleasure given by studying mathematics in vocational students is also low. Those problems are caused by many factors, one of them is due to the use of conventional methods of teaching (lecturing) by mathematics teachers which restricts mathematical representative skill optimal growth and development (Chen, Lee, & Hsu, 2015).

Arifin & Ristadi (2017) showed that vocational high school graduates still contributed the most to the amount of jobless people in Indonesia. The low level of knowledge and skill owned by vocational high school graduates was then concluded as the main reason why many of them could not be absorbed by the industry. It was surveyed that the unskilled and unknowledge vocational high school graduates faced difficulties of internalizing and understanding a problem.

Therefore, graduates were observed to be inflexible and uncreative in solving daily problems, especially those which were correlated with mathematics. This makes vocational high school graduates less competitive compared to other candidates in company recruitment or building their own business. Therefore, it is clear that a planning in mathematics teaching which contains developable approaches and models for vocational students is needed.

One of the approaches developed is blended learning, a combination of face to face (offline) and online learning (Purnomo, Ratnawati, & Aristin, 2016; Surahman & Surjono, 2017). This approach fills the gap of offline learning developed in Kurikulum 13 related to scientific approach, yet also prepare students for the upcoming industry era where everything is done through online instructions. It is widely known that problem-based learning is effective to develop mathematical skill.

Using problems as its key feature, this learning method focuses in cognitive aspect to find solutions, starting with serving contextual problem to understand concept (Mulyana & Sumarmo, 2015). Special characteristic of problem-based learning is that students are active in building detail knowledge through researching, data collecting, and problem solving by building cause and effect relationship to solve a problem (Asmara, 2016; Mulyana & Sumarmo, 2015; Tandiling, 2015).

Furthermore, this student-centered model also explores all mathematics skills (Mulyana & Sumarmo, 2015). Problem-based learning has several excellences, such as: 1) preparing students to face daily problems, 2) teaching students to dig new knowledge independently, 3) helping students in developing mathematical representation skill as well as other mathematical skills (Aziz, Ahyan, & Fauzi, 2016; Tera, 2016).

Learning method used in this study combines offline problem-based learning and online learning. Two days before offline learning in class is held, teacher uploads materials and tasks in Whatsapp media to dig into students' basic skill and to promote them learn new things. Then, offline learning is held in classes using problem-based learning.

Therefore, it is concluded that blended problem-based learning is aimed to: 1) measure the increase of mathematical representation skill in vocational students taught using blended problem-based learning compared to vocational students taught using conventional method, and 2) know the interaction of blended problem-based learning with student grouping based on initial mathematical skill compared to the increase of mathematical representation skill.

Looking at the benefits and how promising it is, blended problem-based mathematics learning in technology and engineering vocational high school is expected to solve learning problems described before. METHOD This research was a quantitative research with pre-test and post-test control group design. Therefore, instruments used were arranged in the form of pre-test and post-test.

Population of the research consisted of all the first-year students of vocational high schools in Kabupaten Bandung Barat. Samples were randomly selected and two classes in SMK Karya Pembangunan Bandung Barat were chosen. A class of X TP 3 was determined as the experiment group which received blended problem-based learning while class of X TP 1 was determined as control group which received the usual scientific approach learning model. Before treatment, the groups were given a pre-test to know their initial mathematical skill.

The initial skill was then compared between experiment and control group. Pre-test was also used to group students into high, middle, and low achiever. Material delivered in the study was arithmetical sequence and series. To analyze the data, t-test and two-way ANOVA with significance value of 0.05 were used. The test results were collected and analyzed using IBM SPSS ver. 19. Statistical features, frequency and percentage were used to describe statistical features.

The collected data was presented in the form of table to make comparison between similarities and differences between groups easier. Achievement of representation skill was determined from post-test scores and analyzed by independent sample t-test. To see if the learning outcome, which was representation skill, was correlated to learning method and initial mathematical skill, two-way ANOVA was used.

RESULTS AND DISCUSSION Results Initial Mathematical Skill Assessment By using post-test scores according to following criteria (Table 1), number of students and their achieving level in each group can be determined as follows. Table 1. Grouping of Students' Initial Skill Based on Pre-Test Scores _ _Criteria _Label _Control (number of students) _Experimental (number of students) _ _55<??=100 45<??=55 ??=45 _High Middle Low _6 (24 %) 13 (52 %) 6 (24 %) _7 (28 %) 12 (48 %) 6 (24%) _ _ It was very important to make sure that the initial mathematical skill between students in treatment groups were similar to eliminate bias.

Therefore independent samples t-test was performed following normality and homogeneity tests to pre-test scores gathered from both groups. The analysis is shown in Table 2. Table 2. Measurement of Initial Skills Difference between Treatments. _ _ _F _Sig. _t _Df _Sig. (2-tailed) _ _Pre-test _.019 _.890 _.028 _48 _.978 _ _ Independent samples t-test performed on pre-test scores of each group showed that ?? ?????????? =0.028< ?? ?????????? =0.680 and p value = 0.489 >0.05. The result indicated that there was no significant difference of initial skill between both groups.

It was concluded that both experimental and control group had similar initial mathematical skill before treatment proceeded. Representation Skill Achievement Following treatment, post-test was held and the scores were gathered. To assess which treatment gave better learning outcome, t-test was performed to post-test scores following normality and homogeneity tests.

Table 3 shows that ?? ?????????? =5,480> ?? ?????????? =0,680 and p value < 0.05, indicating there was significant difference of learning outcome between groups. Therefore, conclusion was drawn that blended problem-based learning was more effective compared to conventional approach. Table 3 t-Test Analysis to Determine Differences in Learning Outcome. _ _Post-test _F _Sig. _T _df _Sig.

(2-tailed) _ _ _2,363 _,163 _-5,580 _48 _,000 _ _ Analysis of pre- and post-test were shown in Table 4. In the analysis of pre-test scores, it was observed that ?? ?????????? < ?? ?????????? and ??>0,05 in high and middle achieving students. While, ?? ?????????? > ?? ?????????? where ?? ?????????? was negative and ??>0,05 was observed in low achieving students. Table 4.

t And p Value of Pre-Test and Post-Test Scores Analysis According to Initial Mathematical Skill of Students. _ _Skill _Group _N _Mean _SD _MD _t _p value _ _Pretest _ _High _Experimental _7 _57.86 _2.037 _.143 _.133 _.448 _ _ _Control _6 _58.00 _1.789 _ _ _ _ _Middle _Experimental _12 _48.92 _4.122 _.083 _.049 _.481 _ _ _Control _13 _49.00 _4.282 _ _ _ _ _Low _Experimental _6 _36.00 _1.673 _-1.833 _-1.534 _.078 _ _ _Control _6 _37.83 _2.401 _ _ _ _ _Posttest _ _High _Experimental _7 _86.57 _2.070 _9.238 _7.561 _0 _ _ _Control _6 _77.33 _2.338 _ _ _ _ _Middle _Experimental _12 _76.92 _3.059 _7.455 _4.617 _0 _ _ _Control _13 _69.46 _4.754 _ _ _ _ _Low _Experimental _6 _68.67 _4.367 _8.667 _3.250 _.005 _ _ _Control _6 _60.00 _4.858 _ _ _ _ _ As previously describes, Table 4 shows that there was no significant difference in initial mathematical skill between groups.

While, in analysis of post-test scores, initial mathematical skill of students categorized into high, middle, and low achieving was observed to be ?? ?????????? > ?? ?????????? , where ??>0,05. The result showed that there was significant difference between experimental and control group. The Increasing of Mathematical Representation Skill To see if there was increasement in mathematical representation skill, N-Gain data as used.

Before performing independent samples test to N-Gain scores, normality and homogenity tests were performed. Table 5. showed that ?? ?????????? =8,827> ?? ?????????? =0,680 and ?? value<0,05, indicating that there was significant increase of learning outcome between experimental group, which received blended-problem based learning, and control group, which received ordinary lecture method. Table 5.

Independent Samples t-Test to Learning Outcome Result. _ _ _F _Sig. _t _df _Sig. (2-tailed) _ _N Gain _,839 _,364 _-8,827 _48 _,000 _ _ Interaction between Initial Skill and Blended Problem-Based Learning and Mathematical Representation Skill After the N-gain data of each experimental and control group was assessed and known to be normally distributed with homogeny data variance (Table 6.).

Therefore, to understand the whole effect of data group, two-way ANOVA was performed. Significance of corrected model showed 0.000, meaning the model was valid. Significant intercept was detected as significance of the intercept was calculated to be 0.000. p value was < 0.05 for learning variable, indicating that there was significant effect of blended problem-based learning to mathematical representation skill. Whereas, p value < 0.05 for initial skill variable indicated that there was significant difference of learning outcome in students with high, middle, and low achievement level treated with blended problem-based learning. However, for the interaction between model factor and initial mathematical skill, p value > 0.05 indicating no significant correlation.

Error model value was better because it got smaller. While, R squared value was 0.991, close to 1, indicating a strong correlation. Table 6. Tests of Between-Subjects Effects _ _Dependent Variable : N-Gain _ _Source _Type III Sum of Squares _Df _Mean Square _F _Sig. _ _Corrected Model _.907a _5 _.181 _90.512 _.000 _ _Intercept _9.460 _1 _9.460 _4718.411 _.000 _ _Learning _.562 _1 _.562 _280.447 _.000 _ _Initial Skill _.283 _2 _.142 _70.587 _.000 _ _Learning * Initial Skill _.008 _2 _.004 _2.010 _.146 _ _Error _.088 _44 _.002 _ _ _ _Total _11.456 _50 _ _ _ _ _Corrected Total _.996 _49 _ _ _ _ _ a.

R Squared = ,911 (Adjusted R Squared = ,901) _ _ Discussion Data analysis showed that the use of blended problem-based learning could escalate mathematical representative skill of vocational students in arithmetical sequence and series material. In line with the result, it was also observed that students from treatment group had higher learning interest compared to students from control group.

Treated students seemed to be more ready in receiving information, more understanding the concepts given, and more explorative when solving problems in class. However, control students were observed to be passive and mono-directed. According to Olivier and Trigwell (Simarmata, Djohar, Purba, & Juanda, 2018), the observed phenomenon are related to student-subject engagement triggered by blended problem-based learning. The word blend in blended learning, more than just defining the combination of online and offline learning, also means knowledge blending.

Exploration of new knowledge from online resources, outside from the frame of knowledge given by teacher at school, is useful to make students see the world openly in a wider point of view. Blended learning is also famous for its flexibility of giving students opportunity to arrange their learning independently according to their self-ability.

During independent online learning, student can use their time for no limit whenever they want, in contrast to the time-measured learning in class. Therefore, students can adjust the time needed for them to understand information without slowing down or fastening up others (Lin, Tseng, & Chiang, 2017; Stockwell, Stockwell, Cennamo, & Jiang, 2015).

This method boosts the understanding of students in all group of achievement, as showed in the learning outcome analysis in each group of achievement. Students are also given opportunity to choose how they would like to learn about new knowledge depending to their learning styles. Material flexibility and availability given in blended learning, such as video and multimedia animation, can accommodate various learning styles (Lin et al.,

2017; Rahman & Ahmar, 2016) while increasing auditory, observation, language, and cognitive aspect of the students (Stockwell et al., 2015). This flexibility increases student-subject engagement and makes learning activity fun yet enjoyable. Therefore, as showed by student behavior observation in class, learning activity and efficiency increases (Aldalalah & Gasaymeh, 2014).

Post-test instruments were designed to evaluate students' representative skill after experiment was finished. According to post-test analysis result, it was seen that scores gained by both treated and control students were correlated with their performance in class. In line with Widakdo (2017), students receiving blended problem-based learning could represent daily life problems to mathematical sentences better.

Thus, they could solve the problems easily by using mathematical tools and approach. Students' creativity was also proved by various approaches used to solve a given problem, according to how each student understood the problem. In contrast, student receiving conventional teaching method faced difficulties to represent a daily problem into mathematical sentences.

Their answers were also similar, showing their creativity and understanding were not explored well. According to Oliver (2005); Stockwell et al. (2015), students receiving blended problem-based learning have enough fundamental and basic knowledge needed to solve problems given during offline learning in class. The fundamental knowledge is seemed to gather during online learning, supported by learning resources available in the internet (Lin et al., 2017; Simarmata et al.,

2018). Then, the gathered fundamental knowledge is sharpened by problem-based learning during offline learning. As learning materials were given early before offline meetings started, teacher could maximize their time to focus on building and training representative skill. Teachers can also give coaching session to students facing difficulties.

In contrast, during conventional learning, teachers face difficulties managing their time to deliver information and to give exercise. As the result, not all needed information are delivered and less exercises are conducted, making the conventional-styled students cannot build their own knowledge and representative skill (Stockwell et al., 2015).

Therefore, the students' thinking pattern and approaches used to solve problems are similar and seems to be not well-developed. CONCLUSION According to data analysis and discussion, it was concluded that the increasing of mathematical representation skill of students receiving blended problem-based learning was better than students receiving conventional learning.

Also, it was suggested that there was no interaction between learning models and student grouping to the increasing of mathematical representative skill increase. Therefore, blended problem-based learning is effective to increase and to achieve mathematical representative skill in vocational high school. Due to the low representative skill of vocational student, it is suggested that this study should be considered to apply to support mathematic learning in vocational high school. ACKNOWLEDGMENTS The author would like to thank SMK Karya Pembangunan Padalarang for allowing this study to be carried out there.

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