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The Effectiveness of *WhatsApp* on Problem Posing Learning towards Students' Motivation and Cognitive Learning Outcome in Stoichiometry Material

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Abstract: The objective of the study is to determine the differences in motivation and cognitive achievement between groups of students that learned with Problem Posing-*WhatsApp* model with group of students that learned with the Problem Posing only in Stoichiometry material. The research design used a quasi-experimental design without pre-test. Experiment class learned with Problem Posing by using *WhatsApp* learning model while the control class learned with Problem Posing learning model. Instruments measuring cognitive learning outcomes in the form of objective tests are 25 questions and motivation questionnaire with total 34 statements. The results showed that there are differences in motivation and cognitive achievement among students that learned with Problem Posing-*WhatsApp* learning model with group of students with Problem Posing model. Students that learned with Problem Posing by using *WhatsApp* learning model has an average of 79.67 and a motivation for cognitive achievement of 79.25, while the group of students that learned with Problem Posing learning model has an average of 73.89 and motivation for learning outcomes cognitive at 71.74.

Key Words: problem posing learning model, WhatsApp, motivation, cognitive learning outcomes, stoichiometry

Abstrak: Penelitian ini bertujuan mengetahui perbedaan motivasi dan hasil belajar kognitif antara kelompok siswa yang dibelajarkan model *Problem Posing-WhatsApp* dengan yang dibelajarkan model *Problem Posing* pada materi stoikiometri. Rancangan penelitian yang digunakan rancangan eksperimental semu tanpa pre tes. Instrumen pengukuran hasil belajar kognitif berupa tes objektif berjumlah 25 soal dan angket motivasi berjumlah 34 pernyataan. Hasil penelitian menunjukkan ada perbedaan motivasi dan hasil belajar kognitif antara kedua kelas. Siswa yang dibelajarkan dengan model *Problem Posing - WhatsApp* memiliki rata-rata motivasi sebesar 79,67 dan hasil belajar kognitif sebesar 79,25, sedangkan kelompok siswa yang dibelajarkan dengan model *Problem Posing* memiliki rata-rata motivasi sebesar 73,89 dan hasil belajar kognitif sebesar 71,74.

Kata kunci: model pembelajaran *Problem Posing*, *WhatsApp*, motivasi, hasil belajar kognitif, stoikiometri

Chemistry is one of the branches of natural science that studies the structure, anatomy, properties, changes of matter, and the energy it attaches, and has a significant influence on the development and advancement of Mortimer technology (Ajick, 2009). National Education Standards Agency (2006) states that the essence of chemistry includes two inseparable things, namely chemistry as a product and chemistry as a process. Chemistry as a product includes a collection of knowledge consisting of facts, concepts, laws, and chemical principles, while chemistry as a process involves scientific work. Chemical learning aims to equip students with logical, analytical, systematic, critical, and creative thinking skills.

This is consistent with one of the competencies in the 2013 curriculum, that the core competence and basic competence in secondary education prioritize on the areas of attitude and intellectual ability or high cognitive ability. Taking into account these circumstances, chemistry subjects must be mastered well

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by students. In fact, students in understanding chemistry lessons encountered innumerable problems. Sirhan (2007) states that the problems faced by students, especially high school is the difficulty of students in understanding chemistry, since the concept is abstract. In addition, chemistry is also a tiered lesson, materials studied from the basics to the complex part (Herunata, 2003).

Such chemical characteristics make students less interested in learning. One of the basic content given to students precisely in Ten graders is the equation of chemical reactions and their quantitative calculations, commonly referred to as stoichiometric material. Material content that combines conceptual and algorithmic materials causes some students to dislike stoichiometric material. The things that cause stoichiometric material is difficult and less favored by students. Students find it difficult to understand concepts and they can not apply the concept when answering questions, it is difficult to understand the steps to solve the equation of the reaction, and also difficult to distinguish the formula in chemical calculations. Several previous studies at various high schools indicate that students' difficulties in understanding stoichiometric material concerns equality of moles, calculation of reactant mass and reaction product, calculation of reactant and reaction volume, determination of reaction reagents of a reaction, and the determination of the empirical formula and molecular formula of a compound (Andhartini, 2009; Toth, 2009; Great & Schawatrz (in Niaz 2012); Istiqomah, 2013; and Haryani, 2014). One of the indications shown by the students is having difficulties in stoichiometric material that is the result of student learning that does not meet the minimum standard of accomplishment that has been set, as delivered by Rohanitasari (2013), that in Senior High School in Bandung the average score of stoichiometric material is 50,25 whereas the Minimum Mastery Criteria is 70.

The lack of motivation in students makes stoichiometry increasingly difficult to understand. Students with low motivation increasingly feel that stoichiometry becomes boring, even frightening when the teacher asks to do it in class. Interest and motivation must be nurtured and enhanced, as both are important in the learning process (Masyudin, 2012, Purwati, 2015, Laurina, 2016). In addition to motivation, teaching methods provided by the teacher will affect the learning process in the classroom.

Koulogliotis & Salta (2012) state that the low motivation of students on stoichiometric material is caused by less attractive learning model employed and less involving the students' role. Jahro and Susilawati (in Rohanitasari, 2013) present that 75% to 89.3% of high school students need innovative learning methods on stoichiometric materials to improve learning motivation. One of the learning models that can be applied in the learning of stoichiometry is the *problem posing* (Iskandar, 2015). *Problem Posing* learning model requires students to practice form the problem and solving it, so that they will not learn more directly to understand the material stoichiometri. *Problem posing* encourages the creativity and excitement during the material understanding (Shukkwan, 2005). Feelings of happiness will arise when students can answer the questions which was made by their friends make. Students will be motivated to understand the concept in depth and they will be challenged to be able to work on the problems made by their friend.

Time allocation for learning stoichiometry, in fact, is insufficient. However, this topic requires considerable time allocation for having an exercise in order to make the students understand the concept and its algorithmic. Limited time allocation during classroom learning could be maximized through the utilization of information technology, social media, as a channel for stoichiometry learning. One of the applicable social medias are *WhatsApp*. *WhatsApp* is a multiplatform mobile messaging apps that allows the user to have message (Yeboah & Ewur, 2014). It is used by creating group among members of *WhatsApp* users. WhatsApp has several advantages compare to other social medias such as e-mail, SMS, *Facebook*, *Twitter*, *Line*, and *BBM*, and thus it is effective for learning (Bouhnik & Deshen, 2014). The implementation of problem posing model on stoichiometry could use *WhatsApp* as interaction media between teacher and students in one class through group chat. The created group chat is for continuing the learning in school. Using *WhatsApp* group chat for discussing the topic could create delightful discussion and encourage students to learn the topic. Barhoumi (2015) showed that blended learning using *WhatsApp* creates effective discussion as an extended discussion from classroom discussion. Zan (2015) indicated that *WhatsApp* provides positive effect to improve knowledge and communication skill on organic chemistry compound.

According to the aforementioned explanation, messaging application *WhatsApp* could be utilized to improve Chemical learning. In addition, taking into account stoichiometry understanding as an important matter, the authors were encouraged to identify and examine the utilization of WhatsApp on students' motivation and cognitive learning outcome in stoichiometry topic of tenth graders.

METHOD

The research design employed was quasi experiment with post-test only control group design approach. This research included Problem Posing model as independent variable, cognitive learning achievement and motivation as dependent variable, and learning material, time allocation, and teacher as contolled variable. This research took 10th graders of SMAN 1 Paciran Lamongan Academic Year 2016/2017 consisting of eight classess amount to 223 students as research population. The sample taken was two classess; X-3 Class as contol class and X-4 as experiment class.

The instrument of this research consisted of two kind of instrument, namely treatment instrument and measurement instrument. Treatment instrument was comprised of Lesson Plan of control and experiment class, handout, student's worksheet, and online social media *WhatsApp*. The measurement instrument were observation sheet. Motivation questionnaires, and test items. The validity test was taken for content validity and items of exercise.

The data of this research were analyzed through two stages of analysis. The initial stage of data analysis was conducted to identify the condition of two classess of sample. Initial stage of analysis was done before the two classes were given the treatment. The data used in the initial stage of analysis was the result of students' exam from the previous topic and initial motivation questionnaire. The initial stage of data analysis was normality test, homogeneity test, and test for the equality of means. After being identified that both initial knowledge and motivation were identical (initial analysis results), the experiment class was given Problem Posing learning model assisted with *WhatsApp* and control class was given Problem Posing learning model without assisted by *WhatsApp*.

Cognitive learning achivement result was obtained from post-test after the learning has ended. Test of cognitive learning achievement was 25 multiple choices items with 5 alternatives and given 90 minutes to complete. The obtained data from post-test and final motivation questionnaire were analyzed to prove the proposed hypothesis. The final stage of data analysis was normality test, homofeneity test, and hypothesis test.

RESULTS

Learning model implementation in experiment and control class for stoichiometry topic was conducted in eight session. According to the observation result regarding the implementation of learning model in Table 1, it shows that the average result of learning model implementation in experiment class is 87.24% and control class is 82.03%. It indicates that the steps composed within the learning model have arranged appropriately by the researchers and it considered as good for both experiment and control class.

Students' initial knowledge data were obtained through previous students' examination score. The initial knowledge data of both classes is presented in the following Table 2.

Normality testing was conducted to identify whether the data obtained was from sample with normally distributed population or not. While homogeneity testing was conducted to identify whether the initial score data from both classess have identical variant (homogen) and test for the equality of means (t-test) was conducted to identify whether both samples have significantly equal average or not. The data obtained regarding normality, homogeneity, and test for the equality of means testing of students' initial knowledge assisted by data analysis computer software are presented in the following Table 3.

Table 1. Learning Model Implementation Percentage

Meeting-	(%) Experiment Class	(%) Control Cla
1	72,92	70,83
2	77,10	75,00
3	85,42	77,00
4	87,50	81,30
5	89,58	85,40
6	93,75	88,00
7	95,83	89,60
8	97,92	90,00
Average	87,24	82,03

Table 2. Students' Initial Knowledge Data

Class	N	Min Score	Max Score	Average	Sd
Control	27	50	88	70,03	10,20
Experiment	27	50	88	71,29	9,96

Table 3. Normality, Homogeneity, and Test for The Equality of Means Data of Students' Initial Knowledge

Class	Normality testing	Homogeneity testing	t-test
Control	0,13	0,73	0,64
Experiment	0,35		

Motivation questionnaire was given to both classess before giving the treatment to identify students' initial knowledge. Both classes received similar questionnaire. The results of questionnaire of initial knowledge are presented in Table 4.

The results of normality, homogeneity, and t-test of students' initial motivation assisted by data analysis computer software are presented in Table 5.

After giving treatment to both experiment and control classes, then final motivation questionnaire was given to both classess to identify students' final motivation. Both classess received similar questionnaire with the previous one. The data obtained is presented in Table 6.

The results of normality, homogeneity, and t-test of students' final motivation assisted by data analysis computer software are presented in the following Table 7.

According to Table 7, it shows that output test of normality using Shapiro-Wilk test with significance rate of 95% generated significance value for experiment class of 0.28 and control class of 0.20. Both experiment and control classes obtained significance value higher than 0.05, it means that final motivation data of both classes was normally distributed.

Table 4. Students' Initial Motivation

Class	N	Min	Max	Average	Sd
Control	27	59,41	80,00	69,71	4,68
Experiment	27	65,29	81,18	71,83	4,29

Table 5. Normality, Homogeneity, and Test for The Equality of Means Data of Students' Initial Motivation

Class	Normality testing	Homogeneity testing	t-test
Control	0,80	0,68	0,64
Experiment	0,08		

Table 6. Students' Final Motivation

Class	N	Min	Max	Average	Sd
Control	27	69,41	79,41	73,89	3,00
Experiment	27	74,12	84,12	79,67	2,58

Table 7. Normality, Homogeneity, and Test for The Equality of Means Data of Students' Final Motivation

Class	Normality testing	Homogeneity testing	t-test
Control	0,28	0,44	0,00
Experiment	0,20		

Based on the data in Table 7, the interpretation of output Test of Homogeneity of Variances using Levene test obtained significance value students' final motivation data equal to 0,44. The value of significance obtained is greater than 0.05, it can be concluded that the final motivation data of both classes appear to have same variant. Based on the data in Table 7, the Output SPSS Independent Sample t-Test obtained a sig. (2-tailed) value of 0.00 <0.05. According to the basic decision-making in the Independent Sample t-Test, H 0 is rejected and H 1 is accepted which means that there is a difference of mean on students' final motivation between experimental class which was taught using Problem Posing assisted with WhatsApp and controlled class just using the Problem Posing learning model .

The effectiveness of *WhatsApp* on students' motivation was examined by testing hypothesis using motivation gain score. Gain score aims at identifying the margin between before and after treatment. Gain score of experimental and controlled classes is presented in the following Table 8.

According to Table 8, it shows that SPSS output interpretation of Independent Sample t-Test obtained sig.(2-tailed) equal to 0.00<0.05, thus it is applicable to take a decision which there is a difference of motivation gain score between experimental and controlled class. On other words, H_1 is accepted and H_0 is rejected. Cognitive learning outcomes of both classes is presented in the following Table 9.

Table 8. Students' Learning Motivation Gain Score

Variable	Class	Mean	Margin	Sig	Remarks
Motivation	Controlled	4,05	3,79	0,00	Significant
	Experimental	7,84			

Table 9. Students' Cognitive Learning Outcome

Class	N	Min	Max	Mean	Sd
Controlled	27	54	85	71,74	7,94
Experiment	27	70	92	79,25	6,82

Table 10. Normality, Homogeneity, and Test for The Equality of Means Data of Students' Cognitive Learning Outcome

Variable	Class	Mean	Mar-gin	Sig	Remarks
Motivation	Controlled	4,05	3,79	0,00	Significant
	Experimental	7,84			

The results of normality, homogeneity, and t-test of students' cognitive learning outcome assisted by data analysis computer software are presented in the following Table 10.

According to Table 10, it indicates that normality test using Shapiro-Wilk with the significance rate of 95% obtained the significance value of experimental class amounted to 0.06 and controlled class amounted to 0.59%. Both classess obtained more than 0.05 significance value which means that the data was normally distributed.

Based on the data in Table 10, the interpretation of output Test of Homogeneity of Variances using Levene test obtained significance value of students' cognitive learning outcome equal to 0,77. The value of significance obtained is greater than 0.05, it can be concluded that the final motivation data of both classes appear to have same variant. Based on the data in Table 10, the Output SPSS Independent Sample t-Test obtained a sig. (2-tailed) value of 0.00<0.05. According to the basic decision-making in the Independent Sample t-Test, H 0 is rejected and H 1 is accepted which means that there is a difference of mean on students' cognitive learning outcome between experimental class which was taught using Problem Posing assisted with WhatsApp and controlled class just using the Problem Posing learning model.

DISCUSSION

Aspects observed by the researchers during the learning of stoichiometry topic in both controlled and experimental class are initial activities, core actvities, and final activities which are based on the designated Lesson Plan to achive learning feasibility and accomplishment. According to the data presented in Table 1, the feasibility of learning model of the first meeting until the eighth meeting of experimental class was 87.24% and as for controlled class was 82.03%. The results show that the average score of learning process feasibility of stoichiometry on experimental class using Problem Posing assisted with *WhatsApp* is considered good as well as controlled class using Problem Posing only.

The difference on average score of learning feasi-bility is due to the utilization of *WhatsApp* as the assisted media. *WhatsApp* is a social media which is applicable as discussion channel outside the classroom to extend class discussion. Interaction within *WhatsApp* increases communication between among students and between students and teacher to learn more about stoichiometry using Problem Posing learning model. In addition, regular and continous interaction within *WhatsApp* increases students' confidence and thus it impacts on students' motivation.

Students' motivation in both experimental and controlled classes were observed in terms of initial motivation and final motivation by giving the students motivation questionnaire. Students' initial motivation of controlled class was 69.17 and experimental class was 71.83. Then, students' final motivation of controlled class was 73.89 and experimental class was 79.67. The increasing results of students' motivation after giving treatment means that Problem Posing learning model could assist students in learning stiochiometry. In addition, Problem Posing learning model could also improve students' creativity and thinking ability. Students' creativity is shown by their ability in creating questions and answer the questions from their friends. The limited time allocation of learning could be minimized by utilizing *WhatsApp*. Using *WhatsApp* for discussion improves communication between students and teacher through group chat. Interaction between students and teacher creates a positive discussion which improves students' motivation in understanding stoichiometry topic. It is proven from the learning motivation measured after the learning ended. Data interpretation regarding the difference of initial and final students' motivation could be seen from gain score test of motivation. Motivation gain score of experimental class was 7.84 and controlled class was 4.05 with margin of 3.79. It means that there is gain score between experimental and controlled class.

Cognitive learning outcome in this study is students' learning outcome obtained from the post-test given to both controlled and experimental classes after giving treatment. According to the data presentation in Table 9, it shows that experimental class' average score was 79.25 and controlled class' average score was 71.74. it means that students' cognitive learning outcome of experimental class which was given Problem Posing learning model assisted with *WhatsApp* is higher than controlled class which was only given Problem Posing learning model without being assisted by *WhatsApp*. The margin of result between experimental and controlled class is considerable, amounted to 7.51. It means that Problem Posing learning model assisted with *WhatsApp* is better than Problem Posing learning model without being assisted by *WhatsApp*. This increasing is due to the utilization of *WhatsApp* as supporting media to support students' activity outside classroom in order to maximize the learning. On-

line discussion through *WhatsApp* group generates an interesting learning and could solve limited time allocation issue. Barhoumi et al., (2015) explain that Blended Learning using *WhatsApp* creates effective discussion after classroom discussion. It is further supported by Ghufroni and Yahya (2013) which explain that Problem Posing improves Senior High School students' cognitive learning outcome and Poba (2015) which argues that college students' learning outcome and motivation increase when the learning is assisted by online media.

CONCLUSION

Problem Posing learning model assisted by *WhatsApp* could improve studens' learning motivation and cognitive learning outcome on stoichiometry topic. Thus, it affirms that *WhatsApp* is effective to improve improve studens' learning motivation and cognitive learning outcome.

It requires further research to identify the effectiveness of Problem Posing learning model on other aspects which is correlated with learning process that is not measured in this research and its implementation on ther Chemistry topic.

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