THE IMPLEMENTATION OF REFUTATION TEXT IN REMEDIATION OF STUDENTS MISCONCEPTIONS IN CHEMICAL EQUILIBRIUM

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Abstract : This research aims to know the differences the students learning outcome before and after remediation with the effectiveness of remediation by using *refutation text* in reducing the students misconceptions at XI IPA of SMA Negeri 1 Sungai Ambawang in the academic year 2015/2016 on the chemical equilibrium matter. The form of this research is a quasi-experimental *(Pre-Experimental Design)* by *One-Group Pre-Test Post-Test* design. The data processed are 26 students by using *purposive sampling* technique. The test used is diagnostic test in form of essay questions. Based on the analysis of the data, the decrease average percentage of the students misconception is 45,6%. The difference in the students learning outcome tested with *paired t-test* and the results of the significance obtained 0,000. The effectiveness of remediation toward *refutation text* in chemical equilibrium concepts is 0.54 and classified as medium category. Remediation by using *refutation text* is effective in reducing the students misconception.

Key Words: refutation text, remediation, misconceptions.

The purpose of learning chemistry is to train the students to understand the concept principles law, and theory of chemistry and theoretical chemistry as well as the interrelationships and its application to solve problems in daily life and technology (Depdiknas, 2006), the students need to understand the concept and apply it in daily life. Chemical equilibrium is one of the chemical materials where most of the concept were abstract (Erdemir et al, 2000). The understanding of this material cannot be achieved if students just memorize the concepts of the material. But, in reality, most of the students just memorize the concepts (Suparno, 2005), leading to misconceptions (Aulia Hikmah Dorotullailai, 2014).

According to Erdemir et al, (2000), one of the most difficult is chemical equilibrium. If the students have difficulty in understanding the basic concepts of chemical equilibrium, so, the students will have difficulties to learn another materials which is related to chemical equilibrium. Chemical equilibrium is very related with the acid-base material, oxidation-reduction reactions and solubility, so that students are required to be able to understand the concept of chemical equilibrium (Bergquist & Heikkien, 1990).

Misconceptions which is often occur in chemical equilibrium concept is calculation the number of moles and the concentration of substances in the equilibrium state, Kc understanding, and understanding the principle of Le Chatelier to describing the equilibrium shift factor (Bergquist & Heikkien, 1990). Lack of understanding about the basic concepts of chemical equilibrium caused

by the students learning outcome is low, so the teachers need to do remedial to the students which have score below the indicator competence.

Considered from the word meaning, remedial means something which is related to improvement. Remedial teaching is a kind of teaching which has a special form, aiming to fulfill the main function of the diagnostic study is to address the problem of students who have difficulties in learning (Mulyati, 1995). Remediation refers to the process of improvement. Remediation is a learning activity that is directed to contend the students' difficulties in learning by change, improve or clarify frame of mind. Many methods are used for remediation, one of them are being by provision of a structured reading *refutation text*. One of the advantage of *refutation text* is to improve the misconceptions of the students are the structure that compare the wrong concept and the correct concept proposed by scientists. Reading material which has *refutation text* structure is arranged to compare with contrasting of the wrong ideas and the correct ideas (Leo Sutrisno, 2008).

Remediation research by using *refutation text* has been applied in chemistry subject, Firman Shantya Budi (2011), the research is about the effectiveness of remediation by using the form of refutation text to improve the students misconceptions in the concept of acids and bases by decreasing students' mistook to 37.1% and effect size was 3.31. A similar research carried out by Icha Regita (2015) which is preparing of *refutation text* to remediate students misconceptions in the concept of solubility and solubility product that contribute in decreased the students' mistook to 25.8% with effect size was 0.7.

Based on the facts and theories explained, be needed to does this research in assembling the *refutation text* in the remediation of students misconceptions, at XI IPA in SMAN 1 Sungai Ambawang on the chemical equilibrium material. The purpose of this research is to determine whether or not the differences the students learning result of the students at XI IPA in SMAN 1 Sungai Ambawang before and after remediation by using *refutation text* on the chemical equilibrium material, and also to know the effectiveness of remediation by using *refutation text*.

RESEARCH METHODOLOGY

The method used in this research is *Pre-Experimental* research. Forms of this research was *one group pretest-posttest design* plan in Table 1.

Table 1
Research Design

Pretest	Treatment	Posttest
O1	X	O2

(Sugiyono, 2015).

Description :
O1   = initial diagnostic test (Pretest).
O2   = finald iagnostic test (Posttest).
X   = Remediation by using *refutation text*.

The population in this research is the students at XI IPA of SMA Negeri 1 Sungai Ambawang in the academic year 2015/2016, the samples are IPA1 XI, XI

IPA 2, and XI IPA3 which the amount of the students are 83 and taught by the same teacher. The sample chosen is using purposive sampling technique, based on the consideration and suggestion by the chemistry teachers. The samples is XI IPA 1 which is consist of 26 students

In this research, the technique of data collecting used a measurement technique, which aims to measure the differences the student learning outcomes before and after remediation by using *refutation text*, giving of initial tests as a diagnosis of students who misunderstood the concept, and final test is to determine the percentage of decrease of students' mistake in understand the concept. The diagnostic test is given in the form of essay test with the same indicator, and validated by two lecturers from chemistry education study program of FKIP UNTAN and 1 chemistry teacher of SMAN 1 Sungai Ambawang, and then made parallel to initial the diagnostic test questions used to test the reliability of the instrument used.

The data processing that will be done in this research is directed to determine the differences between student learning outcomes and the effectiveness of remediation by using reading *refutation text*, which aims to overcome students' mistake in understanding the concept of chemical equilibrium. The differences of student learning outcomes before and after remediation tested by *paired t-test*, and the effectiveness of remediation will be calculated which based on the student decrease of misconception before and after remediation.

THE RESEARCH RESULTS AND DISCUSSION

Below are the data of research result in average percentages of the students misconceptions before and after remediation in each concept.

Table 2
The percentage distribution of Students Misconception

The concept	The indicator	No. The Question	The initial test		The Final Test		ΔS	ΔS (%)
			S_0	S_0 (%)	St	St (%)		
Dynamic Equilibrium	Explain the nature of the dynamic chemical equilibrium	**1**	16	61.5	2	7.7	0.87	53.8
The factors that affect the chemical equilibrium shift	Determine the direction of equilibriums shiftsthataffectedby concentration	**2.a**	20	76.9	0	0	1,00	76.9
	Explain the effect of concentration on the direction of equilibriums shifts	**2.b**	26	100	25	96.1	0.03	3.9
	Determine the direction of equilibriums shiftsthataffectedbytemperature	**3.a**	7	26.9	6	23	0.14	3.9
	Explain the effect of temperature on the direction of equilibriums shifts	**3.b**	26	100	10	38.4	0.61	61.6
	Determine the direction of equilibriums shiftsthataffectedby pressure	**4.a**	26	100	7	26.9	0.73	28.3
	Explain the effect of pressure on the direction of equilibriums shifts	**4.b**	26	100	5	19.3	0.8	80.7
Equilibriums Constants Based on	Write *Kc* equationinhomogenous reaction	**5.a**	8	30.7	4	15.3	0.5	15.4

			S_0	S_0(%)	S_t	S_t(%)	ΔS	ΔS(%)
theconcentration (Kc)	Write *Kc* equationinheterogeneous reaction	**5.b**	7	26.9	4	15.3	0.42	11.6
	Calculate the value *Kc* with the concentration of the substance in the equilibriumsstate	**6**	26	100	17	65.3	0.34	34.7
EquilibriumsConstants Based on the Pressure(Kp)	Write *Kp*equation	**7**	26	100	10	38.5	0.61	61,5
	Calculate the value *Kp* based on partial pressure substance		26	100	11	42,3	0.57	57.7
The Correlation Kp and Kc	Write the correlationewuationbetween *Kp* and *Kc*	**8**	19	73	7	26.9	0.63	46.1
	Calculate the value*Kp* based on *Kc*		26	100	11	42,3	0.57	57.7

Description of Table 2:

S_0 (%) = Percentage of students who have misconceptions on the initial diagnostic test

S_t (%) = Percentage of students who have misconceptions on the final diagnostic test

ΔS (%) = The percentage difference between the S0 (%) and St (%), (S0 (%) - St (%))

S_0 = The number of students who have misconceptions on the initial diagnostic test

S_t = The number of students who have misconceptions on the final diagnostic test

ΔS = A value of the proportion decrease in the number of students who have misconceptions

Where : $\Delta S = \dfrac{S_0 - S_t}{S_0}$

(Wright, 1986).

1. Dynamic Equilibrium

   In the beginning of diagnostic test the number of students who made mistake are 61.5%, the error majorities on these students caused by their assumed that the dynamic nature of chemical equilibrium has the same meaning with reversible reaction. After remediation, the number of students who made errors on the final diagnostic test was reduced to 7.7%. Actually dynamic equilibrium occurs in a closed system, which the reactant concentration and the product changed in microscopic scale and occur continuously (Syukri, S, 1999).

2. Equilibrium Shift Factors :

   a. Concentration

      The concentration factor of the chemical equilibrium in the diagnostic tests are divided into two, determine the direction of equilibrium shifts and explain the effect of concentration improvement. In terms of determining the direction of the equilibrium shift affected by the concentration are 76.9% of students were wrong, after remediation the wrong number of students reduced to 0%. Occur a large number of decreased in the

determination of the equilibrium shifts direction, but the students still do not understand the effect of concentration improvement in the equilibrium system. As many as 100% of the number of students who wrong in the beginning of diagnostic tests, and after the remediation the number of students who wrong are 96.1% in terms of explaining the effect of concentration improvement to the direction of equilibrium shifts. The students error in the initial diagnostic test caused by most of them belief that the compounds in solid state will not influence the effect direction of shifting the equilibrium, and in the final diagnostic test the students cannot explained completely, but based on interviews the students understand that the shift of the equilibrium is influenced by the concentration shifts in the opposite direction from the added side. Generally in constant temperature, the concentration of each compounds in the form of solids or pure liquids unchanged or constant, and will not affect the price of Kc, but If solid contained similar ions when added into the equilibrium reaction, it can influence the direction of equilibrium shifts, can affect the concentration of substances in the system.

b.   Temperature

In the beginning of diagnostic test total 26.9% of the students which answered incorrectly in determining the direction of equilibrium shifts which affected by the temperature, while the other 73.3% answered correctly but could not explain the effect of temperature on the equilibrium reaction, based on interviews with the students, they are merely guessing the answer, be sides another students cannot determine the reaction of exothermic or endothermic.

After remediation in the the final diagnostic test, 23% of the students have wrong answered in determining the shifting direction of equilibrium, and in explaining the effect of the temperature the number of students who are wrong was reduced from 100% at initial diagnostic test to 38.4% students that cannot answer in the final diagnostic test. Although, the remediation has been done, but most of the students still cannot determine the reactions which are classified as exothermic or endothermic. This indicated that the students' understanding on the prerequisites material are not complete especially in thermochemical concept.

c.   Pressure and Volume

In the beginning of diagnostic test all of the students cannot answer correctly in determining the direction of equilibrium shifts and explain the effects pressure and volume in equilibrium system. Based on the interview with the students, they do not know that the coefficients in the chemical equation is the number of moles of the

compound, the students just knew that pressure and volume is inversely proportional.

        After remediation, student errors is reduced at the final diagnostic test, in determining the equilibrium shifts are influenced by pressures, errors in students from 100% to 26.9%, whereas in explaining the effect of pressure on the equilibrium shifts toward students' mistakes by 100% to 19.3% , After remediation students understand that the coefficient of reaction is the number of moles of the compound.

3.   Equilibriums Constants Based on the Concentration (Kc)

    a.   Write the equation of Kc

        In the beginning diagnostic test around 30.7% of the students who answered incorrectly in writing Kc equations in the homogeneous reactions, and 26.9% of the students answered wrong in writing the equation Kc in the heterogeneous reactions. From the pattern of answers students known that most of them already know that the equation Kc is the ratio between the concentrations of products and reactants, but wrong in writing the equations by adding the concentration between products or reactants, and some of them answered without knowing the meaning of the answers that they have wrote, this shows that students' understanding on the sub concept is not exhaustive. Actually Kc express the relationship between the concentration of reactants and products at equilibrium is expressed in a quantity called the equilibrium constant (Chang, 2004).

        After remediation, in the the final diagnostic test the result, around 15.3% of students answered wrong in writing the equation Kc in the homogeneous reaction, and 15.3% of the students answered wrong in writing the equation Kc in the heterogeneous reactions. There are also some students who cannot answer all of the question, it shows that the students don't read and understand the *refutation text* which has been given.

    b.   Calculated the value of Kc

        In the beginning of diagnostic test 100% of the students could not answer, the students do not understand how to calculate the concentration of a substance that reacts and in equilibrium. Generally the students directly using the number of moles listed without reading further information on the test questions. After remediation reduced to 65.3%, total 88.5% of students can write the equation Kc correctly, but 53.7% of them still miscalculations in determining the number of moles of substance reaction. Students' understanding on the concept of the mole is lacking, it can be seen from the responses of the students that they do not know determines the number of moles of a substance that reacts and ignore the coefficient reaction.

4. Equilibriums Constants Based on the Pressure (*Kp*)

    All of the students made a mistake in writing the equation *K*p, in the beginning of diagnostic tests, total 57.7% of students are wronginwriting the symbols, based on interviews with students, they assume brackets [X] used to concentrations similar to brackets in general (X) and does not use the partial symbol pressure of substance (Px), but the students understand that the equation *Kp* is the partial pressure of the product divided by the partial pressure of the substance of the reactants and each multiplied by the coefficient of reaction, in the calculation, the students are able to calculate the correct value of *Kp* based on the partial pressure of the substance.

    At the final diagnostic test 38.5% of the students who still wrong in writing the equation of *Kp*, and 42.3% wrong in the calculation. Most of the students did not answer, based on interviews with students who do not answer, they did not read the *refutation text* that has been given.

5. The Correlation between *Kp* and *Kc*

    In the beginning of diagnostic test, all of the students could not answer correctly in the calculation, and total 73% of students cannot write down the equation ties of Kp and Kc, 7.7% of them did not answer. From the pattern of student answers can be known that students just memorize the formula without understanding. All of the students does not convert Celsius into Kelvin unit (for temperatures) and ignore the value of Δn. Actually Δn is the differences between the moles products and reactants (number of coefficients product-number of reactants coefficion). At the final diagnostic test, students errors reduced to 42.3% which answered wrong in the calculation, 11.5% only write the equation, 3.8% did not convert temperatures unit, and 26.9% did not answer. From the pattern of students which answered correctly the students has understood Δn and understood how it's calculated

Table 3
Student Scores On Pretest And Posttest

No.	Students Code	Pretest	Posttest
1	SI_01	7.69	34,62
2	SI_02	26,92	61,54
3	SI_03	26,92	73,08
4	SI_04	26,92	92,31
5	SI_05	23,08	65,38
6	SI_06	26,92	65,38
7	SI_07	26,92	46,15
8	SI_08	26,92	61,54
9	SI_09	30,77	30,77
10	SI_10	30,77	76,92
11	SI_11	19,23	84,62
12	SI_12	30,77	84,62
13	SI_13	19,23	61,54
14	SI_14	15,38	11,54
15	SI_15	23,08	65,38
16	SI_16	30,77	84,62

17	SI_17	11,54	19,23
18	SI_18	7.69	23,08
19	SI_19	15,38	50,00
20	SI_20	15,38	57,69
21	SI_21	26,92	92,31
22	SI_22	19,23	30,77
23	SI_23	19,23	50,00
24	SI_24	34,62	61,54
25	SI_25	23,08	92,31
26	SI_26	19,23	84,62
	The average	**22,48**	**60,06**

To determine whether the differences in student learning outcomes before and after remediation by using *refutation text*, the researchers used Paired t-test. The use of the test to adjusting the distribution of normality value in the beginning of diagnostic test (pretest) and the final of diagnostic test (posttest). From the Shapiro-Wilk test results obtained Sig. (0.129) for the results of the pretest, and Sig. (0.128) to posttest results, the results of this calculation can be concluded that the data were normally distributed and Paired t-test used. From the results Paired t-test calculations obtained Sig. (2-tailed) of 0.000. This value stated that the differences in student learning outcomes before and after remediation by using *refutation text*.

The size of *refutation text* effectiveness in overcoming the students misconceptions for each concept, then used the proportion decrease in the number of students misconceptions (ΔS). The limits of the effectiveness of remediation for the sample class can be presented in the following table:

Table 4
The Effectiveness Level of Remediation In Students Misconceptions

ΔS	The concept/Sub Concepts	The level of Effectiveness
0.71-1.00	**Dynamic Equilibrium** • Explain the nature of the dynamic chemical equilibrium (questions number 1) **The factors that affect the chemical equilibrium shift** • Determine the direction of equilibriums shiftsthataffectedby concentration (questions number 2.a) • Determine the direction of equilibriums shiftsthataffectedby pressure (questions number 4.a) • Explain the effect of pressure on the direction of equilibriums shifts (questions number 4.b)	High
0,31-0,70	**The factors that affect the chemical equilibrium shift** • Explain the influence of the temperature against the direction of the shift the equilibriums (3.b) **EquilibriumsConstants Based on the concentration (*Kc*)** • Write *Kc* equationinhomogenous reaction (questions number 5.a) • Write *Kc* equationinheterogeneous reaction(questions number 5.b) • Calculate the value *Kc* with the concentration of the substance in the equilibriumsstate (question no. 6)	Moderate

	EquilibriumsConstants Based on the Pressure (*Kp*)	
	• Write *Kp* equation (questions number 7)	
	• Calculate the value *Kp* based on partial pressure substance(questions number 7)	
	The Correlation *Kp* and *Kc*	
	• Write the correlationewuationbetween *Kp* and *Kc*(questions number 8)	
	• Calculate the value*Kp* based on *Kc* (questions number 8)	
	The factors that affect the chemical equilibrium shift	
0,00-0,30	• Explain the effect of concentration on the direction of equilibriums shifts(questions number 2.b)	Low
	• Determine the direction of equilibriums shiftsthataffectedby temperature (questions number 3.a)	

Based on the proportion of decreasing the students misconceptions, the calculation of the effectiveness of remediation b using *refutation text* on the concept of chemical equilibrium is 0.54, and based on the rules of the knuckles the effectiveness were classified as moderate category.

CONCLUSION AND SUGGESTIONS

Conclusion

Based on the data analysis which has been done, so, be able to made some conclusions following the result of the research, the differences in student learning outcomes before and after remediation by using *refutation text* and the effectiveness of remediation by using *refutation text* is 0.54, based on the rules of the knuckles effectiveness were classified as moderate category.

Suggestions

Based on the research which has been done, there are some things that can be used as suggestions for the development of chemistry teaching. The suggestions in this research are the *refutation text* can reduce the number of misconceptions of students, it is expected that chemistry teacher can use *refutation text* as remediation material in learning chemistry, and caused by the interest of students' reading are low, advisable, in the implementation of remediation by using *refutation text* should accompanied by re-learning in order to make the students more understand and know the correct concept.

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