Conception Profile of Students in Class XI.1 Science on Chemical Equilibrium Materials with Pogil Learning Model to Reduce Misconception

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Abstract:- Misconceptions can be caused due to a person's low understanding of a concept, as a result it will influence a person in understanding and connecting between existing knowledge principles. Several studies were conducted to find out what strategies can be used to reduce student misconceptions, especially in chemistry lessons. The purpose of this study is to describe the concept profile of students after using the POGIL learning model to reduce student misconceptions. The subjects in this study were students of class XI.1 Science who had received chemistry learning about chemical equilibrium. The data collection instruments used included observation sheets of learning activities and tests of understanding the concept of multiple choice reasoned and accompanied by the level of confidence of students (three tier). Data analysis was carried out descriptively with a three tier diagnostic test. The results of the analysis of the student's misconception profile that have been obtained are then mapped individually and personally. The results showed that the profile of students 'conception after learning using the POGIL learning model, most of the students' conceptions experienced positive changes with the translation of students with initial misconceptions, not knowing the concept changed to knowing the concept, and students who remained on the profile knew the concept but still there are students who are still in the misconception profile. Through the results of this study, it is hoped that it will be useful for education practitioners in choosing alternative learning strategies in delivering chemical equilibrium subject matter and as a reference for overcoming students who are still experiencing misconceptions.

Keywords:- *Profile, Conceptual Understanding, Misconceptions, Chemical Equilibrium.*

I. INTRODUCTION

Low conceptual understanding can be caused by the occurrence of misconceptions, if this happens students have difficulty understanding and connecting the principles and concepts of chemistry taught with natural events in everyday life. Concept understanding is part of human cognitive and is an important factor in learning. In chemistry learning requires a lot of understanding of concepts, so that students can solve relevant problems with concepts that are in accordance with the understanding of experts [1].

Understanding the concept of a chemistry learning material requires a fairly high generalization and abstraction ability, so that students' understanding of concepts is still weak [2]. The learning difficulties of students can lead to low concept mastery [3]. Misconceptions can cause learning difficulties for students so that student learning outcomes are low [4]. Concept errors occur when students use initial knowledge as a basis for evaluating newly acquired information.

Misconceptions still occur even though students have been introduced to the correct concept, but there is still a chance to return to the wrong initial conception of students (misconception) [5]. If there are still students who experience misconceptions, where these students have mixed and unclear understandings by displaying the incoherence of information if it is related to the desired concept [6]. Students who have good academic abilities can have low self-confidence, so the results shown are unsatisfactory because of fears that they will be wrong, causing misconceptions to recur [7].

If the learning that is carried out is meaningful for students, the misconceptions that occur in students can be corrected properly and the material that has been studied will enter into long-term memory and have good retention in the memory of students. Meaningful learning can be realized with a constructivist approach. One of the learning models that can be used as an alternative for teachers in

teaching and learning activities that can reduce misconceptions is a guided inquiry-based learning model in the form of Process Oriented Guided Inquiry Learning (POGIL) [8].

POGIL learning model has specific learning steps and structures and is consistent with leading to the expected goals of students using skills for the learning process [8]. The skills used by students are able to change their knowledge construction and form new concepts that are in accordance with scientific concepts [9]. The classical load of misconceptions using the Wilcoxon test shows that there are significant differences in misconceptions between before and after remediation learning with the POGIL learning model [10], so that the POGIL strategy is able to reduce student misconceptions.

Based on this, it is necessary to carry out further research to find out whether the POGIL learning model can be used as an alternative to reduce misconceptions in chemistry lessons, especially on chemical equilibrium material. Through the results of this study, it is hoped that it will be useful for education practitioners in choosing alternative learning strategies in delivering chemical equilibrium subject matter and as a reference for overcoming students who are still experiencing misconceptions.

II. METHOD

A. Research design

This study used a pretest posttest research design [11]. Pre-experimental research in the form of experiments conducted in only one group, without any comparison group. The research design is shown in Table 1.

Pretest	Treatment	Posttest
O_1	X_1	O_2

Table 1:- Research design

Information:

O_1 : Pretest (pre-test before learning POGIL and after receiving lessons from the teacher on chemical equilibrium material).

X_1 : The application of POGIL learning to chemical equilibrium material

O_2 : Post Test (the final test after POGIL learning on chemical equilibrium material).

B. Research procedure

The initial activity was carried out by conducting a pretest on students to find out the understanding of the initial concept whether it was a misconception or not. After the student misconceptions data were obtained, the POGIL learning model was applied with a three-tier assessment to reduce misconceptions that occurred in students. After being given this treatment, a posttest will be carried out to find out the final concept of students after the learning process and to analyze the shift in students' misconceptions between before and after the application of the POGIL learning model and student learning outcomes.

C. Partisipant

The subjects of this study were 19 students of class XI.1 Science at Al-Furqon Senior High School in the 2019/2020 school year as many as 19 students who had learned chemical equilibrium material.

D. Research data collection instruments and its techniques

Student misconceptions data on chemical equilibrium material through the application of the POGIL learning model were obtained through several instruments and data collection techniques which were explained as in Table 2.

No.	Research data collection techniques	Research data collection Instrument
1	Observation	Observation sheet for the implementation of the stages of the POGIL learning model
2.	Test	A concept understanding test consisting of 5 multiple choice test questions with reason and the students' level of confidence (three tier)

Table 2:- Pair of research data collection techniques and its instruments

E. Data Analysis
➢ Concept Understanding Profile Analysis

Concept understanding data produces a profile of students' misconceptions. The conceptual understanding data obtained were then analyzed descriptively using a concept understanding test in the form of a three tier diagnostic test. Consists of 3 levels which include content tier, reason tier, confidence tier to measure the degree of confidence of students in determining the answers and reasons selected. The results of the level of concept mastery are grouped in Table 3.

Students' responses			Category	Code
First Tier-content tier (**The Answer**)	*Second Tier - reason tier* (**The Reason**)	*Third Tier - confidence tier* (**the confidence**)		
True	True	Confident	Know the Concept	(TK)
True	True	Not Confident	Don't know the concept (*Lucky Guess*)	TTK 0
True	False	Not Confident	Don't know the concept	TTK 1
False	True	Not Confident	Don't know the concept	TTK 2
False	False	Not Confident	Don't know the concept	TTK 3
True	False	Confident	Misconception (*false positive*)	MK 1
False	True	Confident	Misconception (*false negative*)	MK 2
False	False	Confident	Misconception	MK 3

Table 3:- Data of Concept Mastery Level Results Based on Three Tier Diagnostic Test.

➤ *Analysis of Change in Students' Conceptions*

Changes in the conceptions of students obtained from the test results were analyzed by statistical methods used to analyze data that would produce general conclusions. The type of statistical test used is Wilcoxon's Signed Rank Test with the aim of testing two test samples.

➤ *Conceptual Mapping Analysis*

Student misconception profile data that has been obtained are then mapped individually and personally. This mapping was carried out before and after the implementation of the POGIL learning model. The results obtained will then be grouped based on changes in conception as in Table 4.

Category	Change Category
TK	Know the Concept (TK)
	Don't Know the Concept (TTK)
	Misconception (MK)
TTK	Know the Concept (TK)
	Don't Know the Concept (TTK)
	Misconception (MK)
MK	Know the Concept (TK)
	Don't Know the Concept (TTK)
	Misconception (MK)

Table 4:- Mapping Categories of Conception Change

III.   RESULT AND DISCUSSION

❖ *Students' Conception Profile*
➤ *Students' Conception Profile Before Implementation of POGIL Learning Model*

The conception profile of students can be seen through the results of the pretest and posttest. The pretest is carried out before students get learning by chemistry subject teachers on chemical equilibrium material. The posttest is carried out after students get the POGIL learning model. The identification of the overall profile of the conception of this student aims to determine the total percentage of students who know concepts, do not know concepts and misconceptions. The following is a profile of the overall conceptions of students before the implementation of the POGIL learning model which can be seen through the pretest results shown in Table 5.

No.	Concept	Percentage of Students' Conception Profile		
		Know the Concept (TK)	Don't Know the Concept (TTK)	Misconception (MK)
1	Equilibrium reaction	44,44	27,78	27,78
2		50	22,22	22,22
3	Determines and calculates the equilibrium constant based on concentration	55,55	44,44	0
4		44,44	38,87	16,66
5	Calculating the value of Kc	27,77	0	72,22
6	Calculating the value of Kp	38,88	50	11,11
7	Degree of dissociation	61,11	27,77	11,11
8		27,77	55,55	16,66
9		38,8	49,99	11,11
10	Equilibrium reactions based on concentration	16,66	61,1	22,21
11		11,11	66,66	22,22
12	Equilibrium reaction based on pressure	16,66	44,43	38,88
13		0	61,1	38,88
14	Equilibrium reaction based on volume	53,5	55,55	38,8
15	Equilibrium reactions in industry	5,55	49,99	44,43
16		5,55	61,1	33,33
17	Equilibrium reaction based on temperature	5,55	66,65	27,77
18		5,55	61,09	33,33
19.		16,66	72,16	11,11
20	Reaction questionnaire (Q)	5,55	66,64	27,77
21		5,55	66,66	27,77
22	The relationship between Kc and Kp	5,55	66,65	27,77
23	Equilibrium reaction based on volume	5,55	61,08	33,33
	Overall Average	22,46	51,69	26,09

Table 5:- The Percentage of Students' Conception Profiles Before the Implementation of the POGIL Learning Model in Class XI.1.

Comparison of the overall percentage of conceptions of XI 1 students who know the concept (TK), do not know the concept (TTK) and misconceptions (MK) before treatment can also be visualized in the form of a histogram, it can be presented in Figure 1.
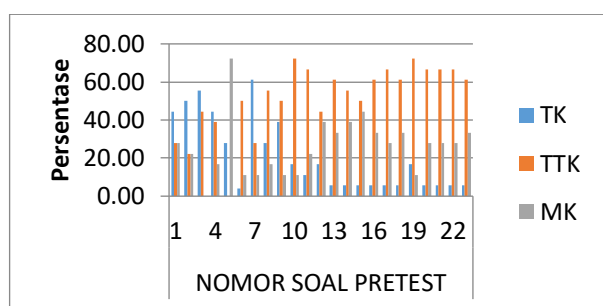

Fig 1:- Percentage Histogram of Class XI 1 Students who Know Concepts, Don't Know Concepts and Misconceptions in Thermochemical Materials Before the Implementation of the POGIL learning model.

Based on the data in Table 5 and Figure 5, the results of the analysis are as follows: Concepts that are understood by students, almost every item of question shows that the overall percentage is in the category of not knowing concepts and misconceptions. The understanding of students in the concept know category seems not optimal, it is shown from the difference in the percentage achieved in each concept which is reversed by several items that get high and varied percentage values. The percentage of not knowing the concept and misconceptions is greater than the percentage knowing the concept.

➤ *Students' Conception Profile After Implementation of POGIL Learning Model*

The conception profile of class XI.1 students after the implementation of the POGIL learning model can be seen through the posttest results shown in Table 6.

No.	Concept	Percentage of Students' Conception Profile		
		Know the Concept (TK)	Don't Know the Concept (TTK)	Misconception (MK)
1	Equilibrium reaction	94,4	0	5,56
2		100	0	0
3	Determines and calculates the equilibrium constant based on concentration	77,78	16,67	5,56
4		100	0	0
5	Calculating the value of Kc	94,4	0	5,56
6	Calculating the value of Kp	83,3	5,56	11,11
7	Degree of dissociation	94,4	0	5,56
8		100	0	0
9		83,33	5,56	11,11
10	Equilibrium reactions based on concentration	94,44	0	5,56
11		77,78	0	22,22
12	Equilibrium reaction based on pressure	94,4	0	5,56
13		83,3	5,56	11,11
14	Equilibrium reaction based on volume	83,33	5,56	11,11
15	Equilibrium reactions in industry	88,89	5,56	5,56
16		94,44	5,56	0
17	Equilibrium reaction based on temperature	72,2	5,56	22,22
18		88,89	0	11,11
19		94,44	5,56	0
20	Reaction questionnaire (Q)	94,44	0	5,56
21		72,22	0	27,78
22	The relationship between Kc and Kp	94,4	0	5,56
23	Equilibrium reaction based on volume	83,33	11,11	5,56
	Overall Average	**88,89**	**3,14**	**7,97**

Table 6:- Percentage of Students' Conception Profiles after the Implementation of the POGIL learning model in Class XI.1

Based on Table 6, it shows that after the implementation of the POGIL learning model students from class XI 1 know the concept, but there are still some students who do not know concepts and misconceptions. Comparison of the percentage of conceptions of class XI 1 students who know the concept (TK), do not know the concept (TTK) and misconception (MK) after treatment can also be visualized in the form of a histogram, it can be presented in Figure 2.
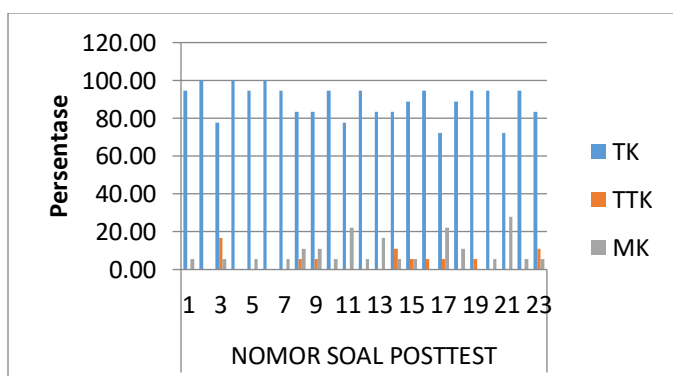

Fig 2:- The Percentage Histogram of Class XI.1 Students Who Know the Concept, Don't Know the Concept and the Misconceptions in the Material of Chemical equilibrium after the implementation of the POGIL learning model

Based on the data in Table 6 and Figure 2, the results of the analysis are given as follows: most concepts are understood by students by knowing the concepts. Almost every item of the question shows that the condition of knowing the concept has a fairly large percentage, almost every item still shows the percentage of not knowing the concept and misconception even though in a small number. This shows that students' understanding is more likely to know concepts than not to know concepts and misconceptions.

The results on the final test show that the students' understanding has changed when compared to the initial conditions. The initial test was in the form of a pretest class XI.1 the tendency of each concept to be more in the condition of not knowing the concept and misconceptions, but the final test showed that the students' understanding was more towards the condition of knowing the concept.

➢ *Changes in students' conceptions*
Conception changes were tested using the Wilcoxon ranked sign test, to show concept changes that occurred in students as a result of treatment during the implementation of the POGIL learning model in learning. Before carrying out the Wilcoxon ranked sign test.

- *Research hypothesis:*

Ho: there is no difference in learning outcomes in the pretest and posttest

H1: there is no difference between pretest and posttest learning outcomes

- *Basic decision making:*

If Asyimp. Sig. <0.05, then H1 is accepted

If Asyimp. Sig. > 0.05 then H1 is rejected, accepting Ho

Test Statistics[a]		
	POSTTEST1 - PRETEST1	POSTTEST2 - PRETEST2
Z	-3.732[b]	-3.725[b]
Asymp. Sig. (2-tailed)	.000	.000
a. Wilcoxon Signed Ranks Test		
b. Based on negative ranks.		

Based on the output of the statistical test above, it shows that the Asymp. Sig. (2-tailed) for all pretest and posttest data for all trial classes <0.05, so it can be concluded that H1 is accepted, meaning that there is a difference in pretest and posttest scores. Changes in the conceptions of students will be shown in Table 7.

Concept	Know the Concept (TK)			Don't Know the Concept (TTK)			Misconception (MK)		
	B	A	Inf.	B	A	Inf.	B	A	Inf.
Equilibrium reaction	8	17	Increase	5	0	Reduce	5	1	Reduce
	9	17	Increase	4	0	Reduce	5	1	Reduce
Determines and calculates the equilibrium constant based on concentration	10	14	Increase	8	3	Reduce	0	1	Reduce
	8	18	Increase	7	0	Reduce	3	0	Reduce
Calculating the value of Kc	5	15	Increase	0	1	Increase	13	2	Reduce
Calculating the value of Kp	7	15	Increase	9	0	Reduce	2	3	Increase
Degree of dissociation	11	17	Increase	5	0	Reduce	2	1	Reduce
	5	15	Increase	10	1	Reduce	3	2	Reduce
	7	15	Increase	9	1	Reduce	2	2	Still
Equilibrium reactions based on concentration	3	14	Increase	13	0	Reduce	2	4	Increase
	2	17	Increase	12	0	Reduce	4	1	Reduce
Equilibrium reaction based on pressure	3	17	Increase	8	0	Reduce	7	1	Reduce
	1	18	Increase	11	0	Reduce	6	0	Reduce
Equilibrium reaction based on volume	1	15	Increase	10	2	Reduce	7	1	Reduce
Equilibrium reactions in industry	1	16	Increase	9	1	Reduce	8	1	Reduce
	1	17	Increase	11	1	Reduce	6	0	Reduce
Equilibrium reaction based on temperature	1	13	Increase	12	1	Reduce	5	4	Reduce
	1	16	Increase	11	0	Reduce	6	2	Reduce
	3	17	Increase	13	1	Reduce	2	0	Reduce
Reaction questionnaire (Q)	1	17	Increase	12	0	Reduce	5	1	Reduce
	1	13	Increase	12	0	Reduce	5	5	Still
The relationship between Kc and Kp	1	18	Increase	12	0	Reduce	5	0	Reduce
Equilibrium reaction based on volume	1	15	Increase	11	2	Reduce	6	1	Reduce

Table 7:- Changes in the Students' conception in Class XI.1

Based on Table 7, the results of the analysis of students know the concepts in each concept increase after being given learning with the POGIL learning model. The condition of students did not know the concept of the average decreased, but the concept of calculating the value of Kc increased. The condition of students in the misconception category was reduced, except for the concept of calculating the value of Kp increased and the concept of the degree of dissociation was fixed.

Some students who initially had misconceptions, at the end of the lesson, still experienced misconceptions. This is in accordance with the opinion of Suparno and Clement who reveal that misconceptions are very difficult to change [12]; [13]. Misconceptions cannot be changed just by presenting new information [14]. Clement also revealed that misconceptions cannot be changed only by classical teaching methods or lectures [12].

Students return to using the old concept to answer concept understanding questions. According to constructivist theory, this is because misconceptions are a natural thing in the process of forming knowledge by students who are learning. The teacher cannot impose "knowledge" on students. Teachers can only help students "know", if students themselves are actively involved in the learning process properly [12]. In this lesson, teachers do not provide elaboration and reinforcement at the end of the lesson because of the limited time available so that they still experience misconceptions.

IV. CONCLUSION

The results of the study shows that the students 'conception profiles after learning using the POGIL learning model, most of the students' conceptions experienced positive changes with the explanation of students with initial conceptions of misconceptions, not knowing the concept changed to knowing the concept, and students who remained on the profile knew the concept but there are still students who are still in the misconception profile.

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DECLARATION OF CONFLICT INTEREST

The author states there is no potential conflict of interest in connection with the research, authorship and / or publication of this article.

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