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MISCONCEPTION PREVENTION OF SENIOR HIGH SCHOOL STUDENTS ON CHEMISTRY CONCEPTS USING SEVERAL INQUIRY-BASED LEARNING MODELS

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Abstract

The aim of this study was to prevent misconceptions of senior high school students on chemistry concepts using several inquiry-based learning models. The meaning of prevention in this research was the proportion of students misconceptions smaller than the proportion of students knowing concept. Chemical concepts that learned and/or tested were the properties of colligative solution, chemical equilibrium, redox reactions, and reaction rate. The implemented inquiry-based learning models were guided inquiry, open inquiry, modified inquiry, and LC 7E. The combination of the implemented model and learned concepts produced 6 (six) learning packages. The targets were students in 6 (six) of representative Senior High Scholl in 6 cities as Unesa target areas (Surabaya, Sidoarjo, Sumenep, Gresik, Bojonegoro, and Jombang). During the implementation used one group pretest posttest design. The results revealed that : (1) the student conception in six cities before the teaching learning was dominated by student without knowing concept and by student with misconception potential; (2) from 6 (six) implemented learning packages showed the variety of student misconception, namely 11.00%; 14,80%; 11,5%; 18,5%; 22,0%; and 11,1% respectively. All these percentage were smaller than the percentage of student knowing concepts.

Key words: misconception, guided inquiry, open inquiry, modified inquiry, LC 7E

INTRODUCTION

Misconception is the most interesting phenomenon in learning to be investigated. Misconceptions on various chemistry concepts have occurred on high school students. This fact was found in Turkey (Demircioglu et al., 2005) and also in other countries where it is reported as Cheung (2008), Camacho & Good (1989), Banerjee (1995). In Indonesia, especially in the six districts/cities included intarget areas of Unesa (Sumenep, Surabaya, Sidoarjo, Gresik, Bojonegoro, and Jombang) the same facts were also found (Rohmawati and Suyono, 2012; Delhita and Suyono, 2012; Arif and Suyono, 2012). These findings strengthen the statement ofBarke et al. (2009) that a number of chemical concepts are often understood by the students' misconceptions. The misconception has become globalized problematic.

The burden misconception born by the student has to be handeled together, college intervention (LPTK) is needed to assist teachers in senior high school. Repairing misconceptions is not easy, as said Barke et al. (2009), but the stakeholders who committed to the quality of education in Indonesia should not disregard on this phenomenon. Efforts to reduce chemistry misconceptions in high school students have also been conducted by various parties or researchers, but have not reached a wider target and involve chemistry teachers who are in the target schools. Through funding sources ofDitlitabmas decentralization (TA 2013), researchers have conducted

dissemination for prevention and remediation models of chemistry misconceptions on high school students in six districts/cities as mentioned above. Prevention of chemistry misconceptions used several inquiry-learning based model, while remediation which is consecutive stages of prevention stage used learning strategies based on conceptual change strategy. This article will only reports a summary of the results of the prevention phase. The selection of learning models to prevent student's misconceptionsis very important. This is in accordance with Pekmez's instructions (2010) *"the selection of teaching methods has an important factor in preventing students' misconceptions*."

Researchers tried to prevent chemistry misconceptions that often presented in high school students using the several inquiry based-learning model as researcher as researchers have argued as follows. By inquiry approach, students are given greater opportunities to learn chemistry concepts by netting (nested) common exercise of thinking skills that are commonly done by scientists, students are expected to comprehendthe way of scientists' working and thinking so gaining insight according to scientists understood, students have no chemistry misconceptions. Barthlow (2011) have shown positive results of this idea that through scientific inquiry learning, students' chemistry misconceptions can be replaced to the true concepts.

The learning model known to accommodate the syntax or a series of scientific inquiry phases and selected to prevent chemistry misconceptions of high school students were: guided inquiry, open inquiry, modified inquiry and LC7E. Chemistry concepts that learned and/or tested includedcolligative properties of solutions, chemical equilibrium, redox reactions and reaction rate. The implemented learning model were guided inquiry, open inquiry, modified inquiry and LC 7E. The combination of the implemented learning models and learned concepts generated 6 (six) learning packages as shown in Table 1.

RESEARCH METHOD

The research design used in this study was one group pretest-posttest design as presented in Figure 1.

O_1	X_1	O_2

Figure 1 Research Design

Description:

O_1 = pretest, mapping student preconceptions before prevention phase

X_1 = treatment, learning topreventmisconception using inquiry-based learning

O_2 = posttest, mapping the students' conceptions after learning topreventmisconception

The research subject was senior high school students in chemistry classes determined as the implementation and dissemination classes. From every District/Municipal, one high school whichits teachers have positive responds and participate actively in conducting research aimed at the improvement of student's misconceptions.The High School name from each district/city is shown in Table 1.The level of implementation accommodatedlearning practices conducted by chemistry teachers (the university students who are researcher) who developed and tested learning packages and instrument package. The level of dissemination accommodatedlearning practices conducted by chemistry teachers in target schools. Chemistry teacher as dissemination actors (teacher disseminator) taught chemical concepts to students using scenarios and learning packages that have been developed by teacher implementer, absolutely by adjustments. Efforts to understand the learning packages, learning scenarios and learning materials through two activities: workshops andscanning.

In order the research findings representing the feasibility of learning packages, the quality oflearning process implemented by teachers and the instructional effect of learning packages on prevention, then it wasmade treatment replication as many as two replications. Every packet was applied in two implementation classes (the first and second research classes) and intwo dissemination classes (first and second research classes). First and second research classes were guided by the same chemistry teacher. To maintaining theresearch feasibility, implementation and dissemination activities of learning packages wereimplemented in high schools targets are listed in Table 1 by crossed, except to Surabaya city. For Surabaya city, SMAN 2 Surabaya as the research target for implementation while SMAN 22 Surabaya for dissemination.

RESULT AND DISCUSSION

Result

The percentage data of students who potentially misconceptions (misconceptions profile at preconception status) and the percentage data of student misconceptions after learning process in every target schools are shown in Table 1.

Table 1 Summary of Research Findings

Learning Packages	Target Schools/Teacher Name	% MC Students		Dissemination Schools/Teacher Name	% MC Students	
		Before	After		Before	After
Guided Inquiry-Colligative Properties of Solutions	SMAN 2 Surabaya/Rosalina Eka Permatasari	16.2	11.0	SMAN 22 Surabaya/Ida Kurniawati	35.5	36.0
Open Inquiry-Chemical Equilibrium	SMAN 1 Kebomas Gresik/Marjuki	34.7	14.8	SMAN 1 Sumenep/Maswiyanto	25.6	31.9
Modified Inquiry-Chemical Equilibrium	SMA Neg 1 Kabuh Jombang/Arif Imam Subagyo	37.5	11.5	SMA Neg Model Terpadu Bojonegoro/Purwanto	49.5	38.5
Modified Inquiry-Redox Reactions	SMAN 1 Sidoarjo/Wahyu Juli Hastuti	10.5	18.5	SMAN Kabuh Jombang/Putut & Eko	9.5	19.0
LC7E-Redox Reactions	SMAN Model Terpadu Bojonegoro/Agus Sri Hono	25.0	22.0	SMAN 1 Kebomas Gresik/Khotmatuz Zuhrufah	26.5	23.0
Guided Inquiry-Rate of Reaction	SMAN 1 Sumenep/Darminto	25.2	11.1	SMAN 1 Sidoarjo/Masrutji Handayani	20.3	13.4

Note: MCbefore learning process = potentially MC

Additional data to complete the data in Table 1 is described as : (1) The structure of students'preconceptions in all target schoolshad similarities. The structure of student

preconceptionsin a class consisted of student unknowing conceptsin the largest proportion, followed by the proportion of student misconceptionand the last wasknowing concepts. If there was a difference, only in the comparison of the proportion difference, but in the same order, (2) Prevention learning in the sixth learning packages has been implemented by the teachers, generally having very good quality and (3) The structure of student conception after the prevention stagewas different.Learning the same chemistry concepts, using the same learning model, commonly being conducted by the same teacher, using the same learning packages, and getting the same assessment of learning quality which was equally good, still generated the different structure of conception and even still leaved student's misconception.

Based on the data in Table 1, it can be concluded: (1) there is no classamong the target schools that is not populated by student misconception, (2) the percentage of student misconception are very greatly among the schools (one to another) and (3) after preventionusing inquiry-based learning in every target school, there isstill found a large percentage of student misconception, (4) inquiry-based learning implemented in some schools producesthe percentage of studentmisconception which is smaller than the percentage of students who previously could potentially misconception, but at some other schools just the opposite (5) inquiry-based learning actually has not yet prevented student misconception successfully to the lowest point.

Discussion

1. The Potential of Student's Misconceptions

Before participating formally in chemistry learningat school, a number of studentshave actually brought several certain concepts.There are several concepts which are accordance with scientific concept but some of those are also not.By relying to the experts' statement that the initial conception is less complete or less perfect so it is needed to design a formal learning in schools aimed to fix that rudimentary of misconception. When students are not involved yet in formal learning,sothe student preconception which are not in accordance with the scientific concept should not be convicted asmisconception, the more appropriate term isthat students is stated have alternative conception (Barke et al. 2009). This study uses the term of potential misconception that is also known knowing and unknowing concepts.From the research data,before prevention, the structure of misconception (preconception) was dominated by the percentage ofunknowing concepts, the following percentage of student misconception and then knowing concepts. This fact almost happened at all learning packages that have been practiced included the learning packages1, 2, 4 and 6, except for the learning packages 3 and 5 which was dominated by the percentage of student misconception, the following percentage of unknowing concepts and then knowing concepts.When found the largest percentage of unknowing conceptsin the earlylearning process, it wasactually equity. The differences status of student misconception indicates that before learning process in the class, students have brought certain concepts into a scheme in their cognitive structure. Scheme in student's cognitive structure would later take part in the process of assimilation and accommodation of new information. This is one of the important things that must be considered by the teacher. The teacher must know the potential of student conceptions and then attempt to awaken ourselves that all possibilities can occur as the result of assimilation and accommodation processes that apply to students of different schemes in their cognitive structure. By knowing the status of preconception students, teachers can use it in considering the learning plan, including the use it in the formation of cooperative groups.

2. The Success of Prevention Using Inquiry-Based Learning Model

Inquiry-based learning is proven to prevent student's misconception while not maximum. The prevention efforts of student misconception conductedwell by teachers proven can actualize students who are potentially unknowing conceptsand misconceptionto turn into knowing

conceptat the end of learning process. When it is stillfound student misconception (potentially student misconceptionchange into student misconception) so that the advantages of inquiry learning have not been able to reconstructmisconception resistance that occurs in most students' cognitive structures. As known, misconception have resistant properties or difficult to change and tend to persist eventhough the students have been taught the concept in the right way, commonly way used by scientiststhat is scientific inquiry (Barke et al. 2009).

3. The Unsuccessful Prevention of Chemistry Misconceptions on Student

The positive facts as stated previously did not appear to the six practiced learning packages. The unsuccessful (students do not actualize themselves) was found to occur in some learning packages that is characterized by the fact that the implementation of inquiry learning still leaved percentage of student misconception even there has exceeded the proportion of student's knowing concept. The number of student'sknowing conceptshas been smaller than student misconception after prevention stage occurs at: (1) learning package 3, dissemination class was the first and second research classes and (2) learning package 4,dissemination class was the first and second research classes. Discussion of the phenomenon is that in term constructing the concepts, students assimilate and accommodate new experiences with the understanding is already exist in the cognitive structure.In the process of assimilation and accommodation, an anomaly can be created (Suparno 1997). The anomaly can be prevented by extending the exercise, the ways to construct a concept. According to Fogarty (1991), exercise the ways to construct a concept would be meaningful if it would be nested process skills (implementation of scientific approach) and thinking skills. The nested process skills and/or skills have been conducted as the integral part of is inquiry-based learning model used in to prevent student misconception. When there were still found a large number of student misconceptionbecause of having process skills, practical exercise of thinking in two or three meetings is really not enough to avoid the occurrence of anomalies in the student's cognitive structure.

The concept is the result of human thought derived from the facts and phenomenastated in the definition (Dahar 2011). The concept are generalization of facts which is have the same characteristics (Ibrahim 2012). Students' failure to build concepts (unknowing concepts) may be due to students fail to make generalizations based on the data to establish the definition by themselves (reading a textbook or through practical activities) or data provided by the teacher through paperworks given to students. Students' failure in making generalizations may be due to the lack frequency ofthinking exercise at this level. Student's failure to build a correct concept, in the sense that accordance with an agreed conception of scientists (students misconception) seems to be more influenced by factors derived from students. This statement is based on the opinions of experts in the fields of learning, the results of previous studies and facts currently that apply to the entire class of research on the entire learning packages which are implemented and disseminated. The essence of the experts' statements in the field of learning associated with the source of misconceptions originating on students is that: (1) before being involvedin formal learning process at school, a student has brought a certain concept (preconception), which became a schematic in the cognitive structure showing the functions as the repellent filter of new knowledge deliberately intervened by teachers through learning so that students failed to improve their wrong conception, (2) student's alternative conceptions were able to explain the problems that occurred (Suparno , 2006) so that students do not want to change it and (3) that student's initial knowledge played an important role in learning (Suyono and Hariyanto, 2011). Muallifah (2013) and Ahmad (2013) found that students' preconceptions to be one of the most dominant factor which is recognized by students as a cause of failure to understand the concept correctly. The fact currently that apply to all research target classes on the entire learning

packages which is implemented and disseminated are that students' prior conceptions structure is still dominated by potential unknowing concepts and followed by potential student misconception. This means that the potential student can not be entirely prevented despite the prevention have been carried out. That potency is real still stuck on students' cognitive structures. Scheme in the cognitive structure of students has not been functioning as the facilitator for the new knowledge gained through learning processthat found student misconception at the end of learning process.

CONCLUSION AND SUGGESTION

Conclusion

1. The structure of students' preconceptions in all research target schools had similarities. The structure of students' preconceptions in a class consisted of potentially unknowing concept in the largest proportion, followed by the proportion of student misconception then knowing concept. If there was a difference, only in the comparison of the proportion difference, but in the same order.
2. The structure of students' conceptions after the prevention phase is different. Learning the same chemistry concepts, using the same learning model, commonly being conducted by the same teacher, using the same learning packages, and getting the assessment of learning quality which was equally good, still generated the different structure of conception and even still leaved student misconception.

Suggestion

1. In learning practice, teacher should not assume that the identified preconceptionsas 'unknowing concept'and 'misconception' would just disappear as advised by Barke et al. (2009). In fact, after prevention, the students who endure the burden of chemistry misconception still exist. Chemistry teachers at school are always encouraged and facilitated to eliminate 'unknowing concept'and 'misconception'on students by finding an appropriate learning strategy for their students. The implementation of inquiry model to prevent studentmisconception still requiresdeep thought in order to gaining a repair mechanism of student conceptionwhich hopefully gives a most good result.
2. Improvement of student misconception through remediation program are an inevitability because there is evidence that prevention efforts using various learning models recommended by various experts still leaves students misconceptions. According to Trumper (1997), a learning cored conceptual change can be considered as a strategy to reduce student misconception.

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