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STUDENTS' METACOGNITION LEVEL THROUGH OF IMPLEMENTATION OF PROBLEM BASED LEARNING WITH METACOGNITIVE STRATEGIES AT SMAN 1 MANYAR

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Abstrak: Penelitian ini bertujuan untuk mengetahui jenjang metakognisi siswa melalui penerapan model pembelajaran berdasarkan masalah dengan strategi metakognitif. Subyek penelitian ini adalah siswa kelas XI IPA 4 di SMA Negeri 1 Manyar. Rancangan penelitian mengacu pada *One Shot Case Study Design*. Teknik pengumpulan datanya menggunakan metode tes. Hasil penelitian menunjukkan bahwa melaluipembelajaran berdasarkan masalah dengan strategi metakognitif di SMAN 1 Manyar pada materi Hidrolisis Garam,jenjang metakognisi siswa adalah sebanyak 33,33% siswa menempati jenjang metakognisi *Aware Use*, sebanyak 43,33 siswa menempati jenjang metakognisi *Strategic Use*, dan sebanyak 23,34% siswa menempati jenjang metakognisi *Reflective Use*.

Kata kunci: Pembelajaran berdasarkan masalah, Strategi metakognisi.

Abstract: The aim of is to know the metacognition level of students through the implementation of problems based learning model with metacognitive strategies. The subjects of this research is student IPA 4 class XI in SMAN 1 Manyar. Design of this reserch refers to the One Shot Case Study Design. Data collection technique that used is test method. The result show that through of the implementation of problems based learning model with metacognitive strategies at SMAN 1 Manyar in Salt Hydrolysis matter , students' metacognition level are 33,33% students occupy the Aware Use metacognitive level, as many as 43,33% students occupy the Strategic Use metacognitive level, and as many as 23,34% students occupy the Reflective Use metacognitive level.

Key words: Metacognitive Strategies, Problem Based Learning Model.

INTRODUCTION

Science is knowledge that related to how to find out about natural phenomena, that systematically arranged. According to the Ministry of Education [1], science is not only the mastery of knowledge in the form of collection of facts, concepts, or principles, but also a discovery process that requires the ability to think and solve problems.

Based on the Study of Policy Kurikulum Tingkat Satuan Pendidikan (KTSP) of science said that

"Learning science should: (1) increase students' confidences that they are capable in science and science is not subject to fear, (2) learning science not only concepts, but also accompanied by the development of attitudes and scientific skills (domain knowledge and cognitive processes), (3) learning science provide learning experiences that develop the ability to think, plan and conduct scientific investigations, using the knowledge they have learned to understand natural phenomena that occurred in the surrounding "[1].

Chemistry is the branch of science, and therefore chemistry has similar characteristics to science. These characteristics are the object of chemistry, how to obtain, and their usage. Therefore, it can be said that the learning of chemistry was also not just limited to the purpose of mastering the concept, but also be able to increase

some of the abilities, skills, and attitudes such as those listed on the learning of science, one of them is to develop thinking skills.

SMA Negeri 1 Manyar is the one of the pioneering international standart school since 2007. The curriculum that used in this school is KTSP as a national curriculum and combined with Cambridge International Examination (CIE) as an international curriculum but still refers to the Badan Standar Nasional Pendidikan (BSNP).

Based on the pre-research questionnaire that was distributed on November, 2nd 2011 to 30 students of Class XI IA 6 SMA Negeri 1 Manyar about Chemistry learning problems in SMA Negeri 1 Manyar as the one of the pioneering international standart school, 83,33% of students said that chemistry is an interesting lesson to be learned, but 63,33% of students still have difficulties in learning chemistry. This is supported by the observations of researchers when doing PPL II in SMA Negeri 1 Manyar, it was found a problem of chemistry learning, that is when students are given new problems, they often feel difficult to understand or to solve.

Kirkwood and Symington [2] states that from students factors, limitations of operating the thinking skills of students is very dominant as the causes of student difficulties in understanding the concepts and their interrelationships. Therefore, an effort that can be done to minimize this problems is with optimize the students' thinking, in this study is metacognition. This is supported by the results of pre-research questionnaire that was distributed to class XI IA 6 student of SMAN 1 Manyar which states that as many as 54,44% of students in this class do not use their metakognition in completing their task.

Generally, metacognition is defined as thinking about thinking. Metacognition was first introduced by J.H. Flavel. Flavel describes metacognition as the knowledge of one's own thinking process [3]. Metacognition consists of metacognitive knowledge and metacognitive experience. Metacognitive knowledge refers to acquired knowledge about cognitive processes. Whereas metacognitive experiences is knowledge that can be used to control the cognitive processes [4].

In the relation with knowledge, Woolfolk [5] states that metacognition involves the three kind of knowledge, they are: (a) declarative knowledge about your self as learner, the factor that influence your learning and memory, and the skill, strategies and resources needed to perform a task, knowing what to do; (b) procedural knowledge or knowing how to use strategies; (c) conditional knowledge to ensure the completion of the task- knowing when and why to apply the procedures and strategies.

Livingston [4] states that metacognition plays an important role in the success of learning. One of the learning strategies that can enhance metacognition is metacognitive strategies. Metacognitive strategies are sequential processes that are used to control the cognitive processes and ensure that the cognitive goal has been achieved [4]. Students who are accustomed to learning with metacognitive strategies will further enhance the awareness of what is known and what is not known, so easy to find strategies that can be used to engance his hnowledge [6].

In chemistry lessons, there are materials to be memorize, understanding of concepts, problem solving, and computation. One of the material in grade XI that difficult to understand by students is salt hydrolysis. It is based on the results of a questionnaire that distributed to 30 students in the class XII IA 1 SMA 1 Manyar, 50% of students in this class stated that Salt Hydrolysis is the material that difficult to understand.

Based on the syllabus of SMAN 1 Manyar, Competency Standards of Salt Hydrolysis material is to understanding the properties acid- base solution, measuring method and application. Basic Competency is describe of variety salt

which can be hydrolyzed in water and calculate pH of the salt solution. This basic competence require students to do practical work related to the determination of salt that can be hydrolyzed. Considering that there are many phenomenon around of students relate with the utilization of salts hydrolysis, such as the uses of ammonium sulfate fertilizer to lower the soil pH in the Gresik that the soil is limestone soil, the use of chlorine as a bleaching agent, etc, so in this material the student should not only accept and memorize but also invented the concept of learning that from those phenomenon. An alternative that can be done to study these materials is apply or implement the problem based learning model. With problem based learning model, students can be given an authentic problems, that can be solved through a practical activity, so be able to help students process the information that has been owned and help students build their own knowledge.

In general, problem based learning model is learning model that presents an authentic problem situation to students and meaningful that can provide convenience to them to conduct an investigation and inquiry [7]. Problem Based Learning was developed to help students develop their thinking skills, problem solving and intellectual skills [8]. Problem Based Learning combined with metacognitive strategies most impact on the ability of problem solving than Problem Based Learning and conventional learning [8].

The aim of this research is to determine the metacognitive skills of students after the implementation of problems based learning models with metacognitive strategies in the salt hydrolysis material. However, metacognition that are the focus in this research is metacognitive knowledge.

METHOD

This research follow One Shot Case Study design, that is a group subject that given a treatment without a comparison group and no pretest. The research was conducted in SMA Negeri 1 Manyar by taking a class XI IPA 4 as the sample. Determination of this sample is random samples.

Metacognition was measured by a special rubric of metacognition that are integrated with essay test developed by Patcharee Rompayom et al [9]. The obtained data about students' metacognitive activity were identified using metacognitive level sheet. The level which are obtained from each essay test question is then taken of the dominant level up, so we get the student’s metacognition level. The students' metacognition levels include Tacit Use, Aware Use, Strategic Use and Reflective Use [10].

Students are classified at Tacit Use level when students solve problems without thinking about his decision [10], in this case does not answer the question (procedural knowledge), or answer the question but not in accordance with the desired objectives of question. This is because students do not understand the question (declarative knowledge), so they only answer by trial and error.

Students are classified at Aware Use level when students are able to realize his own ideas [10] , as seen from the prior of knowledge possessed relating to the matter (declarative knowledge), students are able to correlate the information they have to determine the problem solving steps (procedural knowledge), but have not been able to explain the reason of the selection step or give reasons for the less obvious (conditional knowledge).

Students are classified at the Strategic Use level if students are able to adjust their thinking to improve the precision of their thinking [10], in this case, student realize his own ideas as seen from the prior of knowledge possessed relating to the matter (declarative knowledge), students are able to use prior knowledge they have to determine the steps to completed problem (procedural knowledge), and are able to explain the reason of the selection step (conditional knowledge)

Students are classified at the Reflective Use level if the student are able to realize his own ideas as seen from the prior of knowledge possessed relating to the matter (declarative knowledge). Students at this level are able to reflect their thoughts before and after or even during a problem-solving process, so the answer to solving the problem of students at this level are very regular (procedural knowledge), because they will immediately make corrections when there is a lack. Students at this level are also able to explain the reason of the selection of each problem solving step (conditional knowledge)

RESULT AND DISSCUSSION

Problem Based Learning was developed to help students develop thinking skills, problem solving and intellectual skills. Problem Based Learning combined with metacognitive strategies most impact on the ability of problem solving than Problem Based Learning and conventional learning.

Problem Based Learning syntax with metacognitive strategies are shown in Table 1.

Table 1 The syntax of learning based on problems with metacognitive strategies

Phase	Syntax
Orientates students to the problem	- motivating students by giving questions to provoke students into the material - explaining the learning objectives - provoking students to find the problem in general that is "How to identify salt which is undergoing hydrolysis?"
Organize the student for study	- asking students to form groups of five - asking students to read the phenomena on the Student Worksheet - exploring students' prior knowledge by having students to do Self Understanding Assessment Question in the **(declarative knowledge)** - guiding students to formulate the problem based on the phenomena - Asking students to collect all information related to the formulation of the problem in groups **(declarative knowledge)**
Assist independent and group investigation	- guiding students to observe / practice**(procedural knowledge)** - guiding students to do analysis and make conclusion to find explanations and solutions to the problem **(declarative knowledge, procedural)** - guiding students who have acquired the knowledge revealed from observations and analysis by asking the students do the Self Understanding Assessment Questions and application question contained in the worksheet**(declarative knowledge, procedural, and conditional)**
Develop and Present Artifacts And Exhibits	- Asking students to present the observation result, analysis, and their Self Understanding Assessment Question foward the class - Asking other students to give opinion if there are different answer
Analyze and evaluate the problem solving process	- Guiding students to reflect or evaluate the learning process they use **(declarative, procedural and conditional knowledge)** - Guiding students to conclude the learning outcomes **(declarative, procedural and conditional knowledge)**

The position of problem-based learning with metacognitive strategies in improving students' metacognitive knowledge can not be separated from the syntax of this study. According to Fisher [10] one way of teaching for metacognition is to make explicit and infuse the language of thinking and learning of students, for example by asking "the knowledge that we use today is ...", "learning today is about ... "," knowledge that we get today is ... "that involve declarative, procedural, and conditional knowledge.

Metacognitive knowledge is contains three components, they are declarative, procedural, and conditional knowledge. Explicitly, Table 1 illustrates the learning process oriented metacognition. In the first phase, there is a syntax provoking students to find the problem in general. At this syntax students are required to understand exactly what they will learn **(declarative knowledge).**

In the second phase, there is a syntax exploring students' prior knowledge and asking students collect all information related to the problem formulation**.** In this syntax, students are trained to understand what knowledge is needed to solve problems or to understand the material they learned **(declarative knowledge)**. After that the students were asked to write down the knowledge that has been understood by them. This is in order to students aware for their understanding, so they know what information still needs to be studied to resolve the problem.

In the third phase there are some syntax that contains elements of metacognitive knowledge, the first is to guiding students to observe and record the results. At this syntax, students begin to utilize the knowledge he already has to get the desired data through observation **(procedural knowledge).**

The second syntax in the third phase is guiding students to find the explanation for the problem formulation or do the analysis. In this syntax, students answer the questions that have been designed by teachers for students to discover for yourself how the characteristics of salt that can be hydrolyzed. At this activity the students are required to correlate their prior knowledge (declarative knowledge) with the observation result that they have gotten, and eventually acquire new knowledge about the characteristics of the salt which can be hydrolyzed. How students use their prior knowledge to get the new knowledge its self is indcluded in procedural knowledge. So, the activity of doing the analysis contains elements knowledge of metacognition, they are declarative and procedural knowledge.

The third syntax in the third phase is asking students to write knowledge that are gotten from observation and analysis, and then answer the aplication question. In this syntax, students are required to conclude how to identify a salt that can be hydrolyzed in accordance with the observations and analysis they have done, and how to identify salts that can be hydolyzed if there are not observation or practical activities. These activities contain elements of conditional knowledge, that is the student should be able to determine when and why to use a procedure or a particular strategy in a problem-solving process.

In the activity of doing aplication question, students should answer the question about determining the pH of the hydrolysed salt solution. Each question consists of three sub-questions that contain declarative, procedural, and conditional knowledge. After students read the given problem, for the first students must write down the knowledge of what is needed to resolve these questions (declarative knowledge). The second, students must solve the problems with utilizing the knowledge they already have (procedural knowledge). Then the third students should explain why they chose those step in the problem solving (conditional knowledge).

In the fourth phase there is a syntax to reflect the processes that have been made.In the syntax, students guide by the teacher to reflect all of the learning process that is done. Then the last one is to conclude the matter. In the syntax of this activity is revealed again what students had learned. This syntax element contains **the declarative knowledge.**

After implementation of problems based learning with metacognitive strategies in SMAN 1 Manyar, while the results are as follows:

Table 2 Students' Metacognition After Implementation of Problem Based Learning Model with Metacognitive Strategies on the Salt Hydrolysis Material

No	Metacognition Level	Number of Students
1	Tacit Use	0
2	Aware Use	10
3	Strategic Use	13
4	Reflective Use	7

Here is described the method of determination students' metacognition levels of NR

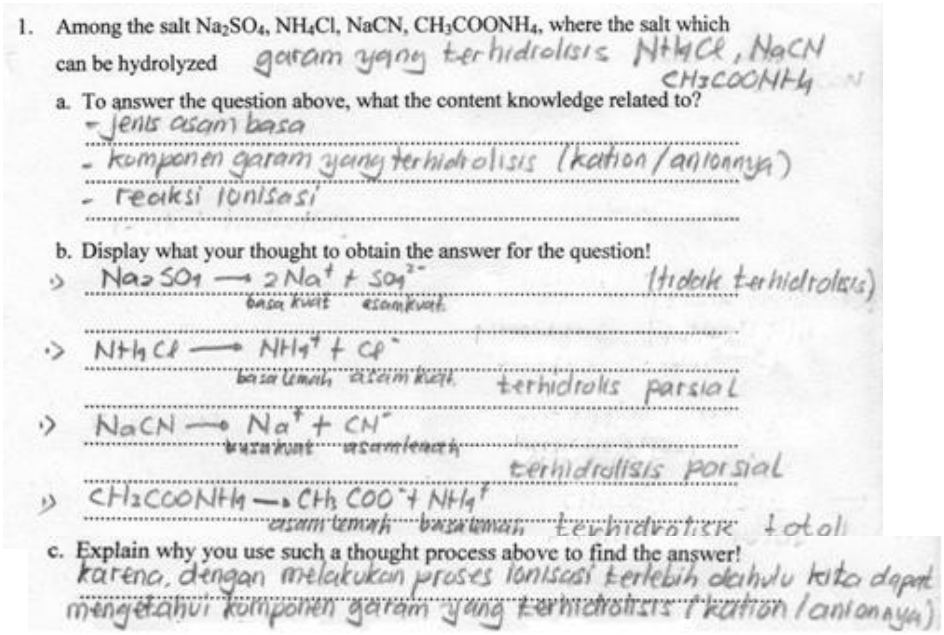
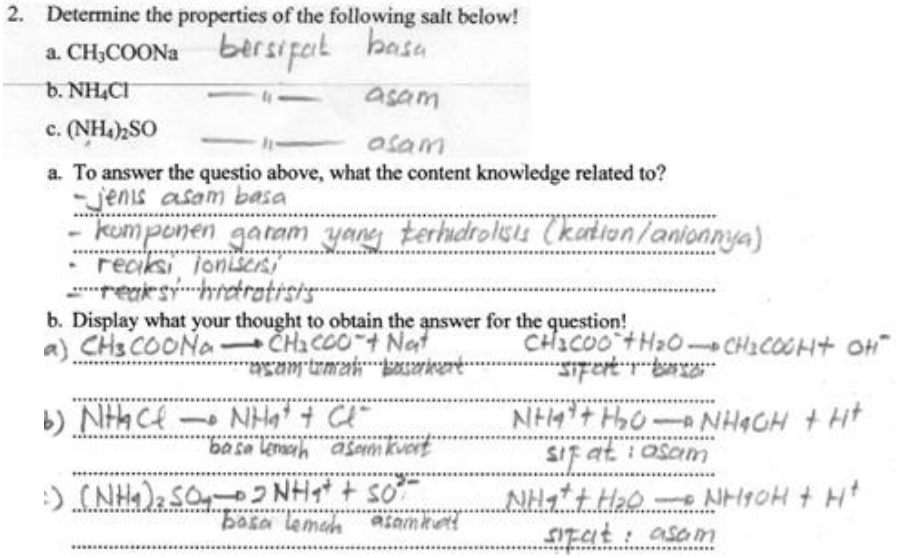

1. Among the salt Na_2SO_4, NH_4Cl, NaCN, CH_3COONH_4, where the salt which can be hydrolyzed garam yang terhidrolisis NH_4Cl, NaCN CH_3COONH_4
a. To answer the question above, what the content knowledge related to?
- jenis asam basa
- komponen garam yang terhidrolisis (kation/anionnya)
- reaksi ionisasi
b. Display what your thought to obtain the answer for the question!
$Na_2SO_4 \rightarrow 2Na^+ + SO_4^{2-}$ (tidak terhidrolisis)
basa kuat asam kuat
$NH_4Cl \rightarrow NH_4^+ + Cl^-$ terhidrolis parsial
basa lemah asam kuat
$NaCN \rightarrow Na^+ + CN^-$ terhidrolisis parsial
basa kuat asam lemah
$CH_3COONH_4 \rightarrow CH_3COO^- + NH_4^+$ terhidrolisis total
asam lemah basa lemah
c. Explain why you use such a thought process above to find the answer!
karena, dengan melakukan proses ionisasi terlebih dahulu kita dapat mengetahui komponen garam yang terhidrolisis (kation/anionnya)

Figure 1 NR's Problem Solving for the Question Number 1.

Based on the Figure 1, students understand the information and purpose of the question, where students know about the knowledge required for problem resolution (declarative knowledge). It is also seen from the answers of students which are suitable with what was asked on the question, that is the students were able to determine the salt which can be hydrolyzed (procedural knowledge). But students have not been able to give reasons for doing problem solving clearly (conditional knowledge). The answer to question number 2 reflects the Aware Use level.


2. Determine the properties of the following salt below!
a. CH_3COONa bersifat basa
b. NH_4Cl 〃 asam
c. $(NH_4)_2SO$ 〃 asam
a. To answer the questio above, what the content knowledge related to?
- jenis asam basa
- komponen garam yang terhidrolisis (kation/anionnya)
- reaksi ionisasi
- reaksi hidrolisis
b. Display what your thought to obtain the answer for the question!
a) $CH_3COONa \rightarrow CH_3COO^- + Na^+$ $CH_3COO^- + H_2O \rightarrow CH_3COOH + OH^-$
asam lemah basa kuat sifat : basa
b) $NH_4Cl \rightarrow NH_4^+ + Cl^-$ $NH_4^+ + H_2O \rightarrow NH_4OH + H^+$
basa lemah asam kuat sifat : asam
c) $(NH_4)_2SO_4 \rightarrow 2NH_4^+ + SO^{2-}$ $NH_4^+ + H_2O \rightarrow NH_4OH + H^+$
basa lemah asam kuat sifat : asam

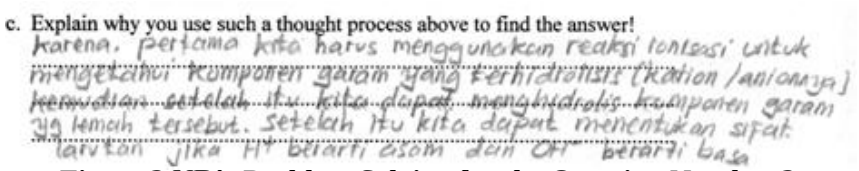
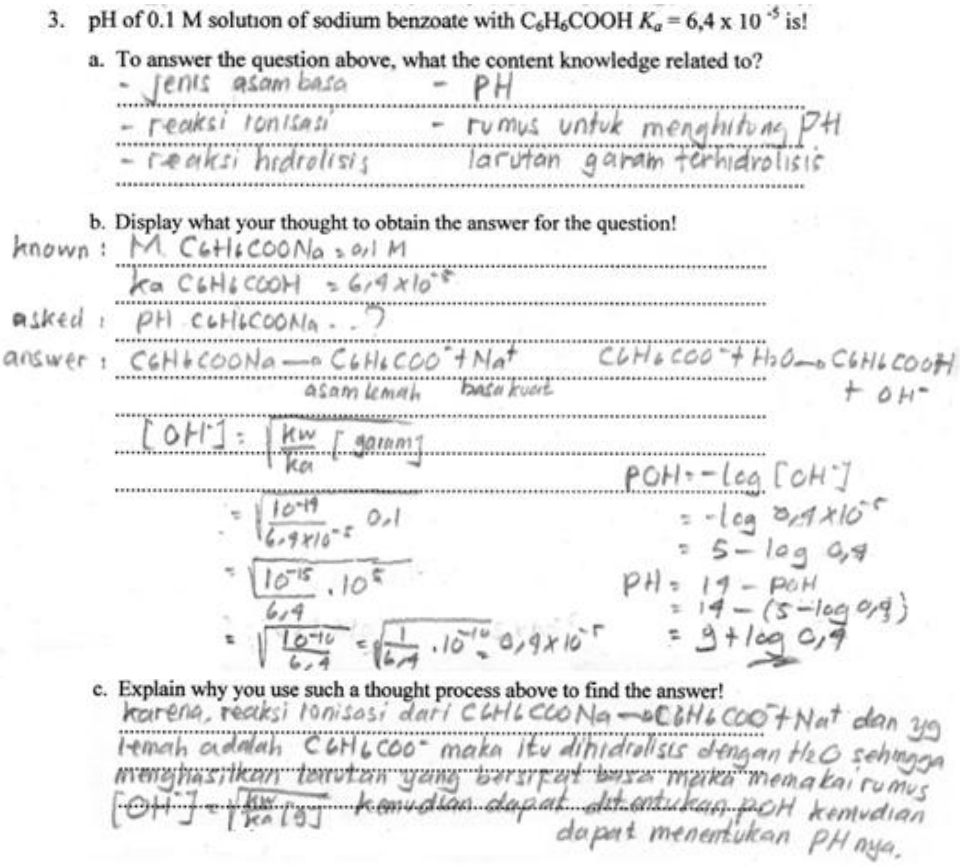

c. Explain why you use such a thought process above to find the answer!
karena, pertama kita harus menggunakan reaksi ionisasi untuk mengetahui komponen garam yang terhidrolisis (kation / anionnya) kemudian setelah itu kita dapat menghidrolis komponen garam yg lemah tersebut. setelah itu kita dapat menentukan sifat larutan jika H^+ berarti asam dan OH^- berarti basa

Figure 2 NR's Problem Solving for the Question Number 2.

Based on the Figure 2, students understand the information and purpose of the question, where students know about the knowledge necessary to determine the properties of the hydrolysed salt solution through of reaction equation (declarative knowledge). It is also seen from the answers of students which are suitable with what was asked in question (procedural knowledge). Students also have been able to give reasons for doing problem solving clearly (conditional knowledge). In addition, students also reflect on each step of problem solving, it can be seen from the completion of the steps are very regular, ranging from the ionization reaction to determine the components of salt, determination the component of salt that can be hydrolyzed, hydrolysis reactions, and determination the properties of the hydrolyzed solution. The answer to question number 2 reflects the Reflective Use level.


3. pH of 0.1 M solution of sodium benzoate with C_6H_6COOH $K_a = 6{,}4 \times 10^{-5}$ is!

a. To answer the question above, what the content knowledge related to?
- jenis asam basa
- reaksi ionisasi
- reaksi hidrolisis
- pH
- rumus untuk menghitung pH larutan garam terhidrolisis

b. Display what your thought to obtain the answer for the question!
known : M C_6H_5COONa = 0,1 M
ka C_6H_5COOH = $6{,}4 \times 10^{-5}$
asked : pH C_6H_5COONa ...?
answer : $C_6H_5COONa \rightarrow C_6H_5COO^- + Na^+$ (asam lemah, basa kuat)
$C_6H_5COO^- + H_2O \rightarrow C_6H_5COOH + OH^-$
$[OH^-] = \sqrt{\frac{Kw}{ka}[\text{garam}]}$
$= \sqrt{\frac{10^{-14}}{6{,}4 \times 10^{-5}}\ 0{,}1}$
$= \sqrt{\frac{10^{-15}}{6{,}4} \cdot 10^{5}}$
$= \sqrt{\frac{10^{-10}}{6{,}4}} = \sqrt{\frac{1}{6{,}4} \cdot 10^{-10}} = 0{,}4 \times 10^{-5}$
$pOH = -\log [OH^-]$
$= -\log 0{,}4 \times 10^{-5}$
$= 5 - \log 0{,}4$
$pH = 14 - pOH$
$= 14 - (5 - \log 0{,}4)$
$= 9 + \log 0{,}4$

c. Explain why you use such a thought process above to find the answer!
karena, reaksi ionisasi dari $C_6H_5COONa \rightarrow C_6H_5COO^- + Na^+$ dan yg lemah adalah $C_6H_5COO^-$ maka itu dihidrolisis dengan H_2O sehingga menghasilkan larutan yang bersifat basa maka memakai rumus $[OH^-] = \sqrt{\frac{Kw}{ka}[g]}$ kemudian dapat ditentukan pOH kemudian dapat menentukan pH nya.

Figure 3 NR's Problem Solving for the Question Number 3.

Based on the Figure 3, students understand the information and purpose of the question, where students know about the knowledge necessary to determine the pH of the hydrolysed salt solution (declarative knowledge). It is also seen from the answers of students which are suitable with what was asked in question (procedural knowledge). Students also have been able to give

reason for the step of selection formula used in problem solving clearly (conditional knowledge). In addition, students also reflect on each step of problem solving, it can be seen from the completion of the steps are very regular, ranging from the ionization reaction, determination the component of salt that can be hydrolyzed, hydrolysis reaction, determination of the hydrolysis reaction products that affect to the pH, selection formula that is used, calculate the pOH, then calculate the pH. The answer to question number 3 reflects the Reflective Use level.

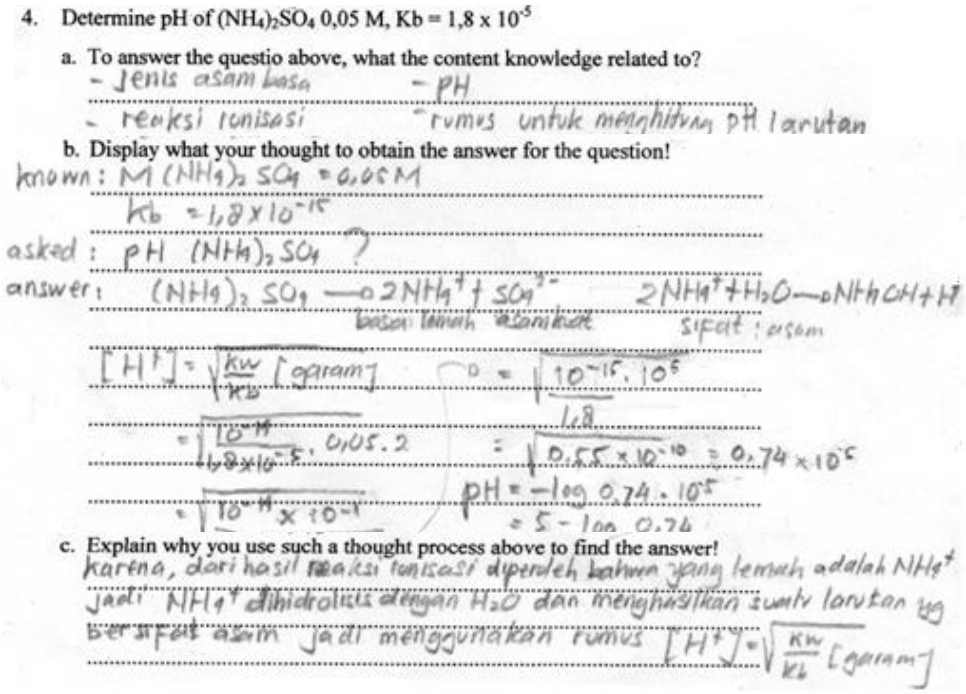
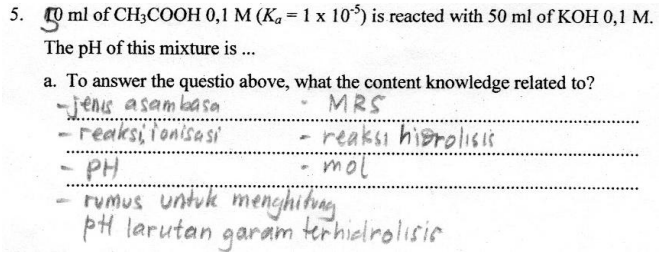


Figure 4 NR's Problem Solving for the Question Number 4.

Based on the Figure 4, students understand the information and purpose of the question, where students know about the knowledge necessary to determine the pH of the hydrolysed salt solution (declarative knowledge). It is also seen from the answers of students which are suitable with what was asked in the question, that is students were able to determine the pH of the hydrolysed salt solution using the correct formula (procedural knowledge). Students also have been able to give reason for the step of selection formula used in problem solving clearly (conditional knowledge). In addition, students also reflect on each step of problem solving, it can be seen from the completion of the steps are very regular, ranging from the ionization reaction, determination the component of salt that can be hydrolyzed, hydrolysis reaction, determination of the hydrolysis reaction products that affect to the pH, selection formula that is used, then calculate the pH. The answer to question number 4 reflects the ReflectiveUse level.



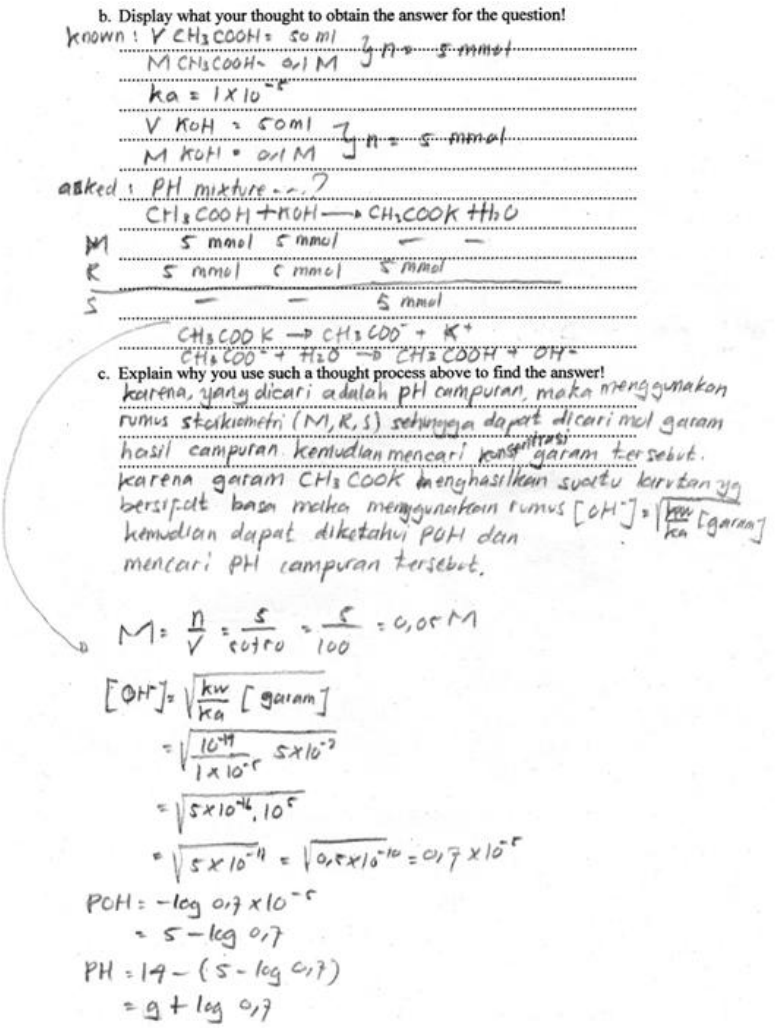


Figure 5 NR's Problem Solving for the Question Number 5.

Based on the Figure 5, students understand the information and purpose of the question, where students know about the knowledge necessary to determine the pH of solution that are mixturing of weak acid and strong base (declarative knowledge). It is also seen from the answers of students which are siutable with what was asked in question (procedural knowledge). Students also have been able to give reason for the step of selection formula used in problem solving clearly (conditional knowledge). In addition, students also reflect on each step problem solving, it can be seen from the completion of the steps are very regular, ranging from the mixing equation, determining the moles of product (salt), determination of product concentration, the ionization reaction of salt, determination the component of salt that can be hydrolyzed, the hydrolysis reaction, the determination of the hydrolysis reaction products which affect the pH, the selection formula is used, then calculate the pH. The answer to question number 5 reflects the Reflective Use level.

Because of the dominant metacognition level of NR is reflective use, so the metacognition level of NR is reflective use.

From the various theoretical and empirical studies that supports the research shows that the integration of metacognitive strategies to problems based learning model has the potential to empower the students' metacognition.

This can be explained that the problem-based learning provides syntax that are very supportive for students to utilize their metacognition.

CONCLUSION AND SUGGESTION

Through of the implementation of problem based learning with metacognitive strategies, the metacognition levels of students are as many as 33,33% students occupy the Aware Use level, as many as 43,33% students occupy the Strategic Use level, and as many as 23,34% students occupy the Reflective Use level. This model has the potential to empower students' metacognition.

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