Analysis of mastery of salt hydrolysis matter in the application of the scientific-based learner worksheet

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Abstract. The aim of the study was to determine the mastery of the salt hydrolysis material of learners. Achievement of mastery of the material measured by the learning outcomes on knowledge domain of the learners while the results of learning on the domains of attitudes and skills were used as supporting data. The learner’s worksheets with a scientific approach was applied during the learning. After being treated, the learners were given formative tests in the form of questions which contained indicators of the mastery of the material. Data were also collected through a validated observation sheet to measure attitude and skill learning outcomes. Behavioral learning outcomes were measured during discussions, while skills learning outcomes were measured during laboratory works. Data from the formative test and observation sheet were analyzed and the conclusions were drawn. The results of the formative research showed that 21 people (63.6%) were on moderate, while the other 12 people (36.4%) were on high achievement of the mastery. Most of the learners were on highly achievement both in attitudes domain (89.22%) and skills domain (91.79%). Based on the data that has been obtained can be concluded that most of the learners of class XI MIA 4 MAN 1 Magelang were on moderate category for the domain of knowledge, and on good category both for attitudes and skills domains of the achievement on their mastery on salt hydrolysis matter.

1. Introduction
Education Regulation of Indonesian government No. 59 of 2014 states that the 2013 curriculum is designed to strengthen students in terms of knowledge, attitudes and skills as a whole and emphasize the implementation of scientific approaches at all levels of education. In reality, the implementation of the 2013 curriculum is not balanced with the abilities and skills of the students. One of the problems in learning that still often occurs is that students are more directed to memorizing information from purchased textbooks, so that the mastery of material for students is still low. Mastery is not just about remembering what has been learned but mastering more than that, which involves various processes of mental activities so that they are more dynamic. Using student worksheets based on the science process will encourage students to explore and explore more about the concepts of experiments, students are more creative in group learning, students get equal opportunities in speaking, making learning more enjoyable [1]. Students should not only act as recipients of information, but as users of information [2].

Observations on chemistry classes in several schools in Semarang showed that the learning method used was still teacher-centered and the teaching material used was not derived from material developed by the chemistry teacher. Teacher-centered learning caused the addition of knowledge to students is less profound so that it was not optimal in mastering the material. The learning was carried out using only the lecture method and provided a little question and answer opportunities, so that most of the students were passive during the learning process and resulted in low learning outcomes of chemistry.
One effort that can be done to overcome the difficulties of learners is by applying problem-based learning. According to a study, problem-based learning models can improve high school student’s learning outcomes [3]. Other studies prove that the Problem Based Learning Model can also improve the mastery of air pollution material and encourage students' creative thinking skills [4]. The application of the scientific approach in teaching materials can improve students' understanding of concepts at the submicroscopic level and the critical thinking skills of students about the concept of solution [5]. Scientific approaches especially problem-based learning models can increase motivation and mastery of the concept of chemistry lessons [5]. Mastery of material is the learning outcomes of the domain of knowledge (cognitive) [6]. The development of teaching materials is needed to improve mastery of the material. The scientific approach to learning is easier to implement if teaching materials are available [7]. Another effort to deal with students' problems is by adjusting teaching materials to suit the needs of students [8].

The development of teaching materials is needed to improve mastery of the material. The scientific approach to learning is easier to implement if teaching materials are available [9]. One of the teaching materials that can increase the activeness and understanding of students about the subject matter is the Student Worksheet [10]. Based on the background that has been described, the problem in this study can be formulated: how the students' mastery knowledge concept related salt hydrolysis is achieved when the student's scientific approach is applied to the learning process. The purpose of this study was to find out how the attitudes, skills and mastery achievement of students' teaching materials, in the implementation of salt hydrolysis learning after applying the scientifically related Student Worksheet. The learning achievement of students in one of the schools in Taiwan increases when taught using a teaching material developed according to the needs of students [11].

2. Methods
This research was a case study. The research design used was a one-shot case study. The research sample was taken using purposive sample technique. The subjects of this study were 33 students of class XI MIA 4 MAN 1 Magelang in the academic year 2017/2018. This study used descriptive qualitative method. The procedure of the research carried out consisted of four stages which include the preliminary stage, the preparation stage, the implementation stage, and the final stage.

The independent variable in this study was the scientific-oriented Student Worksheet. The dependent variables were the achievement of mastery of material, learning outcomes of students' attitudes and skills in learning salt hydrolysis subjects, while the control variables were teacher's ability, curriculum, material, and time allocation. Data collection techniques were carried out using documentation, tests and observation sheets. The instrument used in this study consisted of formative test questions, observation sheets about the attitudes and skills of students.

Data analysis consisted of initial and final data analysis. Initial data analysis was in the form of preliminary observations, high school curriculum studies and validation of all instruments. The final data analysis was in the form of analysis of the achievement of material mastery of students as a whole, the percentage of students in the achievement of mastery of material in each indicator of teaching materials, as well as the percentage of students in achieving learning outcomes attitudes and skills.

This study did not provide a pre-test. Data of the mastery achievement of subject matter was obtained from the results of the formative test of students. Formative test questions were tested in the form of multiple choices which contained 6 indicators of mastery of salt hydrolysis material. Test questions have been analyzed for validity, reliability, differentiation, and difficulty index. Analysis of the achievement of material mastery was carried out on each indicator of mastery. The answers of each student were then analyzed as a whole and on each indicator.

3. Results and discussion
Achievement Analysis of Learners in mastering the material through the application of scientifically related worksheets conducted from the results of the data obtained, including 1) formative test results, 2) learning outcomes from the attitude domain, 3) learning outcomes of the students' skills. Before the question instrument is ready to be used, the content of the instrument was validated first. Validation was carried out by 3 experts consisted of two expert lecturers and chemistry subject teachers. In the process of validating the content of the mastery test material, some invalid test questions were removed and some were repaired, resulting in 20 questions used and declared valid. The results of the multiple choice question reliability test were $r_{11} = 0.7704$. This result indicated that the test questions were reliable because they meet the requirement of $r_{11} \geq 0.70$ [12].

The percentage of students in achieving the mastery of salt hydrolysis material was obtained through 20 predetermined multiple choice questions. The results of this percentage can be used to categorize students based on the level of mastery, namely students with high mastery of material, students with medium mastery of the material, and students with low mastery of the material. The category of mastery of material classically can be seen in Table 1.

| Category of Material Mastery Achievement | Percentage (%) | Frequency of Learners |
|----------------------------------------|----------------|-----------------------|
| High                                   | 36.4           | 12                    |
| Medium                                 | 63.6           | 21                    |
| Low                                    | 0              | 0                     |

Table 1 showed that the number of students with high material mastery were 12 people. The number of students in medium mastery achievement were 21 people. Overall it can be said that students are classified as medium in mastering salt hydrolysis material. The results of almost the same research conducted by the Program of International Students Assessment (PISA) at the 2015 Science Competencies for Tomorrow’s World Program explained that the condition of Indonesian students at the age of 15 years (SMP) was not maximized in identifying, explaining and applying knowledge and science in various complex life situations consistently [13].

This study also analyzed the ability of mastering material in chemistry subjects based on each mastery indicator on teaching materials. The material analyzed is salt hydrolysis. One item fulfills the criteria of the question indicator in the salt hydrolysis material, and fulfills the indicators of mastery of the material of students.

![Figure 1](image-url)  
**Figure 1.** Percentage of learners in achieving learning outcomes in each material mastery indicator

The percentage of students in achieving the material mastery of participants in the six indicators was 72%, 67%, 64%, 52%, 64%, and 58%, as shown in Figure 1. The highest percentage of students was in...
the material mastery indicator number 1, which was the memory of the subject matter that has been learned before. The percentage of students in the achievement of mastering the second most material was on 2nd indicator, which was in understanding the meaning of a material that has been studied. The percentage of the 3rd and 4th highest students were on the 3rd and 5th indicators. The fifth percentage of students was in indicator number 6, namely making an assessment of a material or material based on intention and criteria. The lowest percentage is in indicator number 4, namely describing a subject matter.

Problem-based learning is able to increase the students’ mastery of subject matter [14]. The high percentage of material mastery achievement can be influenced by the number of exercises given. Exercises in answering the questions are reflected in each stage of the learning model syntax. Students are asked to solve problems while answering questions related to the concept of matter. Discussion of important concepts and deep understanding of concepts makes students easier to overcome difficulties in understanding concepts [15].

The assessment of attitudes and skills domains as supporting data in this study was carried out using analysis of the observations of students in each group. The assessment was carried out by three observers when the discussion and practicum activities were carried out on the indicators of the attitude of discussion and indicators of practical skills. The results showed that the average score of the attitude of students was 18 (maximum score 20) with the criteria of "very good". Students have an average skill score of 26 (maximum score of 28) with the criteria of "very good". Recapitulation of student learning outcomes in the attitude domain can be seen in Table 2 and the recapitulation of learning outcomes of skills domain can be seen in Table 3.

| Interval | Criteria | Frequency of Learners |
|----------|----------|-----------------------|
| 17 ≤ Score ≤ 20 | Very Good | 22 |
| 13 ≤ Score ≤ 17 | Good | 10 |
| 9 ≤ Score ≤ 13 | Fair | 0 |
| 5 ≤ Score ≤ 9 | Low | 0 |

**Figure 2.** Percentage of learners in achieving learning outcomes in each attitude aspect

The attitude aspects assessed were (1) Tolerance; (2) Honesty; (3) Curiosity; (4) Responsibility and (5) Communicating ability. The results of this study were relevant to previous research which states that the achievement of learning attitudes of students has increased after the application of scientific approach learning [14]. The scientific approach that applies group discussion methods trains students to be active in the learning process. Through discussion activities students are also trained to be more daring in expressing opinions, responding to statements from friends and teachers, and asking questions about things that have not been understood.
Table 3. Student learning outcomes in the skills domain

| Interval | Criteria   | Frequency of Learners |
|----------|------------|-----------------------|
| 23 ≤ Score ≤ 28 | Very Good | 25                    |
| 18 ≤ Score < 23   | Good      | 7                     |
| 13 ≤ Score < 18   | Fair      | 0                     |
| 7 ≤ Score < 13    | Low       | 0                     |

Figure 3. Percentage of learners in achieving learning outcomes in each skills aspect

Aspects of skills assessed were (1) Preparation of practicum tools and materials; (2) Skills to use practicum tools and materials; (3) Mastery of practicum procedures; (4) Group collaboration; (5) Accuracy in making observations; (6) Accuracy in completing the practicum and (7) Returning practicum tools and materials to the previous place, as shown in Figure 3. The results of this study are in line with other studies which state that problem-based learning has a significant effect on students' learning achievement on aspects of skills [15]. Problem-based learning has been proven to improve learning outcomes, but the implementation must be continuously carried out. Problem-based learning has also been applied in environmental chemistry courses, proving it can improve students' creative thinking skills [16]. Aspects of working together in groups got the highest score, as evidenced by the enthusiasm of participants in role playing as teachers, students and guests.

Problem-based learning makes students' skills better because this learning emphasizes the activeness of students to develop the concept of the nature of salt solution through practicum activities. The scientific-based learner worksheet give opportunity to students to mastery an analysis skills of salt hydrolysis material because the application of students worksheets of by applying scientific approach. It can also foster students' good responses to the scientific approach [17]. The application of the scientific approach can also improve students' thinking skills and students become more active in learning. Thinking skills are important aspects that must be mastered in schools in transferring knowledge between teachers and students as well as between students [18]. Giving real problems in learning will guide students in developing thinking skills [19].

Worksheets of students who are scientifically oriented are able to improve the three domains of learning outcomes, because the steps have indeed been prepared to train so that they able to improve knowledge, attitudes and skills. Learning outcomes of knowledge aspects (mastery of hydrolysis material), obtained from knowledge test result. The question of the test grid is prepared according to the indicators in the basic hydrolic competency of the salt and must have been taught and learned, in accordance with the steps already in the worksheets of students who are scientifically close. The results of this study are relevant to previous research which states that learning attitudes of students' attitudes have increased after the implementation of scientific approach learning [20]. This result is in line with
other studies which state that problem-based learning has a significant effect on students' learning achievement on aspects of skills [21].

Problem-based learning model makes students' skills better because in learning emphasizes the activity of students. Learning by using peer interaction in small groups and guiding questions can improve students' ability to solve problems [22]. In addition, through this practical activity also causes students to experience firsthand experience that is able to increase the motivation of students so that the results of achievement of competency skills tend to be better.

Problem based learning can be varied with various creative actions. The task of making ideas in solving problems related to the subject being studied. The ideas expressed in the form of scientific articles with learning resources from the results of existing research, have been shown to increase student knowledge [23]. Aspects of the observed attitude are also in accordance with the ones being learned, as well as the skill aspects that are assessed in making the observation sheet also in accordance with those trained with the indicators that have been confirmed as well. In this research, there have been five aspects of the Attitude aspect and seven aspects of the skill aspect. All the indicators that have been confirmed are implemented, trained and assessed. In addition, through this practical activity students got direct experience that can increase motivation so that the achievement of skills competencies tends to be better.

4. Conclusion
The results showed that (1) formative mastery test material showed that a number of 21 people (64%) students were in the medium category, while the remaining 12 people (36%) were in the high category; (2), in the attitude aspect, a total of 29 people (88%) have mastery results that are in the very good category; and (3) in the aspect of skills 30 people (92%) have learning outcomes in the very good category. Based on these findings it can be concluded that the mastery of the material of students in class XI MIA 4 MAN 1 Magelang for the domain of knowledge was in the medium category, for the domains of attitudes and skills were in the excellent category.

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