The influence of POGIL learning model by mind mapping and summary assignment of salt hydrolysis outcomes

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Abstract. Salt hydrolysis is a difficult subject matter for some students, due to the characteristic aspects of chemical concepts and aspects of the learning model. Overcoming the difficulties of these students, one of them uses POGIL (Process Oriented Guided Inquiry Learning) learning. The POGIL learning model does not direct students in documenting material, so it is accompanied by mind mapping and summary. The purpose of this study was to determine the differences of students' cognitive learning outcomes in the POGIL learning model by mind-mapping assignment between the students taught using the POGIL learning model with a summary assignment on salt hydrolysis material. This study used a quasi-experimental model with posttest only control group design. The results of this study showed that there were differences in cognitive learning outcomes which shown on the average value of students taught with POGIL learning models accompanied by assignments mind mapping higher compared to students who were taught with the POGIL learning model along with summary assignments.

1. Introduction

Salt hydrolysis is closely related to daily life as an example is the use of clothing bleach, food flavoring known as monosodium glutamate (MSG), cold compresses and fertilizers. The proximity of salt hydrolysis is inversely proportional to the learning of salt hydrolysis material which is considered difficult by students [1]. Salt hydrolysis is the material taught in the even semester SMA XI class. The difficulties in the material of salt hydrolysis experienced by students are determining the nature of the salt solution, writing the hydrolysis reaction equation, calculating the pH of the solution salt [2]. The reason for the difficulties in the salt hydrolysis material is about the characteristics of the concepts of chemistry and teacher teaching [1]. Being a teacher must have a moral commitment and be mentally educated and trained. Students learn from the lessons that the teacher provides so that the teacher is the key to student success [3,4]. Teachers are expected to have adequate expertise in teaching, creating an effective learning environment and can manage the class [5].

Based on the purpose of education in curriculum 13 a scientific approach is used to learning models such as discovery learning and inquiry learning. The difficulties in the salt hydrolysis material can be overcome by using POGIL learning. POGIL is one of the models process-based guided inquiry learning that is centered on group students working and the teacher acts as a facilitator [6]. The POGIL
learning model has five learning stages namely (1) Orientation, (2) Exploration, (3) Concept Formation, (4) Application, and (5) Closure [7]. Based on previous research, POGIL learning can improve cognitive learning outcomes [8]. POGIL model learning improves mastery of students' concepts compared to conventional learning [9]. POGIL applications can improve learning outcomes in colloidal material [10]. These studies show that POGIL learning will have an impact on improving learning outcomes.

Inquiry-based learning has many advantages but on the other hand, it also has disadvantages including students having difficulty documenting what they can write or verbally [11]. In the learning process, it needs creative and active during the learning process. Being a teacher is required to be able to use innovative and creative learning models that are useful in creating an atmosphere of learning and facilitating the transfer of knowledge [12].

The application of mind mapping assignment is an alternative to answering problems in POGIL learning, this is in line with previous research which explains that mind mapping can help students remember material previous to new knowledge, and help connect new knowledge, which will have an impact on participation active, interest and learning becomes interesting [13]. The previous studies explained that the effectiveness of mind mapping, that is the application of mind mapping can improve students' cognitive learning outcomes [14], chemical learning using mind mapping affects learning outcomes [15]. Based on the description above, POGIL learning combined with mind mapping is expected to improve students' cognitive learning outcomes.

The way to document other material is by summarizing, which is to state the core of the reading with a few words The function of summarizing is to shorten the contents of the field of study that has been studied so that it is easier to remember [16]. There are four steps for making a summary including reading, selecting, writing and comparing. The summarizes assignment is expected to help students understand the subject matter and improve cognitive learning outcomes. This is in line with previous research which states that summarizing can improve student learning outcomes, namely review of proven summaries superior and improving learning outcomes [17].

Previous research comparing the use of the mind map strategy with its summaries [18]. Based on the data presented, the background of the researchers to conduct research by comparing the cognitive learning outcomes of students taught with the POGIL learning model assisted by mind mapping and students who are taught with the POGIL learning model assisted by summary, this is due to having equivalent learning steps and comparable weight so that it can be examined. The purpose of this study is to determine the differences of students' cognitive learning outcomes in the POGIL learning model by mind-mapping assignment between the students taught using the POGIL learning model with a summary assignment on salt hydrolysis material.

2. Methods
This type of research is a study of Quasy Experimental posttest-only Design conducted at SMAN 7 Malang. The research subjects were class XI IPA students at SMAN 7 Malang in the academic year 2017/2018. In this study, there were 2 classes, namely XI IPA 4 class as experimental class 1, consist of 33 students who were taught with POGIL accompanied by mind-mapping assignment and XI IPA 5 class as experimental class 2 totaling 34 students who were taught with POGIL accompanied by summary assignments.

This study uses two groups of instruments, namely treatment instruments and measuring instruments. The instrument's treatment includes the syllabus, learning implementation plan, and student worksheet, while the measurement instrument includes a test of understanding the concepts developed referring to taxonomy Bloom, it's starting from level C2 to level C5. The cognitive learning test consists of 15 multiple choice questions, assessment rubrics mind mapping and summary and Learning Implementation Observation Sheet. Experts validated the research instrument in the field, namely two chemistry lecturers and one chemistry teacher.
3. Results and discussion
The implementation of the study was carried out for five meetings for 2 x 45 minutes per each meeting. The last meeting was carried out posttest cognitive learning outcomes. The implementation of the learning of the two experimental classes was based on observations made by the observer with the average percentage of learning implementation in the class experimental1 amounting to 92% in the experimental class 2 percentage at 91%. Based on the results of the percentage, it can be concluded that the implementation of learning is very good in both classes. The Observer used in this study were two people, while the observed aspects included opening, core activities, and closing. The results of this study are informed of the answers to cognitive learning outcomes tests obtained from the results posttest. The measurement of students' cognitive learning outcomes in a study refers to the Bloom Taxonomy indicator criteria which start from the level of understanding (C2), apply (C3), analyze (C4), to evaluates (C5).

The instrument for testing cognitive learning outcomes in the study was a multiple-choice question. The results of the study were in the form of data from the posttest of the experimental class 1 POGIL accompanied by the assignment of mind mapping and experimental class 2 which was taught using the POGIL model along with summary assignments. The analysis posttest results of the cognitive learning outcomes can be seen in table I.

| Aspects            | Calculation | Category      |
|--------------------|-------------|---------------|
| Normality          |             |               |
| Experiment 1       | 0.200       | Normal        |
| Experiment 2       | 0.074       | Normal        |
| Homogeneity        | 0.903       | Homogeneous   |
| Hypothesis         | 0.048       | There are significant differences |

Test for normality of cognitive learning outcomes Kolmogorov Smirnov at a significance level of 0.05, while the Homogeneity Test used the test Levene Statistics with the help of SPSS 23 for Windows. testing is Hypothesisedone after the normality test and homogenous test are fulfilled, in this study the hypothesis test used is the T-test with the method one-tailed independent sample T-test at the 95% confidence level obtained significance of 0.048 smaller than 0.05. This means that there are significant differences in the POGIL model learning with assignments mind mapping in experimental class 1 with a mean of 79.97 higher than model learning POGIL with summary assignments in experiment 2 with a mean of 75.59.

Learning in both experimental classes used the POGIL model with its syntax (1) Orientation, (2) Exploration, (3) Concept Formation, (4) Application and (5) Closure [4]. One of the successes of this learning is because every POGIL model learning syntax integrates bloom taxonomic indicators that can improve learning outcomes cognitive, first stage Orientation students are given a stimulation by linking the previous material, at this stage students need to understand (C2) the concept of previous learning well. The second stage of Exploration students observe, design experiments, collect data, analyze and test hypotheses so students can construct knowledge independently, so students need to remember (C1) material, apply (C3) learning outcomes obtained, analyze (C4) findings generated and evaluate (C5) findings. The third stage of Concept Formation, concepts that students find from the stage are Exploration reinforced with critical and analytical questions, students need to understand (C2) in-depth material, then analyze (C4) material to be able to explore the relationship between various things and answer questions correctly, at the third stage assignments were given mind mapping in the experimental class 1 while in the experimental class 2 given a summary assignment. Providing mind mapping and summaries assignments to make it easier for students to associate the concepts learned.
The fourth stage of application is the stage of forming new concepts, concepts that have been obtained are strengthened and expanded by applying material contained in daily life, this stage students must conduct an investigation to find new concepts so students need to apply (C3) concepts obtained and examine them deep by analyzing (C4), after that students can revise the mind mapping and summaries that have been made at the beginning. In the last stage of closure, this stage students do an evaluation (C5) validate learning outcomes, then reflect on what is learned, assess work results and discuss together, so that students are expected to understand the concept correctly then revise mind mapping and summary.

The POGIL model learning in both classes produced an average cognitive learning outcome above the KKM, this was in line with the results of previous studies [8,19,20] which concluded that POGIL learning models could improve learning outcomes. Another thing that causes high cognitive learning outcomes is the existence of student worksheets by researchers by the POGIL learning syntax which can guide students to understand the material being studied. POGIL learning makes students actively involved in group discussions so that they can find concepts during learning, this can be seen from students' cognitive learning outcomes above average minimum completeness criteria. The following is the linkage of the expected competency components in summary assignments with cognitive learning outcomes can be seen in table 2.

**Table 2.** Linkages components of summary competence with cognitive learning result.

| Summary assessment | Category cognitive learning result |
|--------------------|-----------------------------------|
| A. Structure summary | C1-Remembering |
| B. Contents         | C2-Understanding |
| A. Structure summary | C3-Applying |
| B. Contents         | C4-Analyzing |
| B. Contents         | C5-Evaluating |
| C. Explanation information |                        |

Based on the analysis the data related to the summary with cognitive learning results in table 2 is known to summarize the structure of points (A) related to aspects of cognitive learning, namely remembering (C1) and understanding (C2), because in compiling the summary need to remember the material and understand the concepts so that they can classify concepts important that need be summarized. Assessment of summary points (B) the contents of the notes relate to aspects of cognitive learning, namely remembering (C1), understanding (C2) and analyzing (C4), because the contents of the notes are correct if students read, understand, select, and summarize the material in order to find the subject information. Assessment of summary points (C) explanation of information relating to aspects of cognitive learning outcomes analyze (C4) because explaining information is needed to analyze the material well to get the essence of the reading and then summarized with sentences that are easy to understand and understand students so that it is easy to remember. The following is the linkage of the expected competency components in mind mapping assignments with cognitive learning outcomes can be seen in table III.
Table 3. Linkage components competence mind mapping with cognitive learning result.

| Mind mapping assessment | Cognitive learning result |
|-------------------------|--------------------------|
| P. Structure note       | C1-Remembering           |
| T. Use of Languages and Term | C2-Understanding |
| U. Used of images and Symbols |                   |
| Q. Form Branches and Color  | C3-Applying          |
| R. Fill material         | C4-analyzing            |
| U. Used of images and symbols |                   |
| S. Complete concept     | C5-Evaluating           |

Data analysis of the relationship of mind mapping with cognitive learning outcomes in table 3, it is known that the structure of the P point notes relates to aspects of cognitive learning outcomes remembering (C1) and understanding (C2), because compiling mind mapping needs to find the main ideas and write them down and add branches to fill in the keywords of each submitter. Points Q branch shapes and colors are related to aspects of cognitive learning outcomes applying (C3), this is because the addition of branches with varying amounts depends on the main ideas found and giving color to each branch gives a more lively and attractive impression, and in finding ideas the main and branch need to apply the concept and pour ideas in making themes mind mapping and branches that are made to represent the material.

The point R content of the material relates to the aspects of cognitive learning outcomes analyze (C4) because the content of the material includes the depth of the content, the depth of the concept, the truth of the concept so that it produces the content of material weight. Point S completeness of the material is related to aspects of cognitive learning outcomes, namely analyzing, this is due to the breadth of the concept fulfilled by conducting a literature study so students can find keywords as outlined in mind mapping. T points of use of language and terms relate to aspects of cognitive learning outcomes understand (C2) because by understanding the contents of the material it can find the essence and formulate words that are short, clear and easy to understand. Points U of using images and symbols are related to aspects of cognitive learning, namely understanding (C2) and applying (C3), this is because finding appropriate images and appropriate symbols require understanding concepts and applying concepts of mind mapping to facilitate the right brain in remembering material well.

Based on data analysis summarizes the linkage task, mind mapping with the cognitive learning in tables 2 and 3, it was found that there is one cognitive learning outcome point that is not contained in the task summarizing that is evaluating (C5) that causes the value of POGIL model learning with assignments mind mapping is higher than students who are taught POGIL models with summary assignments. The results of the study were in line with previous research which showed that the assignment of mind mapping can improve student learning outcomes in legal chemistry subjects basic chemical law [21] and POGIL learning assisted by mind mapping was superior to POGIL and conventional learning [22]. Based on these data, the results of the study were in line with previous studies. The following is a figure in the summary of students' work.
Figure 1. Sample summary of students with the highest scores.

Other factors that led to the learning of the POGIL model with mind mapping were superior, including the existence of planning factors, because by assigning mind mapping students to have planned in searching for keywords and concepts important by reducing words that represent concepts, this is in line with Buzan which states that single words and striking headlines are easier to remember than long sentences [23]. The second factor is the organization of concepts, namely the students' efforts in grouping concepts by connecting concepts so that it makes easier for students to study the material. The third factor is creativity, students become more creative in decoding material with designs mind mapping following the theme and provide interesting colors in each submission to distinguish groups of concepts. The use of color in mind mapping adds meaning and perspective to stimulate creativity and improve memory. These things cause students in the experimental class 1 with assignments to mind mapping to be higher than students in the experimental class 2 with summary assignments. The following is a figure of the mind mapping of students' work.

Figure 2. Sample mind mapping work of students with the highest scores.

4. Conclusion
The results of research on salt hydrolysis material, it can be concluded that the cognitive learning outcomes of students taught with the POGIL learning model accompanied by assignments mind mapping (mean 79.97) are higher than the students taught with the POGIL learning model accompanied by summary assignments (mean 75.59).

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