The Analysis of Higher Order Thinking Skills: Transfer Aspect of Student Concept in Reaction Rate Material

Herunata Herunata¹, Zahro Nurul Aini¹

¹ Universitas Negeri Malang, Jalan Semarang 5, Malang 65145

Abstract. 2013 curriculum requires that in its learning, it requires students’ higher-order thinking skills. Furthermore, in developing students’ higher-order thinking skills with the 2013 curriculum-based learning process, especially in chemistry, an analysis is needed regarding students’ HOTs abilities in chemistry, one of which is in the reaction rate topic. This study aims to describe the higher-order thinking skills (HOTs) transfer aspect in class XI students on the topic reaction rate according to the 2013 curriculum based on the percentage of students’ correct answers. This research is a descriptive study using the survey method. Moreover, the assessment instrument in this study was developed on reaction rate material based on indicators of higher-order thinking skills transfer, according to Brookhart (2010). This study involved 105 students in Malang, East Java, Indonesia. The study’s result shows that students with the HOT ability to transfer aspect skills are included in the high category with a percentage of 70%. The rate of each indicator comprises: (1) analyzing (C4) 78% in the high category, (2) evaluating (C5) 63% in the high category, and (3) creating (C6) 68% in the high category.

1 Introduction

Higher-order thinking skills (HOTs) are familiar in education, especially in the 2013 curriculum. The implementation of the 2013 curriculum explains that its learning objectives are to enhance students’ skills to compete in the global and international. According to an outcome, the 2013 curriculum requires students’ higher-order thinking abilities during the learning process. According to Permendikbud No. 22 of 2016, the learning objectives in the 2013 curriculum include the development of the domains of attitude, knowledge, and skills defined for each educational unit. Knowledge aspects can be achieved through remembering (C1), understanding (C2), applying (C3), analyzing (C4), evaluating (C5) and creating (C6) activities. Based on the revised Bloom’s Taxonomy, the cognitive domain of analysis (C4), estimate (C5), and design (C6) includes high-level thinking skills. This indicates that students in the 2013 curriculum are required to develop high-level skills. It is also expected that paradigms will evolve toward adopting learning assessment throughout the implementation of the 2013 curriculum.

The HOTs assessment is considered to be the implementation of the 2013 curriculum-based assessment improvement by international educational standards. The characteristics of the HOTs assessment are questions that measure higher thinking skills, contextual checks, and various forms of questions. High-level thinking skills can be measured by asking questions.
in the HOTs category. In the 2013 syllabus, learning requirements that consider the HOTs questions were implemented. Questions in the HOTs category can enhance thinking exercises focused on problem-solving and reasoning. It can be implemented through assessment instruments or by applying HOTs questions to students.

The reality in the field indicates that the implementation of HOTs questions is positive, as evidenced by the research results of Herunata et al. (2020), who discovered that the chemistry national exam questions from 2009/2010 to 2017/2018 school years represented contextual HOTs, PISA, and transfer evaluations. However, all variables in each aspect have yet to be fully implemented. One of them is in the transfer aspect, where HOTS inquiries are only implemented in the variable of Analyze. Meanwhile, the variables of evaluating and creating have yet to show in the questions frequently. As a result, using HOTs questions in the transfer aspect must be improved to enhance students’ higher-order thinking skills.

Before enhancing students’ higher-order thinking skills with the 2013 curriculum-based learning method, information on how much students’ higher-order thinking skills are now required. Higher-order thinking skills of students must be evaluated. This is also supported by a survey implemented by researchers through literature and field investigations, which reveal that higher-order thinking skills have been assessed and analyzed, especially for chemistry.

Research on analyzing high-level thinking skills in chemistry using HOTs questions has been conducted by Cindiana et al. (2020), where the results show that the percentage of students’ skills to solve HOTs questions on primary chemical law material as a whole is 20% with a deficient category (Cindiana et al., 2020). Previous research has also been conducted by Novitasari (2020) by measuring the skills to solve HOTs questions on acid-base material by the 2013 curriculum at a senior high school at Lumajang; the results of students’ HOTS skills were 62% with a high category. With the percentage of each indicator, the development of (1) logic and reasoning at 82% in a very high category, (2) decision making at 60% in a sufficient category, (3) problem-solving at 66% in a high category, (4) creativity and creative thinking at 46% in a sufficient category, and (5) transfer at 63% in a high category. To enhance students’ higher-order thinking skills, especially in chemistry, it is essential to analyze students’ HOTS abilities in various chemistry materials, including the reaction rate material.

Previous research has been conducted related to the analysis of higher-order thinking skills on reaction rate material by Azmi (2020) by measuring students’ HOTs abilities using a two-tier multiple choice test instrument where the results of students’ HOTs abilities based on the achievement of Bloom’s Taxonomy cognitive levels, which is in the cognitive domain of analyze (C4) by 23.33%, the mental part of evaluate (C5) by 13.75%, and the cognitive domain of create (C6) by 3.33%. Students’ HOTs skills in the transfer aspect of the reaction rate material are still in the low category; therefore, before improving students’ high-level thinking skills, especially for the reaction rate, it is necessary to analyze students’ current HOTS abilities, especially in the transfer aspect.

The reaction rate topic was chosen and used to assess and analyze students’ higher-order thinking skills because the reaction rate material has a lot of conceptual, contextual, and algorithmic knowledge and is related to everyday life. The characteristics of the material on the reaction rate subject matter are concept understanding and applications that must be resolved with higher order thinking skills so that it is very suitable if HOTS questions are applied, which require analyze (C4), evaluate (C5), and create (C6) skills. One of the question instruments that is considered capable of supporting students’ higher-order thinking skills on reaction rate material has been developed by Chazana (2020) using HOTs instruments oriented to higher-order thinking skills according to Brookhart (2010) transfer aspects. Brookhart’s high-level thinking skills in the transfer aspect include analyzing (C4), evaluating (C5), and creating (C6) skills.
Higher-order thinking skills cannot be separated from the dimensions of thinking skills in the cognitive domain by the revised Bloom's Taxonomy, where aspects of analyze (C4), evaluate (C5), and create (C6) include higher-order thinking skills (HOTs). Therefore, using indicators of transfer aspects in the research instrument can measure students' higher-order thinking skills that cover all cognitive elements of higher-order thinking. Based on this description, this research aimed to describe the skills of higher order thinking aspects of transfer in students of class XI students at a senior high school in Malang on reaction rate material by the 2013 curriculum based on the percentage of students correct answers.

2 Method

The research used in this study is descriptive research with a survey method based on Robert M. Groves (2004). The data used in this research is quantitative data used to describe students’ higher-order thinking skills. The specific stages of this research can be seen in Figure 1.

![Fig. 1. Research Stages (Robert M. Groves, 2004)](https://doi.org/10.1051/e3sconf/202448104006)

This research was conducted at A senior high school in Malang. The research subjects used were based on discussions between researchers and chemistry teachers of class XI of A senior high school Malang, namely classes XI SCIENCE: I, II, and III in the 2022/2023 academic year, totaling 105 students. The research subjects selected have the criteria that students in the class have learned the reaction rate material in the odd semester of the 2022/2023 school year taught directly by the teacher in the classroom. Data collection was done through direct tests on the sample class, which were carried out on November 8, 2022, from 07.00-13.00. This study used a higher-order thinking skills assessment instrument Chazana (2020) developed. The question instrument consists of 20 multiple-choice questions with five answer options. The device used has been tested for limited skills by previous researchers. The average percentage of overall content and construct validation results was 84%. These results indicate that the instrument developed is categorized as very feasible to measure students’ higher-order thinking skills on reaction rate material. After the data was collected, the data analysis technique in this study was carried out in two stages. The two stages of data analysis carried out by researchers are as follows.

1. The first stage is correcting students’ answers in choosing options in multiple choice and scoring according to the criteria in the higher-order thinking skills assessment instrument used. Score 1 is given to students who choose the correct answer, and score 0 is given to students who choose the wrong answer. After the scoring process, the calculation of the percentage value of each student answering correctly on the whole question is carried out with the formula:

\[
\% \text{ Student Correct Answer} = \frac{\text{Sum of Scores}}{\text{Total Score}} \times 100\%
\]
In addition, the percentage of the number of students answering correctly on each item was also calculated. The calculation in question is based on the equation with the following formula.

\[
\% \text{ Students Answering Each Question Number Correctly} = \frac{\text{Number of Students Answering Correctly for Each Question Number}}{\text{Number of Students Sampled}} \times 100\%
\]

After obtaining the percentage of each question number from the students’ correct answers, the ratio of each question number is summed up according to the indicators of higher-order thinking skills according to Brookhart (2010). The average percentage is calculated based on the following formula.

\[
\% \text{ average of each indicator} = \frac{\text{Total % Each Indicator}}{\text{Number of Students Sampled}} \times 100\%
\]

2. The percentage value of the results that have been obtained is then categorized using the criteria according to Arikunto (2013) presented in Table 1.

<table>
<thead>
<tr>
<th>Percentage (%)</th>
<th>Category</th>
</tr>
</thead>
<tbody>
<tr>
<td>81 - 100</td>
<td>Very High</td>
</tr>
<tr>
<td>61 - 80</td>
<td>High</td>
</tr>
<tr>
<td>41 - 60</td>
<td>Simply</td>
</tr>
<tr>
<td>21 - 40</td>
<td>Low</td>
</tr>
<tr>
<td>&lt; 21</td>
<td>Very Low</td>
</tr>
</tbody>
</table>

Source: Arikunto (2013)

### 3 Results and Discussion

This research was conducted on the XI SCIENCE class of SMAN 1 Malang, involving 105 students on November 8, 2022. Students were directed to answer HOT questions on the transfer aspect, according to Brookhart (2010), in reaction rate material with 20 multiple-choice questions for 90 minutes. The data obtained were analyzed to describe students’ higher-order thinking skills in class XI SCIENCE on reaction rate material at A senior high school in Malang according to the 2013 curriculum. Students’ higher-order thinking skills were analyzed based on the variables and sub-variables of HOTS according to Brookhart 2010 on the transfer aspect. The variables of higher-order thinking skills, according to Brookhart 2010 on the transfer aspect are analyze (C4), evaluate (C5), and create (C6).

#### 3.1 Analyze (C4)

Analyze skills can be interpreted as students’ skills to describe the parts that make up a specific statement or problem so that students can show the relationship between them. The HOTS skills to analyze (C4) include the cognitive process of differentiating (C4.1), organizing (C4.2), and attributing (C4.3). The percentage of students’ higher-order thinking skills on the analyze variable (C4) is in Table 2.

<table>
<thead>
<tr>
<th>Variables</th>
<th>Sub Variables</th>
<th>Question No.</th>
<th>%Students who Correct Answer</th>
<th>Criteria</th>
</tr>
</thead>
<tbody>
<tr>
<td>Analyze</td>
<td>Differentiating</td>
<td>1</td>
<td>59%</td>
<td>Simply</td>
</tr>
</tbody>
</table>

Table 2. Percentage of students’ higher level thinking skills in the transfer aspect of analyze variables (C4)
<table>
<thead>
<tr>
<th></th>
<th>Differentiating</th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td>2</td>
<td>78%</td>
</tr>
<tr>
<td>1</td>
<td></td>
<td>3</td>
<td>92%</td>
</tr>
<tr>
<td>2</td>
<td></td>
<td>4</td>
<td>76%</td>
</tr>
<tr>
<td>Average</td>
<td></td>
<td></td>
<td>76%</td>
</tr>
<tr>
<td>3</td>
<td></td>
<td>5</td>
<td>74%</td>
</tr>
<tr>
<td>4</td>
<td></td>
<td>6</td>
<td>69%</td>
</tr>
<tr>
<td>5</td>
<td></td>
<td>7</td>
<td>90%</td>
</tr>
<tr>
<td>Average</td>
<td></td>
<td></td>
<td>78%</td>
</tr>
<tr>
<td>6</td>
<td></td>
<td>8</td>
<td>90%</td>
</tr>
<tr>
<td>Attributing</td>
<td></td>
<td></td>
<td>90%</td>
</tr>
<tr>
<td>Average</td>
<td></td>
<td></td>
<td>90%</td>
</tr>
</tbody>
</table>

The sub-variable of differentiating (C4.1), according to Table 3, is presented in questions 1 to 4, with a percentage of students answering correctly of 76%. The sub-variable of organizing (C4.2) is shown in questions 5 to 7, with a % of students answering correctly at 78%. The sub-variable of finding implied meaning (C4.3) is presented in question number 8, with a ratio of students answering correctly of 90%.

Differentiating skills (C4.1) can be measured by presenting questions that can direct students to analyze each part of the statement given in the stimulus and conclude the results of the analysis of the information in the trigger based on the desired characteristics. One of the questions to measure students’ skills in differentiating (C4.1) is in Figure 2.

**Fig. 2. Questions No.3 Sub Variable differentiating.**

It can be seen that students are directed to be able to analyze each part in the data table of experimental results presented in the stimulus to find out the effect of surface area, concentration, and temperature on the reaction rate. This problem reveals students’ skills to apply the concept of factors that affect the reaction rate and then use the information obtained to solve the problem. Students must first understand the concept of collision theory, where students carry out the process of transferring data that has been received that the reaction occurs due to collisions between reactant particles. Only effective collisions that produce sufficient energy and the right direction of impact produce reactions. After students understand the theory of clash, they students apply the concept to be able to determine the correct conclusion by Analyzing the experimental data that shows the difference in reaction time in a chemical reaction with different surface area, temperature, and concentration treatments in the answer choices provided for the level of differentiating (C4.1). One of the student’s answers shows how the process of determining (C4.1) answers is shown in Figure 3.
Fig. 3. Students’ Answers on Problem No. 3 Sub Variable Differentiating

The % of students who answer correctly on the differentiating (C4.1) sub-variable is 76%. It means the students’ higher-order thinking skills based on the variable analyze the differentiating sub-variable (C4.1) in the high criteria. Students can explore the stimulus, describe each part of the statement, and conclude the results of analyzing the features of the information on the trigger based on the desired characteristics.

The organizing sub-variable analyzes high-level thinking skills in the following Analyze variable (C4.2). The skills to manage (C4.2) can be measured by presenting questions that can direct students to associate relationships between statements analyzed based on their differences, similarities, or relevance and make conclusions from the reports analyzed.

Fig. 4. Questions No. 7 Sub-variable Organizing.

Problem No. 7 sub-variable organizing (C4.2) By Figure 4, it can be seen that to measure the skills to organize (C4.2), students are directed to associate the relationship between the statements analyzed with the stimulus given. In this problem, students are given several statements related to the second-order reaction equation for NO gas and zero-order for CO gas. Students are asked to associate the correct statement based on the stimulus given. In answering the question, students analyze each part of the statement. Students must first know the reaction rate equation for the reaction in the problem, which has a known reaction order, namely second order to NO gas and zero-order to CO gas so that the reaction rate equation can be written in the form of the equation \( r = k[NO]^2 \). Statement 1 in the problem is different from a true statement. In statement 2 of the problem, students apply an understanding of the concept of reaction order. In NO gas, which has the second order, if the reagent concentration is increased twice the original, then the reaction rate will increase four times from the original. Meanwhile, in CO gas, which has zero order, no matter how much the concentration of the reactant increases, it will not affect the reaction rate, so statement 2 in the problem is the correct statement. The statements given are bound by one another; in statement 3, based on the reaction equation, it can be determined that the reaction’s rate constant \( k \) is \( \text{mol}^{-1}\text{L}\text{.sec}^{-1} \). The fourth statement is not true because the CO graph should be horizontal. After all, the change in [CO] does not affect \( r \). One of the student answers shows how the process of organizing (C4.2) the answer is shown in Figure 5.
The percentage of students answering correctly on the sub-variable of organizing (C4.2) meaning is 78%. Students’ higher-order thinking skills based on the variable analyze the organizing sub-variable in the high criteria. Students can relate the relationship between the analyzed statements to provide conclusions from the analyzed reports.

Fig. 5. Students’ Answers to Questions No. 7 Sub Variable Organizing

Analysis of high-level thinking skills in the following variable analyze (C4) is the sub-variable of attributing (C4.3). The skills to attribute (C4.3) can be measured by presenting questions that can direct students to examine parts of each statement in the stimulus to find implied information based on their point of view and purpose. The questions to measure students’ skills to attribute (C4.3) are contained in questions 8 to those presented in Figure 6.

Fig. 6. Questions No. 8 Sub-variable Attributing.

Problem No. 8 sub variable attributing (C4.3) by Figure 6, it can be seen that to be able to measure the skills to attributing (C4.3), students are directed to examine the statements in the stimulus given regarding an alabaster stone experiment with water, where the goal is to find implied information based on factors that can affect the reaction rate by investigating the parts of each statement given in identifying a substance added to the solution in the experiment. Students are expected to conclude that the substance X referred to in the experimental reaction is a catalyst. The HOTs assessment in this question requires students to remember the concept of catalyst and apply it to solve a problem in a real-world context. The percentage of students answering correctly on the attribute sub-variable is 90%. Based on the variable, students’ higher-order thinking skills analyze the sub-variable of attributing in the very high criteria. Students can think critically and examine each statement’s parts in the stimulus to find implied information based on their point of view and purpose.
3.2 Evaluate (C5)

The skills to evaluate (C5) based on Bloom’s cognitive level can be interpreted as making judgments based on criteria or standards. In the question instrument used to measure students’ HOTS skills, the variable evaluating (C5) is presented in question numbers 9 to 13. HOTS skills to evaluate (C5) include the cognitive processes of checking (C5.1) and critiquing (C5.2). The percentage of students’ higher-order thinking skills on the evaluated variable (C5) is in Table 3.

Table 3. Percentage of Students’ Higher Level Thinking Skills in the Transfer Aspect of Evaluate Variables (C5)

<table>
<thead>
<tr>
<th>Variables</th>
<th>Sub Variables</th>
<th>Question No.</th>
<th>% Students who Correct Answer</th>
<th>Criteria</th>
</tr>
</thead>
<tbody>
<tr>
<td>Evaluate C5</td>
<td>Checking Average</td>
<td>9</td>
<td>53%</td>
<td>Simply</td>
</tr>
<tr>
<td></td>
<td>Critiquing</td>
<td>10</td>
<td>79%</td>
<td>High</td>
</tr>
<tr>
<td></td>
<td>Critiquing</td>
<td>11</td>
<td>81%</td>
<td>Very High</td>
</tr>
<tr>
<td></td>
<td>Critiquing</td>
<td>12</td>
<td>23%</td>
<td>Low</td>
</tr>
<tr>
<td></td>
<td>Critiquing</td>
<td>13</td>
<td>78%</td>
<td>High</td>
</tr>
<tr>
<td></td>
<td>Average</td>
<td></td>
<td>65%</td>
<td>High</td>
</tr>
</tbody>
</table>

The sub-variable of checking (C5.1) is in Table 4. They are presented in question number 9, with a % of students answering correctly by 53%. The critiquing sub-variable (C5.2) is shown in questions 10 to 13, with a portion of students answering correctly of 65%. The skills to check (C5.1) can be measured by presenting questions that can direct students to judge the skills of a material based on relevant evidence, where one of the questions is found in Figure 7.

**Fig. 7.** Questions No.9 Sub-variable Checking.

It can be seen that to measure the skills to check (C5.1), students are directed to be able to examine statements by assessing the relationship of the information to the cause based on relevant evidence regarding the activation energy of chemical reactions. This question reveals students’ skills in applying the collision theory concept and then using the information obtained to solve the problems given by analyzing in-depth material regarding activation
energy. The percentage of students answering correctly on the sub-variable checking (C5.1) is 53%. It means that the students’ higher-order thinking skills are based on the variable Analyze the sub variable checking in the sufficient criteria. Students have been able to think critically about a problem by assessing the skills of a material based on relevant evidence. The analysis of higher-order thinking skills in the following variable evaluation (C5) is the sub-variable critiquing (C5.2). The skills in critiquing (C5.2) can be measured by presenting questions that can direct students to criticize the suit skills of material with applicable rules, compare a material with other similar materials, and make decisions on a statement based on relevant evidence, where one of the questions is in Figure 8.

![Fig. 8. Questions No. 13 Sub-variable Critiquing.](image)

The problem from No. 13 sub-variable critiquing (C5.2) by Figure 8 is written there. It can be seen that to be able to measure the skills to critiquing (C5.2) in the problem, students are directed to be able to make decisions to accept or reject statements based on evidence of the results of the alabaster experiment with HCl to determine the relationship of events based on the influence of reaction rate factors. In the problem, it is known that alabaster in powder form reacted with 2 M HCl at high temperatures reacted faster. In this problem, students apply the concepts of factors that can affect the reaction rate to solve the problem by examining the relationship between the material and the situation given. HOTs assessment in this problem requires students to understand the concept of factors affecting the reaction rate and apply it to solve a problem in a real-world context. Furthermore, students are asked to accept or reject statements related to the alabaster experiment with HCl based on the experimental evidence in the problem.

The percentage of students answering correctly on the critiquing sub-variable (C5.2) is 65%. It means that students’ higher-order thinking skills are based on the variable evaluating the critiquing sub-variable in the high criteria. Students can think critically in criticizing the suit skills of material with applicable rules, comparing a material with similar materials, and making decisions on a statement based on relevant evidence.
3.3 Create (C6)

Based on Bloom’s cognitive level, the skills to create (C6) can be interpreted as the skills to combine elements to form a coherent or functional whole and rearrange elements into new patterns or structures. The question instrument used to measure students’ HOTs skills, the variable create (C6), is presented in questions 14 to 20. HOT skills to develop (C6) include the cognitive process of generating (C6.1), planning (C6.2), and producing (C6.3). The percentage of students’ higher-order thinking skills on the created variable (C6) is in Table 4.

Table 4. Percentage of Students’ Higher Level Thinking Skills in the Transfer Aspect of Create Variables (C6).

<table>
<thead>
<tr>
<th>Variables</th>
<th>Sub Variables</th>
<th>Question No.</th>
<th>%Students who Correct Answer</th>
<th>Criteria</th>
</tr>
</thead>
<tbody>
<tr>
<td>Create</td>
<td>Generating</td>
<td>14</td>
<td>73%</td>
<td>High</td>
</tr>
<tr>
<td>C6</td>
<td>Generating</td>
<td>15</td>
<td>90%</td>
<td>Very High</td>
</tr>
<tr>
<td></td>
<td>Generating</td>
<td>16</td>
<td>21%</td>
<td>Very Low</td>
</tr>
<tr>
<td>Average</td>
<td>Generating</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Planning</td>
<td>17</td>
<td>75%</td>
<td>High</td>
<td></td>
</tr>
<tr>
<td>Planning</td>
<td>18</td>
<td>78%</td>
<td>High</td>
<td></td>
</tr>
<tr>
<td>Planning</td>
<td>19</td>
<td>57%</td>
<td>Simply</td>
<td></td>
</tr>
<tr>
<td>Average</td>
<td></td>
<td>70%</td>
<td>High</td>
<td></td>
</tr>
<tr>
<td>Producing</td>
<td>20</td>
<td>83%</td>
<td>Very High</td>
<td></td>
</tr>
<tr>
<td>Average</td>
<td></td>
<td>83%</td>
<td>Very High</td>
<td></td>
</tr>
</tbody>
</table>

The sub-variable of generating (C6.1) by Table 4. is presented in questions 14 to 16, with a % of students answering correctly by 61%. The planning sub-variable (C6.2) is shown in questions 17 to 19, with a % of students answering correctly by 70%. The producing sub-variable (C6.3) is presented in question 20, with a percentage of students answering correctly at 83%. Students’ skills in generating (C6.1) can be measured by presenting questions that can direct students to make hypotheses about a symptom and make experimental designs based on the material to be tested, where one of the questions is in Figure 9.

The Problem of No. 14 sub-variable generating (C6.1) by Figure 9 is written. To be able to measure the skills to generate (C6.1) in the problem, students are directed to be able to make hypotheses based on issues that occur in the surrounding environment associated with factors that affect the reaction rate. In the trial, students are given problems related to the risk of fire in the dry season compared to the rainy season. At this stage, students are trained to think critically in receiving information and then use their knowledge related to factors that affect the reaction rate to make hypotheses in solving problems based on a given symptom. HOT assessment on this question requires students to understand the concept of factors affecting the reaction rate and apply it to solve a problem in a real-world context. One of the students’ answers shows how the process of generating (C6.1) the answer is shown in Figure 10.

The percentage of students answering correctly on the generating sub-variable (C6.1) is 61%. It means that the students’ higher-order thinking skills are based on the variable of creating the generating sub-variable in the high criteria. Students can think critically in making hypotheses about a symptom and making experimental designs based on the material to be tested.
Analysis of high-level thinking skills in the following creates a variable (C6), which is the sub-variable of planning (C6.2). Students’ planning skills (C6.2) can be measured by presenting questions that can direct students in making experimental procedures and making detailed steps in making or doing something; one of the questions is found in Figure 11. The Problem No. 19 sub-variable planning (C6.2) in Figure 11 is written. To be able to measure planning skills (C6.2) in the problem, students are directed to think creatively to develop experimental steps based on the issues presented by applying knowledge about the effect of temperature and concentration on the reaction rate. HOT assessment in this problem directs students to issues that have never been encountered or done before. In preparing the experimental steps, students must be able to determine the control and independent variables first in the experiment. The percentage of students answering correctly on the planning sub-variable (C6.2) is 70%. The students’ higher-order thinking skills based on the variable create the planning sub-variable in the high criteria. Students can think critically and creatively when preparing experimental procedures and taking detailed steps in making or doing something.

The analysis of higher-order thinking skills in the variable create (C6) is then the sub-variable producing (C6.3). Students’ skills in making (C6.3) can be measured by presenting questions that can direct students to create new ideas or ideas; one of the questions is found in Figure 12.

It can be seen that to be able to measure the skills to producing (C6.3) in the problem, students are directed to be able to create ideas or ideas related to the proper experimental steps from an issue that has been presented in the statement to prove the effect of the surface area of the touch area on the speed of the reaction rate. HOT assessment in this problem requires students not only to understand the concept of reaction rate factors but also to apply their knowledge about the effect of the surface area of the touch area on the reaction rate. It requires students
to think creatively in making a design. In this question, students will determine the control, independent, and dependent variables in the experiment before designing the experimental steps. In proving the effect of surface area on the reaction rate, the independent variable made different in the investigation is the test material used in the experiment with different shapes.

Fig. 11. Questions No.19 Sub-Variable Planning.

Beberapa siswa ingin membuktikan pengaruh luas permukaan bidang sentuh terhadap kecepatan laju reaksi. Diantara beberapa langkah-langkah berikut ini manakah yang paling tepat untuk membuktikan pengaruh luas permukaan terhadap laju reaksi.
A. Siswa 1: menggunakan obat maag dalam 3 varian bentuk (serbuk, cair dan kepingan) yang direaksikan dengan larutan HCl kemudian dipanaskan pada suhu yang berbeda.
B. Siswa 2: menggunakan balon udara serta 3 varian bentuk (serbuk, cair dan kepingan) dari obat redoksan kemudian dilarutkan dalam botol yang telah terpasang balon karet pada tutupnya.
C. Siswa 3: menggunakan batu pualam (CaCO₃) dalam berbagai bentuk yang direaksikan dengan larutan HCl dalam konsentrasi yang berbeda yakni 1 M, 2 M, 3 M.
D. Siswa 4: menggunakan batu pualam (CaCO₃) dalam berbagai bentuk yang direaksikan dengan larutan HCl dalam suhu yang dibuat berbeda.
E. Siswa 5: menggunakan larutan H₂O₂ 5% yang direaksikan larutan NaCl dan FeCl₃ dengan larutan dengan menambahkan katalis

Fig. 12. Questions No.20 Sub Variable Producing.

In contrast, control variables such as temperature and the solution used are the same. Students can conclude that the right step is to use an air balloon and three variants of forms (powder, pieces, and liquid) of redox medicine, then dissolve it in a bottle with a rubber balloon attached to the lid. One of the students’ answers that shows how to produce (C6.3) is shown in Figure 13.
The percentage of students answering correctly on the producing sub-variable (C6.3) is 83%. It means that the students’ higher-order thinking skills based on the variable of creating the producing sub-variable are included in the very high criteria. Students have been able to generate new ideas or ideas to solve contextual problems.

The analysis results show that the skills to think at a high level in the transfer aspect, according to Bookhart 2010 in class XI SCIENCE A senior high school Malang, is good with the percentage of high thinking skills in each variable presented in Table 5.

<table>
<thead>
<tr>
<th>Variables</th>
<th>% of Students who Answered Correctly</th>
<th>Criteria</th>
</tr>
</thead>
<tbody>
<tr>
<td>Analyze (C4)</td>
<td>78%</td>
<td>High</td>
</tr>
<tr>
<td>Evaluate (C5)</td>
<td>63%</td>
<td>High</td>
</tr>
<tr>
<td>Create (C6)</td>
<td>68%</td>
<td>High</td>
</tr>
<tr>
<td>Average</td>
<td>70%</td>
<td>High</td>
</tr>
</tbody>
</table>

High-level thinking skills are based on Table 5. Students of class XI SCIENCE A senior high school Malang in the transfer aspect according to Bookhart 2010 on the variable analyze (C4) at 78% (high), variable evaluate (C5) at 63% (high), and variable create (C6) at 68% (high). According to the results, students solved more questions with the cognitive dimension of analyze (C4) compared to the cognitive dimensions of create (C6) and evaluate (C5). This is based on the research of Agustina et al. (2021), on the analysis of HOTs questions based on Brookhart’s categories in the 2013 high school chemistry curriculum, shows that questions that train students’ skills to analyze (C4) have a higher percentage than evaluate (C5) and create (C6). So that students are more trained in solving questions that measure analysis skills (C4).

According to this study, most of the teacher’s reaction rate material has indirectly led to students’ higher-order thinking skills. According to Bookhart 2010, the high-level thinking skills of students in class XI SCIENCE A senior high school Malang in the transfer aspect are in the high category with a percentage of 70%. The results of this study indicate that HOTs assessment by applying HOTs category questions has been implemented well. Students’ higher-order thinking skills are strongly influenced by learning. As the main actors in the learning process, teachers must have the skills to include HOTs questions during learning assessment. According to Widarti et al.’s research (2020), most teachers in East Java province have implemented HOTs assessment. So that students are trained in solving problems that measure HOT abilities. HOTs have mainly been applied in grade 11, where students can understand and answer HOTs questions well.

4 Conclusion

The results of the research that have been analyzed and discussed can be concluded by the researcher: the level of high-level thinking skills in the transfer aspect of students in class XI SCIENCE in the 2022/2023 school year on reaction rate material at A senior high school Malang by the 2013 curriculum is in the high category with the percentage of students’ correct answers of 70%, with the portion of each indicator of transfer high-level thinking.
skills: (1) analyze indicator (C4) of 78% with high category, (2) evaluate indicator (C5) of 63% with high category, and (3) create indicator (C6) of 68% with high category.

References