Indonesian Society for Science Educators

Journal of Science Learning

journal homepage: ejournal.upi.edu/index.php/jslearning

# The Effect of Implementation of Inquiry-based Learning with Socio-scientific Issues on Students' Higher-Order Thinking Skills

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**ABSTRACT** This study investigates the effect of inquiry-based learning with socio-scientific issues on students' higher-order thinking skills in the first year based on chemistry topics. This study used a quasi-experiment design as a method. A sample of 96 students in three classes was selected and was divided into two groups. An experimental group used two classes (68 students) that received the instruction by inquiry-based learning with socio-scientific issues, while the control group (28 students) received instruction using verification learning. The data were collected using pretest and post-test. The results were analyzed using SPSS 16.0 for windows software by employing ANOVA and effect size. This study showed that the experimental groups have a higher score in Higher Order Thinking Skills than the control group students, and there was a significant difference between the experimental groups and the control group with a large effect size. Thus, this study concluded that inquiry-based learning with socio-scientific issues helps conduct the classroom's learning strategies to improve students' higher-order thinking skills.

**Keywords** Inquiry, Socio-scientific issues, Higher order thinking skills

## 1. INTRODUCTION

The development of science and technology has both positive and negative impacts. The positive impact of this development is everything becomes fast and easy to improve life quality. Meanwhile, the negative impact is individuals' exposure to various problems related to ethics, morals, and global issues that can threaten human dignity and survival (Rahayu, 2016). It is necessary to build a society with scientific literacy abilities through the educational process. Scientific literacy skills are essential to be mastered by students because of their relation to concern for the surrounding environment and social issues. Scientific literacy skills will create a desire to solve problems or social issues around them (Graber, Neumann, Erdmann, & Schlieker, 2006).

Solving problems related to the environment or social issues will expose a person to several different scientific, social, or moral viewpoints (Zeidler & Nichols, 2009). Therefore, meaning-making needs to be done to connect what they learn with environmental problems around them (Sadler, 2009). The creation of meaning will occur when individuals can transfer what they know to other conditions. The transfer process is unlimited to remembering the knowledge that is owned. Still, it is also related to using knowledge or things that have been learned to other experiences or conditions (Brookhart, 2010). Thus, the learning process is not enough to transfer information to remember and store it in the brain, but it needs education that helps students have thinking skills (Rahayu, 2016; Subiantoro, 2017).

Thinking skills refer to mental activities that allow individuals to make meanings for various information obtained to form relevant knowledge to solve problems (Subiantoro, 2017). Thinking skills encourage individuals to think critically and creatively in decision-making and problem-solving. Such thinking skills well-known as higher-order thinking skills (HOTS). HOTS will cause individuals became an adapt to the development of science and technology. HOTS include critical, logical, reflective, metacognitive, and creative thinking skills (Nurohman, Wibowo, & Widhi H, 2013; Shidiq, Masykuri, & Susanti, 2015). HOTS based on Bloom's taxonomy includes analysis, evaluation, and synthesis skills. Higher-order thinking skills - analysis, evaluation, and synthesis or creation - are HOTS categories as transfer (Brookhart,

**Received:** 01 January 2021
**Revised:** 19 March 2021
**Published:** 01 July 2021

2010). Not all individuals can spontaneously think at high levels, but they need encouragement, guidance, or habituation in these skills.

Chemistry is closely related to social science problems; for example, global warming and ecosystem damage can direct individuals to relate conceptual material to issues around them (Mahanani, Rahayu, & Fajaroh, 2020). It makes Chemistry becomes a subject that can contribute to training student's HOTS. However, the presence of a lot of chemistry content can cause students unable to know how to form what relationships are obtained from the learning process with how to give meaning to what is learned (Tsaparlis, 2020). It also causes the assumption that chemistry is boring, difficult to understand, and irrelevant to everyday life (Cardellini, 2012), so students will only tend to memorize. Therefore, it is necessary to have learning chemistry, which allows students to experience learning by constructing meaning, which means students are actively involved in building concepts independently. One of the methods that accommodate is learning by inquiry.

The inquiry-based learning process allows students to find, decide, and use various sources of information and ideas, which are used to improve understanding of problems or phenomena (Kaltakci & Oktay, 2011). Inquiry-based learning will ensure that students get the knowledge and become actively involved in the process (Malik, Ertikanto, & Suyatna, 2015). Previous research has shown that inquiry-based learning can improve students' HOTS, including inquiry-based learning to enhance HOTS on reaction rate material (Hendryarto & Amaria, 2013). Another research compares conventional learning and inquiry-based learning in improving HOTS (Madhuri, Kantamreddi, & Goteti, 2012). Based on these results, it can be concluded that inquiry-based learning in other chemistry topics, one of which is acid-base, may improve HOTS. However, the research of Hendryarto & Amaria (2013) and Madhuri, Kantamreddi, & Goteti (2012) that has been carried out only focuses on the topics of learning. If students focus on the topics, it can cause students not to relate the temporal context to the events around them (Subiantoro, 2017; Sadler, 2009). There is a gap between abstract concepts and the reality of events around them (Mahanani, Rahayu, & Fajaroh, 2020). Therefore, learning was needed to relate to everyday life, namely by providing relevant context. The teacher should shape the context to lead students to engage in the learning process to understand, reflect, and create meaningful knowledge (Sadler & Zeidler, 2004; Subiantoro, 2017). One context that can be used is socio-scientific issues (SSI).

SSI are problems related to science and social content that are unstructured, have uncertain solutions, complex, and related to morals and ethics (Eastwood, et al., 2012; Sadler, 2004; Sadler & Zeidler, 2004; Zeidler, Sadler, Applebaum, & Callahan, 2009). SSI describes social dilemmas related to conceptual, procedural, or technological relationships in social science problems (Sadler & Zeidler, 2004). SSI is controversial and requires a level of moral reasoning and associated evaluation/ethics in the decision-making process for solving problems (Zeidler & Nichols, 2009). SSI will encourage individuals to reflect and relate relevantly between science and several scientific points of view, resulting in conflicts with held beliefs or others' beliefs (Zeidler, Sadler, Applebaum, & Callahan, 2009). The resulting conflict will lead individuals to analyze, evaluate, and synthesize sources, knowledge, or evidence to produce justification (Kitchener & King, 1981; Zeidler, Sadler, Applebaum, & Callahan, 2009). SSI has a role in providing global issues and making individuals prepare themselves to deal with this (Sadler & Murakami, 2014). The involvement of the SSI context will create learning where individuals face complex decision-making problems that are factually, conceptually, and ethically related to ethics and morals (Paraskeva-Hadjichambi, Hadjichambis, & Korfiatis, 2015). It means that SSI learning will train students to analyze problems, evaluate the sources to be used, and create solutions. In learning by using SSI, there is an interaction between three components; educators (lecturers), students, and the context of the problems that must be solved (Imaduddin & Khafidin, 2018; Kristiana, Afandi, & Wahyuni, 2019). That description is proven by similar research but on different variables and topics: inquiry-based learning on the context-based SSI can improve critical thinking skills (Mahanani, Rahayu, & Fajaroh, 2020). Based on the research described, research studies on inquiry-based learning in the context of SSI to advancing HOTS need to be done. It caused to provide alternative learning information that the lecturer can use to be advancing students' HOTS. Therefore, this study aims to examine the effectiveness of inquiry-based learning with SSI as context by making the reflective ability available to improve students' higher-order thinking skills.

## 2. METHOD

This research used a between-group design with quasi-experiments pre-and post-test methods (Creswell J. W., 2012). Quasi-experiments pre-and post-test method was used because it is impossible to randomize the existing group of subjects. The experiment design of this study is shown in Table 1.

**Table 1** The research design of *quasi pre-and posttest*

| Group | Pretest | Treatment | Posttest |
|---|---|---|---|
| EG | $O_1$ | X | $O_2$ |
| CG | $O_1$ | Y | $O_2$ |

**Explanation:**
EG: Experimental Group
CG: Control Group
$O_1$ : *pretest* HOTS used 20 multiple choice questions
X : treatment using process inquiry-based learning with socio-scientific issues as context
Y : treatment by utilizing verification learning
$O_2$ : *posttest* HOTS used 20 multiple choice questions

This research was conducted on first-year students who took introductory chemistry. This research was held in the even semester of 2019/2020. This research used two classes as the experimental groups (EG) (68 students) and one class as a control group (CG) (28 students). Two classes as EG were carried out to expand the research findings. Two classes as EG were given the same instruction, inquiry-based learning with SSI, while a CG was assigned verification learning. The researcher conducted the treatment in the EG, and the lecturer gave the treatment in CG. This research used chemistry topics by utilizing online media. The details of treatment are four asynchronous assignments and two synchronous assignments via *zoom* application. The treatment was carried out because it adjusted to the pandemic situation. In this situation, learning was carried out asynchronous and synchronous by online media.

The researcher developed the instruments used in this research-based competency in subject achievement and adjusted them to HOTS levels. Research instruments that were used included treatment (Worksheets & SSI article) and measurement instruments. More concisely, the treatment scheme in this research is described in Table 2.

The measurement instruments form a HOTS test that consists of 20 multiple-choice questions. The test consists of eight questions of analyzing type (C4), seven questions of evaluating the type (C5), and five questions of creating type (C6). A higher-order thinking skill test was developed based on the indicator "action verbs" of Bloom's Taxonomy revised (Anderson & Krathwohl, 2001). HOTS tests were developed based on acid-base topics, which multiple-choice items. The score is given a numeric value of one to correct answer and zero for incorrect. That instrument has been tested for reliability on 98 students. A validity test was conducted to determine the HOTS instrument's suitability with the ability to be measured. Two expert lecturers carried out the validity test. Based on the validity test, 10 questions out of 30 are suggested not to be used. This is because it does not match with the HOTS level. Furthermore, there are 2 questions from 20 need to revise. Validity and reliability test were conducted using SPSS 16.0 for windows. Reliability score obtained is equal to 0.812 > r table (0.199). The reliability score belongs to

**Table 2** Comparison of treatments in the experimental and control groups

| Meeting to- | Discussion Topics | Time Allocation | Experimental Groups (Inquiry-based learning with SSI) | Control Group (Verification Learning) |
|---|---|---|---|---|
| 1 | Introduction to Acids and Bases | 3 x 50 minutes | Students introduced to surrounding subjects related to acid-base, then perform analysis of other topics related to acid-base. This introduction will provide an overview of the relationship between the concept of acid-base and daily life events so that it will attract students' interest to participate actively in learning. | Students were given books on acid-base materials to study independently. This learning will make students learn according to the desired learning style but focused on the lecturer's resources. |
| | Acid-base theory | | Students are given the worksheet that presents examples and non-examples of each acid-base theory, then formulated concepts based on leading questions. Such learning will train students to illustrate examples that can build ideas. Based on this description, students were taught to analyze ideas to create conclusions about the acid-base theory studied. | Students were asked to read various acid-base theories, then given the assignment to understand the understanding of the acid-base theory proposed by experts |
| 2 | Damage to coral reefs | 3 x 50 minutes | Students were given coral reef damage, then analyzed the relationship between the acid-base concept and the problems presented and made possible solutions. Such learning will help students practice their ability to analyze information in reading and evaluate existing sources and data to determine the relationship between coral reef damage and acid-base material. | Students understood and learned acid-base calculations based on material provided by the lecturer. This learning will make students fixated on solving the problems given. |
| | Acid-base calculation | | Students in an inquiry using worksheet learned acid-base calculations to then applied to a problem. Such learning will train students to apply the knowledge/concepts obtained to similar issues or concerns that have been modified. | Students applied the formulas that had been learned through doing assignments given by the lecturer. Learning can cause students to train to use the formula obtained in the same case. |

**Table 2** Comparison of treatments in the experimental and control groups (*continued*)

| Meeting to- | Discussion Topics | Time Allocation | Experimental Groups (Inquiry-based learning with SSI) | Control Group (Verification Learning) |
|---|---|---|---|---|
| 3 | Acid rain | 3 x 50 minutes | Students associated the concept of acid-base reactions with acid rain events by practicing, analyzing, reading, and evaluating various sources to create solutions. The acid rain event will make students relate the material of acid-base reaction equations and acid-base theory. | Students were given videos related to the acid-base titration process and the application of calculations to be studied independently. Students can know the process of change that the sense of sight can directly observe. |
| | Acid-base titration | | Students in an inquiry analyzed the processes that occur in the titration implementation with the worksheet's help. Then they were given a similar problem to solve based on the inquiry steps that had been carried out. In this titration learning, students were introduced to titration and trained to understand the process during titration. It will make students analyze the reactions that occur to evaluate what substances are present during the response and formulate acid/base calculations, formulate buffer solutions, and salt hydrolysis. It will make students apply formulas, analyze differences, and evaluate problems related to events during the reaction process. | Students were given assignments in the form of questions related to acid-base titration as a strengthening of understanding. Students could practice knowledge by applying problem-solving steps, but thinking for other problems was not trained. |
| 4 | Verification | 3 x 50 minutes | Students conducted face-to-face discussions and lectures via *zoom* to discuss concepts that are not yet understood and addressed the relationship between the problem and the acid-base idea. | Students were given questions to work on as an exercise before the measurement process was carried out |

the high category based on Arikunto (2014). The difficulty index of 20 question: four questions with difficult (n=0.259 – 0.283) category, and 16 questions with moderate (n=0.322 – 0.566) category. Based on these results, the instrument of a HOTS test is declared decent to use. Examples of the HOTS test are presented in Table 3.

Data analysis that was carried out in this study includes a preconditioning test and a different test. A precondition test was used to determine the average HOTS before the treatment is carried out. The difference test was carried out to determine how much affect the treatment for advancing students' HOTS. The details of data analysis in this research are described as follows. Precondition test. It includes normality and homogeneity tests followed by one-way ANOVA. The normality test used the *Shapiro-Wilk* method, while the homogeneity test used *Levene statistic*. Each test was utilizing *SPSS 16.0 for windows* as assistance. The difference test used ANOVA followed by an effect size test. Both tests were utilizing *SPSS 16.0 for windows* as assistance by using the post-test score.

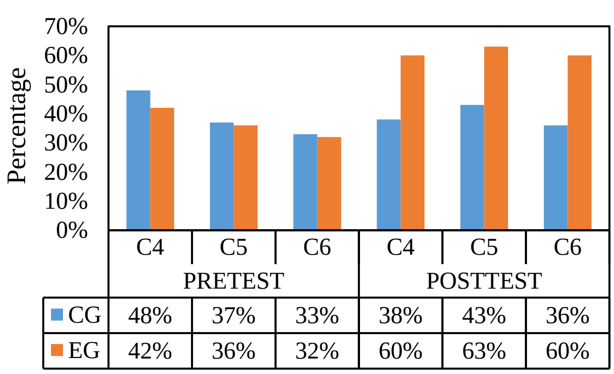



**Figure 1** The percentage achieving each level of HOTS

## 3. RESULT AND DISCUSSION

The pretest data showed that the experimental and control groups' HOTS level was normal (p=0.100 for EG; p=0.147 for CG) and homogeny (p=0.976). The one-way ANOVA test results showed no significant difference in students' pre-higher order thinking skills achievement scores for the CG and students in the EG (p=0.405). The resulting ANOVA is described in Table 4. After treatment, post-test data showed that there was advancing on the average score of the HOTS test. The resulting score of HOTS tests before and after treatment is described in Table 5 and Figure 1.

Furthermore, the normality and homogeneity tests were carried out based on post-test to determine data distribution. The normality and homogeneity test showed

**Table 5** Pre-and posttest data of Higher-Order Thinking Skills

| Class | Average Score | |
|---|---|---|
| | Pretest | Posttest |
| EG | 40 | 68 |
| CG | 38 | 40 |

that data of EG (p=0.200) and CG (p=0.535) was normal and homogeny (p=0.60 9). Caused by the results, ANOVA was conducted to compare the students' HOTS achievement in the CG and EG by utilizing SPSS 16.0 for windows as assistance. Table 6 showed that score of significance < 0.05. It means there was a significant difference in students' HOTS level for the CG and EG. Details of the differences in students' HOTS level EG and CG are shown in Figure 1.

Figure 1 showed that in each level of higher-order thinking skills in the students who treatment by inquiry-based learning with SSI as context were higher than the CG

**Table 4** The result of one-way ANOVA pre-higher order thinking skills

| Category | Sum of Squares | df | Mean Square | F | Sig. |
|---|---|---|---|---|---|
| Between Groups | 127.103 | 1 | 127.103 | .701 | .405 |
| Within Groups | 17047.637 | 94 | 181.358 | | |
| Total | 17174.740 | 95 | | | |

**Table 3** Examples questions of HOTS

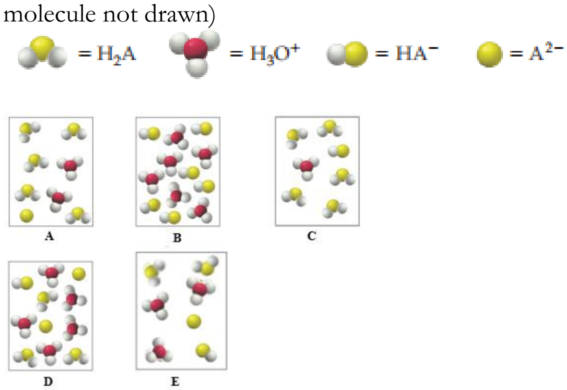
| Questions Level | Questions Indicator | Questions |
|---|---|---|
| C6<br>Creating | Presented with statements and examples of Lewis acid-base reaction, students can determine the right hypothesis about the fundamental development of Lewis acid-base theory. | The limitation of the Bronsted-Lowry acid-base concept is explaining reactions involving compounds without $H^+$, such as the reaction between copper (II) and ammonia ions that produce complex tetraamincopper (II) ions.<br>This limitation then became the basis for the development of Lewis's acid-base theory.<br>Based on this statement, determine the correct hypothesis based on Lewis acid-base theory development!<br>a. Lewis's acid-base theory is based on proton donors and acceptors, where ammonia acts as a proton donor, while the copper (II) ion acts as a proton acceptor.<br>b. Lewis's acid-base theory is based on electron-pair donors and acceptors to form covalent bonds between the bonding species, in which ammonia acts as a base and the copper ion acts as an acid.<br>c. Lewis's acid-base theory is based on the formation of coordinate covalent bonds. The species donating an electron pair acts as a base, and the electron-pair acceptor acts as an acid.<br>d. Lewis acid-base theory is based on the donor and acceptor of the central atom's lone pair. The ammonia species as an electron-pair donor acts as a base, and the copper ion as an acceptor is acidic.<br>e. Lewis acid-base theory is based on the formation of stable compounds, in which species that have unstable lone pairs will bind to species without more stable lone pairs. |
| C5<br>Evaluating | Given a sub-microscopic representation of the species present in a solution, students can predict pictures that are unlikely to occur in a weak acid solution. (make guesses based on particular criteria) | Submicroscopic figures can represent species present in acidic and alkaline solutions. In the Bronsted Lowry acid-base context, the most unlikely submicroscopic representation of a diprotic acid solution, $H_2A$, is in an aqueous solution? (Water molecule not drawn)<br><br> |

**Table 3** Examples questions of HOTS (*Continued*)

| Questions Level | Questions Indicator | Questions |
|---|---|---|
| C4 Analyzing | Students can analyze errors in the practical steps to make a particular pH solution, based on the facts and reasonable measures. (analyze the elements by separating the problem into its components) | Nahda wants to make a sodium hydroxide solution with a pH of 10.3 using solid NaOH. The steps used by Nahda are as follows!<br>1. Weighing solid NaOH using glass as much as 8.00 g.<br>2. Dissolve solid NaOH in a beaker with distilled water. The volume of distilled water is ± 10 ml.<br>3. After all solid NaOH dissolves, please put it in a 1000 ml measuring flask. Then add distilled water to mark the limit. Shaken until homogeneous<br>4. 10 mL of the solution were taken using a volume pipette. Then put in another 1000 mL measuring flask.<br>5. Diluted by adding distilled water to mark boundaries. Shaken until homogeneous.<br>6. The solution formed is then taken 10 mL to measure the pH using a pH meter.<br>Based on the experiments that Nahda has done, it turns out that the pH of the solution formed is ± 11.3. Determine which step of the Nahda experiment was incorrect!<br>a. Step 2. In this step, Nahda should immediately put the solid NaOH into the measuring flask so that no NaOH is left in the beaker geals.<br>b. Step 1. In this step, Nahda should not have weighed NaOH immediately but did the calculations first so that the amount of solid NaOH was considered right.<br>c. Steps 3 and 4. In these steps, Nahda should use a 100 mL measuring flask to dilute the solution formed.<br>d. Step 5. In this step, shaking should not be needed because it allows the NaOH solution to spill so that the water content is reduced and the solution becomes more concentrated than before.<br>e. Step 4. In this step, you should use a measuring cup to take the solution so that the accuracy level is higher than before. |

**Table 6** The result of one-way ANOVA post-higher order thinking skills

| Category | Sum of Squares | Df | Mean Square | F | Sig. |
|---|---|---|---|---|---|
| Between Groups | 15764.741 | 1 | 15764.741 | 60.636 | .000 |
| Within Groups | 24439.092 | 94 | 259.990 | | |
| Total | 40203.833 | 95 | | | |

**Table 7** The results of effect size

| Aspect | Effect Size | Mean Difference | Mean | | Std. Error Difference | Std. Deviation | | Partial Eta Squared | | |
|---|---|---|---|---|---|---|---|---|---|---|
| | | | CG | EG | | CG | EG | Corrected Model | Intercept | Group |
| HOTS | 1,90976 | 28.193 | 39.57 | 67.76 | 2.984 | 10.905 | 17.800 | 0,392 | 0,903 | 0,392 |

who treatment by verification learning. It means that inquiry-based learning with SSI as the context affected students' HOTS. That meaningfulness is also followed by the effect size score, which shows a score of 1.909. It led to a high contribution to the learning method based on Becker (2000) to advancing HOTS among classes that treat inquiry-based learning with SSI as context and verification learning. The result test effect size showed in Table 7.

Higher-order thinking skills are related to meaningful learning (Aksela, 2005), increasing reading comprehension (Indriyana & Kuswandono, 2019), and scientific literacy (Rahayu, 2016; Subiantoro, 2017). The results showed that treatment acid-base inquiry with SSI as the context has HOTS that better verifies learning with a high contribution. This result is possible because students in the EG are accustomed to being actively involved in understanding concepts by analyzing problems and evaluating various sources and evidence to synthesize them into understanding. Teaching strategy that involves students to active would play an essential role in long-term memory. It will enhance meaningful learning that leads students to apply it in other conditions (Bahrick & Hall, 1991; Slavin, 2019).

Although the data pretest showed that both groups have equal level HOTS, students already understand the concept. However, students in the CG have not solved problems that require higher thinking skills than just memorizing, understanding, and applying. SSI in the EG will train students to analyze the issues and evaluate evidence and sources to solve them. The implementation of SSI can encourage students to actively engage in dialogue, discussion, and debate to provide a challenge to evaluate knowledge and provide an opportunity to rebuild mastery of concepts related to the concepts they have (Cahyarini, Rahayu, & Yahmin, 2016).

The issues in treatment related to acid rain, damage to coral reefs, and the use of Steam Electric Power Generating (SEPG) are the contexts of SSI conflicting. For example, using SEPG as a power plant will produce substances that can cause acid rain or damage coral reefs (Middlecamp, et al., 2012). On the other side, SEPG in Indonesia is the primary electricity source (Yatim, 2007). Such problems are complex and related to morals and ethics that can lead to conflict. Because of conflict in the context of SSI, it can lead students to analyze, evaluate, and create solutions (Kitchener & King, 1981; Zeidler, Sadler, Applebaum, & Callahan, 2009). The existence of problems with the SSI context will provide many opportunities for students to exchange ideas with one another. Because SSI problems involve science and social problems, arguments need to be built from various perspectives (Sadler, 2004). Such a process will make students think carefully by paying attention to various sources before making a final decision (Pratiwi, Rahayu, & Fauziatul, 2016). In the process of consideration, students will train three essential aspects, namely (1) students need to analyze so that they can understand and describe SSI problems; (2) students formulate several possible solutions to problems; and (3) students need to evaluate decisions that have been made before the decisions are submitted (Ratcliffe & Grace, 2003). Based on that study, it can be concluded that the context of SSI in the treatment affects students' higher-order thinking skills (analyzing, evaluating, and creating).

Students in the treatment class have also been accustomed to getting a concept with the inquiry process presented in each topic. The inquiry process will actively involve students through activities, namely understanding problems, identifying problems, then making conclusions to make concepts or solutions (Aksela, 2005; Hendryarto & Amaria, 2013; Kaltakci & Oktay, 2011). These activities will encourage students to practice HOTS. The lecturer in inquiry learning plays an essential role as a motivator, facilitator, and director in learning. The lecturer as a motivator has a function to encourage students to provide opinions on the SSI. As a facilitator, the lecturer functions to provide context SSI that can make students think actively and have a function to show solutions if there are obstacles in the learning process. The lecturer as a director has a function to lead students in the thinking process to achieve the expected goals.

Previous research has shown that inquiry-based learning needs to be done to improve higher-order thinking skills (Malik, Ertikanto, & Suyatna, 2015). Inquiry showed success in improving higher-order thinking skills (Aksela, 2005; Kaltakci & Oktay, 2011; Madhuri, Kantamreddi, & Goteti, 2012). Inquiry-based learning with SSI can enhance critical thinking skills (Mahanani, Rahayu, & Fajaroh, 2020). Based on the study and the results of these studies, it can be concluded that inquiry-based learning applied to treatment also affects students' higher-order thinking skills. Inquiry learning provides benefits for students, including (a) students learn to be responsible for gaining knowledge and assignment that given; (b) students are free to use various media, sources, and technic of constructing knowledge; and (c) students learn to develop his ability and solve the problem on his way.

In addition to the context and methods used in the treatment class, the learning process that involves discussion for verifying students' understanding is also a factor in training students' higher-order thinking skills to understand acid-base. Confirming students' understanding used in the treatment class was not intended to teach or provide training. The comprehension verification process is used to determine whether students understand what they have learned (Slavin, 2019). The treatment class's discussion process was carried out by being briefed with questions to get the correct concept. Fisher & Frey (2007) state that educators can use questions as an examination of understanding. Questions asked to encourage students to think about ideas will help them understand concepts (Sadker & Sadker, 2013; Slavin, 2019).

Meanwhile, in the classroom with verification learning, students only build their understanding, but there is less guidance in obtaining the correct concept. An independent learning process in the verification class also allows students to practice HOTS. The separate learning process will cause students to adjust to learning styles, but it will also have different impacts (Slavin, 2019). However, experiments have also shown that learning with verification is no better than inquiry-based learning, either with a guided inquiry or open inquiry (Aksela, 2005; Hendryarto & Amaria, 2013; Mahanani, Rahayu, & Fajaroh, 2020; Malik, Ertikanto, & Suyatna, 2015); as well as other contextual learning, such as problem-based learning (Magsino, 2014; Sismawarni, Usman, Hamid, & Kusumaningtyas, 2020). Besides, in verification learning, students are not trained intensively to lead to wrong understanding or students only to memorize and apply what the educators give. Students in the verification class are also not prepared to relate various problems around them, causing them to focus on concepts without applying them to situations around them that tend to be the same.

## 4. CONCLUSION

This study concluded that process inquiry-based learning with SSI as context could be advancing students' higher-order thinking skills. It showed an enhancement of EG's average post-test score and the result ANOVA that followed the effect size. Higher-order thinking skills are successful because in inquiry-based learning with SSI environment, real-life problem scenarios are used. It also encourages students to engage themselves in the learning process. Inquiry-based learning with SSI as context gives a high contribution to advance students' higher-order thinking skills.

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