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Pembelajaran *Collaborative Guided Inquiry* untuk Peningkatan Hasil Belajar pada Konsep Kelarutan dan Hasil Kali Kelarutan

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Abstrak

Penelitian ini bertujuan untuk mengetahui penerapan model pembelajaran dan pengaruh kinerja model pembelajaran kolaboratif inkuiri terbimbing terhadap prestasi belajar siswa pada konsep kelarutan dan hasil kali kelarutan. Penelitian ini menggunakan desain eksperimen dan dilaksanakan di kelas XI SMA di Kota Malang dengan desain pretest and posttest. Data dikumpulkan dengan menggunakan tes pilihan ganda dan dianalisis menggunakan statistik deskriptif dan inferensial (uji-t). Lembar kerja siswa dan uji reabilitas konsep kelarutan dan hasil kali kelarutan tergolong valid dan sangat efektif. Selain itu, setiap fase pembelajaran dari jadwal dilaksanakan secara memadai. Hasil penelitian menunjukkan adanya pengaruh penerapan model pembelajaran kooperatif inkuiri terbimbing terhadap prestasi belajar siswa pada kelarutan dan hasil kali kelarutan. Prestasi kognitif siswa yang diajar inkuiri terbimbing kolaboratif memiliki prestasi lebih tinggi (nilai rata-rata 80,83) dibandingkan dengan siswa yang dibimbing inkuiri terbimbing (skor rata-rata 70,93).

Kata Kunci: inkuiri terbimbing kolaboratif, hasil belajar, kelarutan dan hasil kali kelarutan

Collaborative Guided Inquiry for Chemistry Learning Outcomes Improvement on Solubility Product Concept

Abstract

This research aims to know the implementation of the learning model and the effect of the performance of the guided inquiry collaborative learning model on the students' achievement on solubility and solubility product concepts. This study used the design of experiments and was conducted in 11th grade at Malang High School in the group's pretest and post-test design. Data were collected using a multiple-choice test and analyzed using descriptive and inferential statistics (t-test). Student worksheets and proficiency tests in solubility and solubility product concepts were classified as valid and very effective. In addition, each learning phase of the timetable was adequately implemented. The study showed an effect of implementing the guided inquiry cooperative learning model on the students' achievement on solubility and solubility product. The student's cognitive achievements taught by collaborative guided inquiry had higher achievement (the average score was 80.83) than those led by guided inquiry (the average score was 70.93).

***Keywords**: collaborative guided inquiry, learning outcomes, solubility product*

INTRODUCTION

The chemistry learning process emphasizes providing direct experience to develop competencies to scientifically explore and understand the natural surroundings (Chanifah & Lathifa, 2019). One of the chemistry concepts that must be studied in high school is the solubility and solubility product. The average daily test scores for solubility and solubility product concepts obtained by one of the selected high schools in Malang in the two consecutive academic years were 70.5 and 70.2 (data obtained from the chemistry teacher). These results are still below the minimum completeness standard set by the school in chemistry subjects, which is 80, and this is most likely because students lack understanding, so they have not been able to construct their concepts. In addition, the heterogeneous condition of students makes it difficult for teachers to improve the abilities of their students simultaneously (Sullivan et al., 2006). Therefore, we need an appropriate learning model so that the concepts that need to be understood by students can be appropriately constructed. One of the learning models that can be used is the collaborative learning model.

Collaborative learning emphasizes specific tasks and sharing tasks in group work, comparing conclusions and group work procedures, and giving students greater flexibility (Dixon-Krauss, 1996). There are several superior collaborative learning, among others regarding (1) higher learning achievement, (2) more profound understanding, (3) developing leadership skills, (4) increase positive attitude, (5) increase self-confidence, (6) learn inclusively, (7) feel belonging to each other, and (8) develop future skills (Hill & Hill, 1993). Collaborative learning is based on constructivism's philosophy, particularly Vygotsky's social constructivism, which states that social interaction plays an essential role in students' cognitive development. Social interaction with students will build new ideas and accelerate their intellectual development. In general, Vygotsky's theory focuses on social interaction on three factors: culture, language, and zone of proximal development (ZPD) (Santrock, 2007). Vygotsky's theory of ZPD means that learning occurs through the social interactions of teachers and peers. Through challenge and help from teachers or more capable peers, students move into their ZPD, where the learning process occurs.

William James and John Dewey's theory reveals that constructivism emphasizes that individuals actively construct and build knowledge and understanding (Santrock, 2007). In other words, the teacher is no longer the center of learning but acts as a facilitator for students to build ideas to develop their knowledge together. So, guided inquiry learning models allow students to find their concepts and principles with the teacher's help and guidance. Students can infer their newly acquired knowledge through observation and analysis by recognizing patterns from data or literature studies. Guided inquiry learning aims to develop the teaching and learning process in the classroom and process skills by guiding students in understanding the concepts (Aulia *et al.,* 2018; Sukma *et al.,* 2016; Ural, 2016).

Solubility and solubility products concepts are complex concepts because they involve understanding the concepts that have been studied previously in acid-base concepts. These concepts also requires students to have prerequisite skills, such as neutralization reactions, weak/strong acid/base concepts, number of moles of acid/base after dilution, molarity in solution, acid-base solution reactions, buffer solutions, salt hydrolysis, and stoichiometry of chemical reactions in solution. This complex thinking ability can make students feel difficult and ultimately indolent to learn this concepts (Nakiboğlu & Nakiboğlu, 2019). The concept chart of the prerequisites for studying solubility and

solubility product can be seen in the following hierarchy:

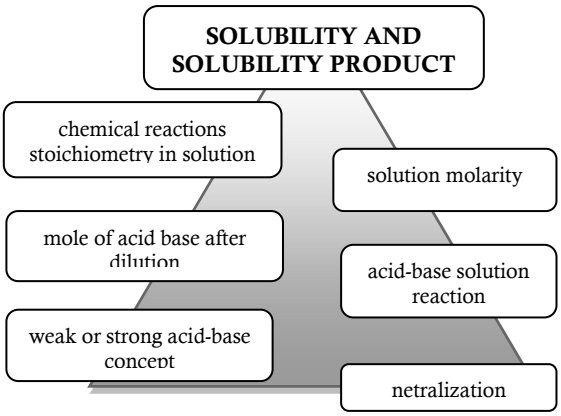

Figure 1. The prerequisite concept for studying the solubility and solubility product concept.
Source: Analysis result

Based on the collaborative and guided inquiry learning models described previously, a combined learning model of the two methods can be carried out. Collaborative guided inquiry can improve thinking skills based on problem analysis based on existing facts (Donohoo, 2013). In collaborative research, teachers work together to identify common issues, analyze relevant data, and test the teaching methods. This systematic and collaborative approach improves student learning and knowledge through reflection with peers, builds the concept through collaborative action, and forms the experiences of each student together (Stoll, 2020).

The role of peer tutors can be one of the solutions to help their friends who still do not fully understand the solubility and solubility product concepts. At the same time, the guided inquiry method can construct their thoughts to understand the concepts better. Combining the two methods above is expected to increase students' understanding of the concepts. It is hoped that students with good abilities can strengthen the concepts they already have, while other students with medium and low concept understanding can understand concepts better. These are the steps of collaborative guided inquiry learning that carried out in this study (modified from (Dillenbourg, 1999) :

a) Preparation to start learning activities.
   1) open learning activities with greetings,
   2) explain the learning objectives to students,
   3) do a pretest to determine the initial ability of students.
b) Incorporating strategies in collaborative guided inquiry.
   1) form a group of students consisting of 4-5 people with different gender and learning achievement levels; one group consists of one high achiever student, 2-3 medium achiever student, and one low achiever student,
   2) distribute handouts and worksheets to each group,
   3) all students in the group read the handout, discuss with the group, and try to solve the problems given,
   4) the teacher builds collaboration enforcement to students,
   5) the teacher strategizes collaboration for individual students in collaboration with other students,
   6) students strategize collaboration in their groups,
   7) After the group agrees on the results of the discussion, each student works on the worksheet given individually,
   8) The teacher appoints one group at random to present the results of their collaborative group discussion in front of the class; students in other groups observe, compare the presentation results, and respond.
   9) Each student in the collaborative group elaborates, inferences, and revises (if necessary) the worksheets that have been collected.
c) Carry out evaluation
   1) make observations on the productivity of student interactions in the learning process,
   2) provide input from the results of the analysis of student collaboration,

3) assess student worksheets and provide corrections,
4) carry out post-test,
5) supervise and regulate collaboration,
6) maintain the conditions of collaboration that have been going well at the next meeting.

From the explanation mentioned earlier, this study investigates the implementation and effectiveness of the collaborative guided inquiry learning model on high school students' solubility and solubility product concept.

METODE

This research was conducted for three months. The research design used was quasi-experimental. The population of this study was students of 11th graders of science at a senior high school in Malang in the second semester. The sample was selected using a cluster random sampling technique. We used class 11th A as the experimental class using the collaborative guided inquiry model and class 11th B as the control class using the guided inquiry model. The instruments used in this study include treatment instruments (syllabus, lesson plans, handouts, and worksheets) and measurement instruments (sheets and rubrics for learning implementation, post-test questions, and daily tests).

The measurement instrument for the solubility product and the solubility product is 23 objective test questions, and each question has five alternative answers. Before the test questions were used, content validation was carried out by two chemistry teachers and one chemistry lecturer. The results of trials in other classes obtained that the value of the validity of the items used to retrieve data was between 0.000 - 0.621; the difference was between -0.010 – 0.570; the difficulty level was between 0.070 – 0.980, and the reliability of the test items was 0.775. Data analysis of student learning outcomes was carried out using an independent t-test, which was first carried out by testing requirements analysis in the form of normality test and homogeneity test of variance.

The data on the affective abilities of students in the experimental class and control class in this study were obtained from the student's observation scores in participating in the chemistry learning of the solubility product and the solubility product. The affective domain of character behavior assessment includes responsibility, conscientiousness, and honesty recorded from student activities working on evaluation questions.

This hypothesis was tested using the t-test method with a two-part test. The two-part test is for pairs of H_0 (there is no difference in students' affective abilities in the experimental class and control class) and H_1 (there is a difference in students' affective skills in the experimental class and control class). The similarity test of the two averages uses the independent sample t-test at a significance level of 0.050.

RESULT and DISCUSSION

The results obtained from research that aims to determine the effect of the collaborative guided inquiry learning method on student learning outcomes will be described as follows:

Implementation of Learning with Collaborative Guided Inquiry on Solubility and Solubility Products

Two observers were observed during the learning process to check the implementation of learning in the lesson plans. Based on observations from two observers, the average achievement level of lesson plans in the experimental class was 96.10%, while the control class was 96.61%. Complete implementation of learning in all experimental and control class meetings is shown in **Table 1** and **Table 2.**

Table 1. Implementation of the Collaborative Guided Inquiry Learning Model (experimental class)

Lesson plan	Maximal score	Evaluation		Average	Implementation percentage
		1st observer	2nd observer		
I	144	138	140	139	96,52 %
II	144	140	135	137,5	95,47 %
III	144	136	137	136,5	94,79 %
IV	144	142	140	141	97,91 %
V	144	136	140	138	95,83 %
IMPLEMENTATION PERCENTAGE					96.10 %

Source: Analysis result

Table 2. Implementation of the Collaborative Guided Inquiry Learning Model (control class)

Lesson plan	Maximal score	Evaluation		Average	Implementation percentage
		1st observer	2nd observer		
I	136	130	131	130,5	95,95 %
II	136	129	130	129,5	95,22 %
III	136	136	132	134	98,53 %
IV	136	133	128	130,5	95,95 %
V	136	130	135	132,5	97,43 %
IMPLEMENTATION PERCENTAGE					96.61 %

Source: Analysis result

Description of Initial Ability and Student Learning Outcomes

Students' initial abilities were obtained from the mid-semester exams, while student learning outcomes were obtained from post-test results. The description of the initial ability data and student learning outcomes can be seen in **Table 3**.

Table 3. Data of Initial Ability and Student Learning Outcomes

	Students' Initial Ability		Students' Learning Outcomes	
	Exprm (11th A)	Control (11th B)	Exprm (11th A)	Control (11th B)
Number of students	36	36	36	36
Average	55.86	56,75	80,83	70,93
Median	55	55	83,33	70
Modus	55	55	83,33	73,33
Standard deviation	7,149	8,858	5,649	8,179
Highest score	35	45	93	87
Lowest score	80	73	60	60
Number of students over minimum completeness standard	1	-	25	4
Number of students below minimum completeness standard	35	36	16	32
% completeness	2,78%	0 %	69,44 %	11,11 %

Source: Analysis result

The Application of Collaborative Guided Inquiry Learning Model on Cognitive Ability

This research design treats the experimental and control classes with different learning models. The experimental class was taught using the collaborative guided inquiry method, and the control class was taught using the guided inquiry method. Before the learning was carried out, the researchers designed the instruments to be used with the guidance of expert lecturers.

To maintain the implementation of learning under what was designed, observers made observations. As explained above, the level of implementation shows results that are close to 100% of the implementation of all lesson plans. Learning outcomes, which are the dependent variable in this study, are influenced by the treatment as designed. After being given a different treatment, student learning outcomes in the experimental and control classes were analyzed.

Based on the analysis results, there are differences in the test scores on the solubility of the material and the solubility product in the experimental class and control class; in the experimental class, the average is 80.83, and in the experimental class control class 70.93. This value shows students' understanding of the material being studied. This data explains that there has been a significant difference in the class average learning outcomes in learning with the collaborative guided inquiry method.

Table 3 shows the learning outcomes of the experimental class with an average grade of 80.83, better than the average value of the control class of 70.93. The median of the experimental class was 83.33, while that of the control class was 70. These results indicate that more than half of the students in the experimental class achieved the KKM daily test scores. The mode of both classes also shows that most students in the experimental class achieve higher daily test scores than those in the control class.

The standard deviation of the experimental class, which is 5.694 is smaller than the control class, whose standard deviation is 8.179, indicating that the experimental class has experienced higher homogeneity than the control class, this shows the success of implementing the collaborative guided inquiry learning model in the experimental class, so it can be concluded that learning with the collaborative guided inquiry method is more able to improve learning outcomes on the solubility and product solubility product compared to guided inquiry learning alone.

This score increase is probably because the learning process with the collaborative guided inquiry learning model involves process skills so that students are more active in their learning. These results are in line with the theory of Piaget dan Vygotsky which states that the stages of learning activities with the collaborative and guided inquiry model can make students play an active role so that learning objectives can be achieved (Laksana, 2017).

In the learning that has been carried out, there are several obstacles, including 1) At the beginning of the meeting, students are not familiar with using the collaborative guided inquiry learning model; 2) Some sub-chapters require a more extended time allocation, and 3) The difficulty of controlling students' attention when students are asked to discuss and present the results of their discussions.

The Application of Collaborative Guided Inquiry Learning Model on Affective Ability

Two observers observed the experimental class students' activities during the learning process based on the observation sheet on process skills. In contrast, the affective learning outcomes of collaborative guided inquiry discussion skills were not compared in research because this behavior would only appear if students were grouped into learning that would produce results, which is better in the experimental class that uses the collaborative guided inquiry learning model. The observer consisted of one chemistry teacher and one 8th semester chemistry student. The affective domain consisted of social skills and characteristic behavior, analyzed together. Summary of student distribution data based on student process skills criteria can be seen in **Table 4**.

Table 4. Distribution of Students Based on the Student's Affective Ability

Criteria	Score	Percentage
Low	0	0 %
Fair	5	27,78 %
Good	19	52,78 %
Outstanding	12	33,89 %

From **Table 4**, it can be seen that the most significant percentage is students who have affective with Good criteria with 52.78%. Next are students who have achieved Outstanding criteria with 38.89%, followed by Fair criteria with 27.78%. In addition to being

seen from the percentage of students' affective domain criteria, this collaborative guided inquiry method can also be observed from the average value of the indicators used to assess the achievement criteria of affective domain indicators in learning. The average value of these indicators is also seen in each lesson plan's collaborative guided inquiry method and used to determine students' affective domain changes in each meeting. A summary of the average value of the achievement of process skills indicators in guided collaborative guided inquiry learning can be seen in **Table 5.**

Table 5. Average Score of Affective Achievement (Social Skills and Character Behavior)

Indicators	**Average score (each meeting)**					**Total**	**Achievement criteria**
	1st lesson plan	2nd lesson plan	3rd lesson plan	4th lesson plan	5th lesson plan		
Social skills							
Asking questions	3,1	3,0	2,9	3,2	3,2	3,08	Good
Contribute ideas or opinions	2,6	2,9	3,1	3,3	2,9	2,96	Good
Being a good listener	2,9	2,8	3,1	3,1	3,2	3,02	Good
Bring out good communication	2,9	3,1	3,0	3,3	3,1	3,08	Good
Character behavior							
Honest	3,4	3,1	3,2	3,0	3,1	3,16	Good
Responsibility	3,1	3,3	3,1	3,2	3,3	3,20	Good
Accuracy	3,0	2,9	2,8	3,2	3,2	3,04	Good
Total Average	3,00	3,02	3,03	3,14	3,14	3,10	**GOOD**

Table 5 showed that based on the average value of the results of observations of students during learning with the collaborative guided inquiry method, the achievement of each indicator can be categorized as good. The average value of each indicator from the first to the fourth meeting has increased and achieved good criteria. The total average value of each indicator also shows that all indicators are well achieved. In addition, from the calculation of with good and fewer ability scores. With collaborative guided inquiry methods, students with high abilities help their less capable friends understand the concept. The average graph in the affective at each meeting in the experimental class can be seen in **Figure 2.** Thus, it can be further concluded that the learning outcomes of students taught using the collaborative guided inquiry model are better than those taught using the guided inquiry model itself. Collaborative guided inquiry is a learning process in which students jointly examine and assess their learning outcomes the average achievement of the indicator as a whole, an average value of 3.08 is in good criteria. The criteria for achieving indicators in the affective domain of this learning are good, so it can be said that learning with the collaborative guided inquiry method can be carried out well and makes an excellent contribution to improving students' affective domains. In addition, the interaction of students in collaborating is noteworthy. The study showed a significant increase in students with teacher guidance systematically and thoroughly using a particular research technique.

This learning can involve at least two teachers or a group of teachers who have the same interest in teaching with various considerations about the learning needs of students. (Donohoo, 2013). It recommends that teachers take an active role in expressing and testing hypotheses. Another study explains that collaborative guided inquiry in teaching means "explaining knowledge through a combination of reflection and analysis,

rebuilding the knowledge through collaborative action, and building the knowledge together through group learning based on the knowledge that has been acquired." (Stoll, 2020).

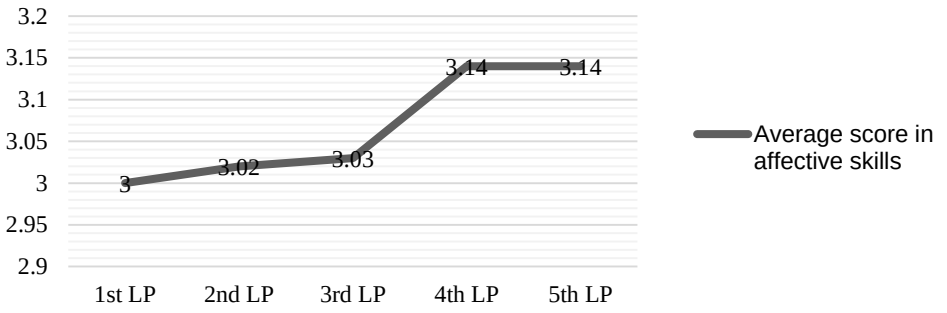

Figure 2. The Graph of The Average Score in Affective Skills

This collaborative guided inquiry is a learning model that involves a group of students with heterogeneous abilities to solve a problem or produce a product based on the results of systematic research. The heterogeneous group in question is that in one group has members with diverse student abilities, high, medium, and low ability students with the hope that more competent students will teach less intelligent students, and teachers and students will teach each other, while with guided inquiry learning will expose students to problem-solving systematically and thoroughly using research techniques. A study suggests five critical ideas for collaborative guided inquiry research and learning as follows (Utami et al., 2015): Collaborative research is one of the most promising strategies for enhancing education and learning. At the same time, it can be one of the most difficult to implement. The most significant risk in setting up a collaborative study is lacking leadership and support. First, schools and districts need to create a shared understanding of the purpose and value of collaborative research between teachers and managers. Another essential condition is the time for teachers to meet regularly and make appropriate investments in training and facilitation. Substantial shared lessons and student assignments that are sufficient to justify collaborative research serve as a structure for discussion. It takes patience and patience to be an effective research team. Collaborative research is not for the timid, but it is well worth the effort. Collaborative inquiry holds the capacity for deep and widespread alternate in education. Bringing educators collectively in inquiry sustains interest to desires over time, fosters teachers` getting to know and exercise development, and affects students' profits. Together the four helps we have identified – structural, cultural, and social/emotional, getting to know and process, and trainer ownership/agency – can create and preserve inquiry communities.

1. Using various formats of collaborative learning (large classes, small groups, and pairs) and creating more opportunities for the success of the learning model provided to students.
2. Creating a community where students will feel accepted and valued will improve students' academic and social abilities.
3. Select the right students to get a positive and maximum learning experience.
4. Choose a variety of learning strategies to support active student participation and student social interaction with collaborative action and guided inquiry.
5. Adopting a general approach to teaching with the collaborative guided inquiry

model with the existing curriculum will increase learning effectivenes.

SIMPULAN

The implementation of the collaborative guided inquiry learning model in this study went well, shown from the implementation sheet of the learning implementation. The average percentage of implementation reached 96.10%. In addition, there is an effect of applying the collaborative inquiry learning model in improving students' chemistry learning outcomes on the solubility product and solubility product. This can be shown from the differences in students' cognitive and affective ability tests between the collaborative inquiry and guided inquiry learning models. This difference can be seen from the average score on the cognitive ability test; in the experimental class, the average class is 80.83. While the average value of the cognitive ability test in the control class was 70.93.

The learning outcomes of students who were taught using the collaborative guided inquiry learning model were higher than those who were taught using the guided inquiry learning model. This difference can also be seen from the average score in the affective ability analysis; in the experimental class, the average class is 3.10, while the average affective test score in the control class is 3.08. The learning outcomes of students who were taught using the collaborative guided inquiry learning model were higher than those who were taught using the guided inquiry learning model.

Based on the description of learning outcomes with inquiry-based collaborative learning, applying the collaborative guided inquiry method to the solubility and solubility product concept can improve student learning outcomes in cognitive, affective, and psychomotor aspects. The cognitive aspect increases because all students help each other so that their friends who have minor mastery of the material increase their level of mastery and become the same level as their friends who are good at solubility and solubility product concept through collaborative groups. The affective aspect will increase because students learn and are trained to accept and respect others; students are encouraged to ask questions, answer responses, and respond.

Based on the research that has been done, the suggestions that can be submitted are : (1) The collaborative guided inquiry learning model is recommended to be applied to the solubility and solubility product concept and can be applied to other concepts; (2) This study only examines the effect of the application of the collaborative guided inquiry learning model on students' cognitive and affective learning outcomes, so that other researchers can examine the effect of applying the collaborative guided inquiry model to psychomotor learning outcomes and other variables, such as student learning motivation, concept understanding, and higher-order thinking skills; and (3) the learning process using the collaborative guided inquiry learning model takes a longer time than conventional learning, so other researchers must have thorough preparation and have skills in conditioning students.

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