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Guided Inquiry Learning Model to Improve Students Scientific Literacy Skills and Learning Outcomes

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Abstract: Students scientific literacy skills and learning outcomes tend to be low in chemical equilibrium material. One of the influence factors is the use of not exactly learning models. An alternative that can be done is using the guided inquiry learning model. This research aims to determine the effect of the guided inquiry learning model to improve student scientific literacy skills and learning outcomes chemical equilibrium. The research design was used Quasi-Experimental type Nonequivalent Control Only Group Design. The experimental class use the guided inquiry learning model meanwhile the control class use the conventional learning model. The data analysis technique was used independent sample t-test and multivariate analysis of variance. The result showed that guided inquiry learning model on chemical equilibrium material affects the scientific literacy skills and outcomes of students of class XI SMAN 1 Kalidawir with a significance. Based on the results obtained from implementation the guided inquiry learning model on chemical equilibrium material, it has an effect on scientific literacy and learning outcomes for class XI students at SMAN 1 Kalidawir.

Keywords: guided inquiry, chemical equilibrium, scientific literacy, learning outcomes

INTRODUCTION

The quality of superior and competitive human resources is realized in students who have noble character and have a high level of reasoning, especially in literacy and numeracy (Rina Febrian, Muhtadin, 2022). In overcoming various educational problems in the 21st era, students must have scientific literacy skills to solve a problem. Scientific literacy skills are part of education that has an important role in producing and shaping students who have the ability to think critically, logically, creatively, innovatively, and globally competitive (Syofyan & Trisia Lusiana Amir, 2019). Scientific literacy is able to become a major foundation of education for students to recognize scientific contextually and apply it in everyday life.

The level of scientific literacy skills of students in Indonesia is in the low category. The level of scientific literacy skills and knowledge of students can be observed based on PISA data followed by Indonesia. According to the PISA (Program for International Student Assessment) report, Indonesia obtained below-average results, namely students reading ability scored 371 with an average OECD score of 489, the average math score reached 379 with an average OECD score of 487 and science scored 371 with an average OECD score of 487. Indonesia's PISA score followed in 2018 has a low score and this makes Indonesia rank at 72 out of 78 countries that participated in PISA (Balitbang Kemdikbud, 2019). The low PISA assessment shows that the low level of scientific literacy skills will result in low learning outcomes for students.

Low scientific literacy skills and learning outcomes are often found in subjects that are abstract and require more understanding, one of which is in chemistry. Many students dislike chemistry because they find it difficult to learn chemistry. The incident of the difficulty of learning chemistry was also revealed by Sri Wahyuna Saragih, et. all where there is a student's fear of chemistry lessons so that it has an impact on the low student chemistry learning outcomes (Saragih et al., 2019). Chemistry materials are interrelated, so understanding one concept will have an impact on understanding

other concepts. One of the chemistry materials that has a concept linkage, namely chemical equilibrium.

Chemical equilibrium is one of the chemical materials that studies dynamic chemical equilibrium, shifts in the direction of equilibrium, factors that affect equilibrium, and equilibrium settings. Students' difficulties in chemical equilibrium material mostly lie in the part of the concept of dynamic equilibrium included in the high category (73,5%), the concept of equilibrium constant is included in the medium category (41,3%), and the factors that affect the equilibrium shift are included in the low category (29,0%) (Basyiroh dkk., 2022). Almost all components of the concept of chemical equilibrium students still lack understanding of the concept and have difficulty in linking one another (Marfu'a & Astuti., 2022). Chemical equilibrium needs to combine concepts and calculations. Facts in the field show that students often find it difficult to combine concepts and calculations so that it has an impact on low scientific literacy skills and learning outcomes in chemical equilibrium material. The low literacy skills and learning outcomes are influenced by several things, one of which is that the learning model used is less relevant and the students understanding of concepts in the previous material is low (Mu'minin et al., 2020).

Chemical equilibrium material is not only enough to learn about theory and calculation but also requires practice. Because in the domain of the scientific literacy component there is procedural knowledge that must be obtained by students through practicum in the laboratory. The learning concept is verification where the learning method begins with a lecture by the teacher followed by proving the concept through laboratory experiments (Ardhana, 2020). The scientific literacy skills of students tested in chemical equilibrium material is 23,6%, including a very low category because only the lecture method is carried out without practice (Maullidyawati & Hidayah, 2022).

One of the chemistry teachers of SMAN 1 Kalidawir conducted an interview for preliminary study stated that: 1) Student scientific literacy skills are still relatively low. Many students assume that learning chemistry requires more understanding so they are reluctant to learn. Chemistry subjects if taught to students using the right learning model and supported by appropriate teaching materials will improve student scientific literacy skills. 2) Student learning outcomes are still relatively low, as evidenced by the results of daily test assessments that are below the minimum completion criteria average. Minimum completion criteria, which is the lowest criteria that must be achieved by students to be declared complete. 3) The learning model used is still mostly using the conventional model. With this model students will mostly be passive in learning.

The learning model that is still mostly applied by teachers, namely the conventional model with the lecture method. In learning, teachers provide a lot of information, students are lacking in expressing ideas, providing abstract experiences, giving less time to solve problems, and homogeneous learning (Rewalino et al., 2020). The conventional learning model implemented in the classroom focuses on the teacher and only a few students actively participate in learning. Therefore, there are students who are passive and feel bored quickly so that the understanding of the concept of the material provided is not strongly embedded, which has an impact on low scientific literacy skills and learning outcomes.

One of the learning models is expected to be able to improve scientific literacy skills and student learning outcomes, namely guided inquiry or guided inquiry. The guided inquiry learning model according to Richard Suchman, states that students are able to understand the research process and explain an event (Nurdyansyah & Fahyuni, 2016). The guided inquiry learning model is a learning model where the teacher acts as a guide by providing a stimulus in the form of an opening question and then continuing with joint discussion activities. At each step the teacher periodically provides full direction then in the next step is gradually reduced until they are able to carry out the learning process independently. According to Trianto, the steps of guided inquiry model learning activities are as follows: 1) Asking Questions or Problems; 2) Formulate Hypotheses; 3) Collect Data; 4) Analyze Data; 5) Make Conclusions (Puspitasari et al., 2019).

Some supporting data from previous studies, namely the results of the first study stated that students gave a positive response to the application of the guided inquiry learning model to train scientific literacy skills (Citra & Muchlis,. 2017). The results of the second study stated that hypothesis testing of conventional learning models was less effective for optimizing scientific literacy skills and student learning outcomes, so it was concluded that there was an effect of guided inquiry learning models on the scientific literacy skills of grade XI students of SMA Negeri 2 Poso (Rewalino et al., 2020). The third research result states that there is a relationship between scientific literacy skills and learning outcomes known through Pearson correlation statistical testing (r = 0,032) indicating that there is a positive relationship between scientific literacy skills and learning outcomes, meaning that the higher the scientific literacy skills, the higher the student learning outcomes (Jufrida et al., 2019).

Based on the explanation of the problems above, the authors are interested in conducting research to determine the relationship between guided inquiry learning models with scientific literacy skills and learning outcomes. With the hope that the guided inquiry learning model on chemical equilibrium material can affect the improvement of scientific literacy skills and learning outcomes of class XI students of SMAN 1 kalidawir.

METHOD

This research uses quantitative methods with the type of Quasi Experimental type Nonequivalent Control Only Group Design. Where in the experimental class previously conducted a pretest and certain treatment then conducted a posttest and observed. Whereas in the control class previously a pretest was also carried out and afterwards a posttest was carried out but no specific treatment was given and not observed. The following is the research pattern:

Table 1. Research Pattern Nonequivalent Control Only Group Design

Description	Pretest	Treatment	Posttest
Experiment Class	O_1	X	O_2
Control Class	O_3	-	O_4

Description:
O1 : Experimental class pretest
O3 : Control class pretest
O2 : Experimental class posttest
O4 : Control class posttest
X : Treatment given with guided inquiry learning model
- : No treatment given with conventional learning model

The sample in this study, namely students of class XI MIPA SMAN 1 Kalidawir who took chemistry specialization, where class XI MIPA 4 as the experimental class and class XI MIPA 5 as the control class. The experimental class was given a certain treatment, namely applying the guided inquiry learning. Meanwhile, the control class did not receive any treatment, namely applying a conventional learning model.

The data collection technique in this study used tests. The instruments in this study both variables of scientific literacy ability and learning outcomes used questions in the form of multiple choice and essays. The research instruments this time before being used has gone through the validity and reliability test stages to prove feasible and valid in its use.

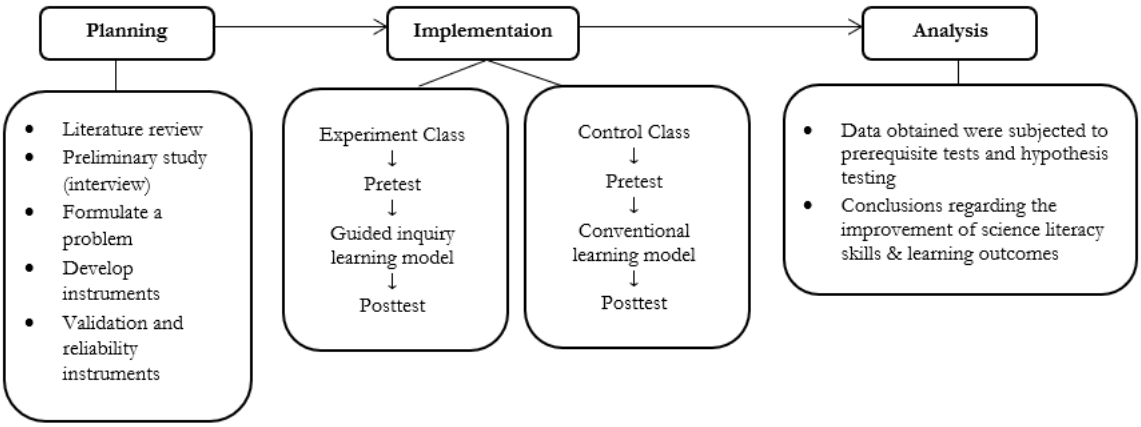

Figure 1. Research Procedure

The instruments used in this study are treatment instruments and measurement instruments. There are two measurement instruments, namely scientific literacy skills instruments and learning outcomes instruments in the form of questions. While there are two treatment instruments, namely lesson plans and learner worksheet with guided inquiry learning model. Learner worksheets, which are printed teaching materials that contain material, summaries, and instructions for completing learning tasks. The validity of the instruments used in this study used content validity and empirical validity. The validators chosen for content validity were one chemistry lecturer and one chemistry teacher. In the test instrument, the validator is asked to assess the feasibility of the question whether it is in accordance with the concepts, components, grammar used in each item. Empirical validity and reliability of test instruments are measured using the Cronbach alpha technique after the trial activities are carried out.

The data obtained in this study will be analyzed using prerequisite tests first with normality and homogeneity tests. After the data is known to be normal and homogeneous, the next test is carried out, namely hypothesis testing using the independent sample t-test and the multivariate analysis of variance.

RESULTS AND DISCUSSION

Data on Avarage Difference between Pretest and Posttest Results

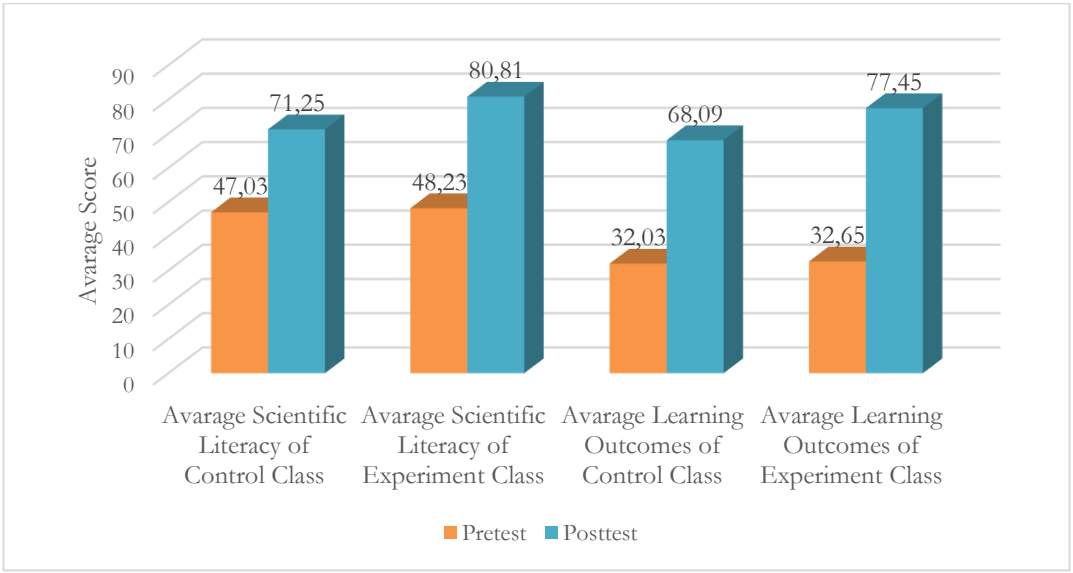

Figure 2. Avarage Difference

The average difference occurred before treatment and after treatment in both classes. The difference in the average value of the experimental class is greater than the average value of the control class due to differences in the use of learning models. The control class applied a conventional learning model while the experimental class applied a guided inquiry learning model.

Data on Scientific Literacy Aspects

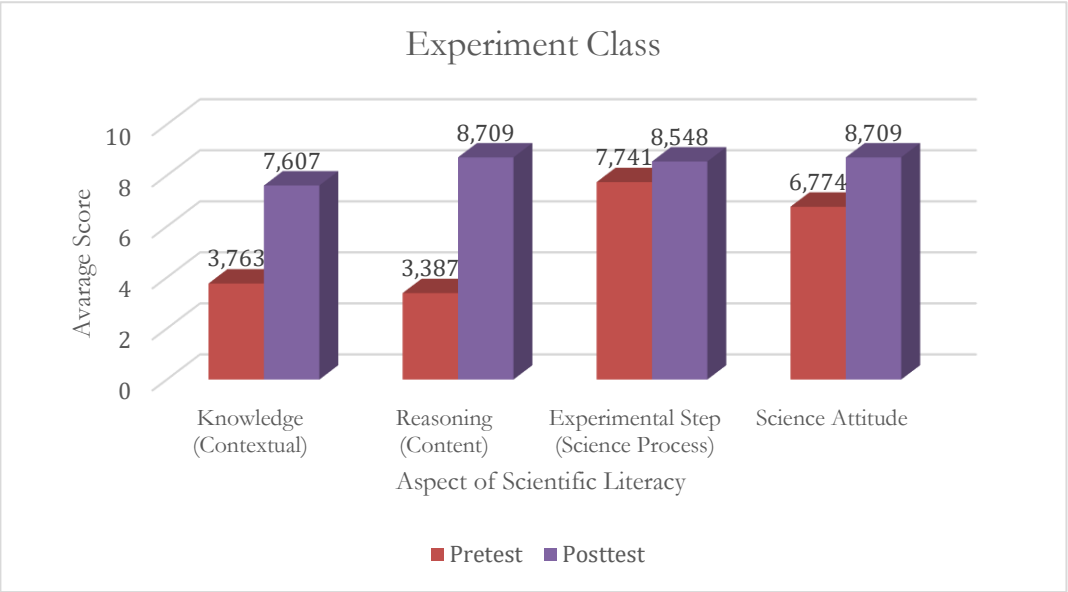

Figure 3. Scientific Literacy Aspect of Experimental Class

Aspects of scientific literacy skills can be measured using the average score of pretest questions given before treatment and posttest questions given after being treated with guided inquiry learning model. The aspect of knowledge (contextual) the average score before was 3,763 while after was 7,607. In the aspect of reasoning (content) the average score before was 3,387 while after was 8,709. In the aspect of experimental steps (scientific process) the average score before was 7,741 while after was 8,548. In the aspect of scientific attitude, the average score before was 6.774 while after was 8,709.

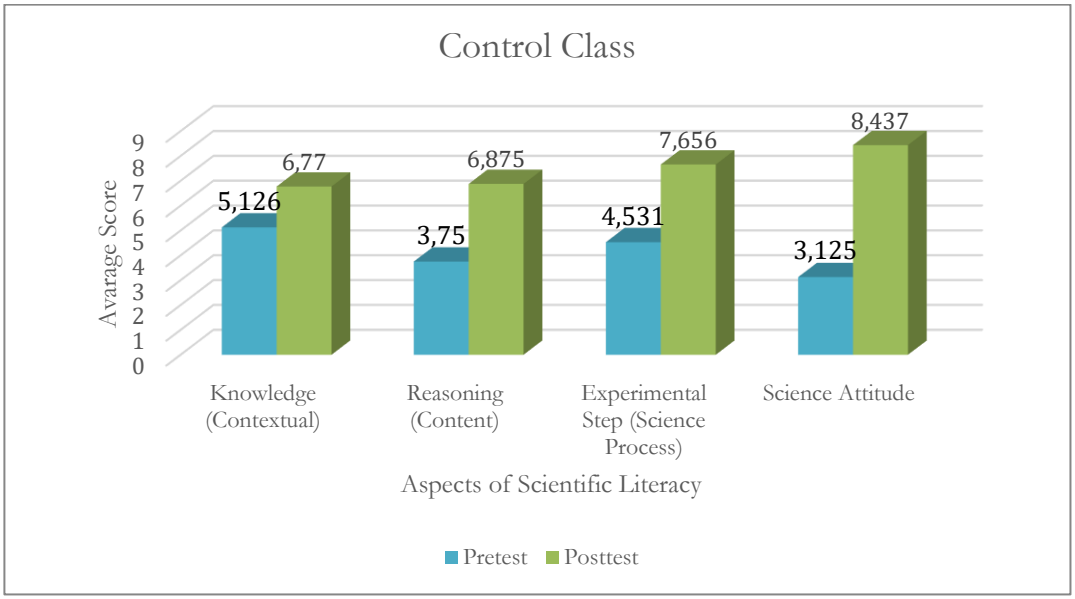

Figure 4. Scientific Literacy Aspect of Control Class

Aspects of scientific literacy can be measured using the average score of pretest questions given before treatment and posttest questions given after treatment model conventional learning. In the aspect of knowledge (contextual) the average score before was 5,156 while after was 6,770. In the aspect of reasoning (content) the average score before was 3,750 while after was 6,875. In the aspect of experimental steps (science process) the average score before was 4,531 while after was 7,656. In the aspect of science attitude, the average score before was 3,125 while after was 8,437.

Data on Prerequisite Test

Normality Test

Table 2. Normality Test

One Sample Kolmogorov Smirnov Test	Posttest of Scientific Literacy XI MIPA 4	Posttest of Learning Outcomes XI MIPA 4	Posttest Of Scientific Literacy XI MIPA 5	Posttest of Learning Outcomes XI MIPA 5
Asymp. Sig (2-tailed)	.059[c]	.074[c]	.149[c]	.060[c]

In the experimental class, the significance value of the scientific literacy posttest was 0,059>0,05; while the significance value of the learning outcomes posttest was 0,074>0,05. In the control class, the significance value of the scientific literacy posttest was 0,149>0,05; while the significance value of the learning outcomes posttest was 0,060>0,05. These results can be concluded that all posttest data are normally distributed.

Homogenity Test

Table 3. Homogenity Test

Levene's Test	Posttest of Scientific Literacy	Posttest of Learning Outcomes
Asymp. Sig (2-tailed)	.746	.370

The significance value of the two-sample average scientific literacy posttest assessment data is 0,746>0,05. While the significance value of the posttest assessment data of the average learning outcomes of the two samples was 0,370>0,05. These results can be concluded that the overall posttest data obtained is homogeneous.

Guided Inquiry Learning Model on Chemical Equilibrium Material Affects Students Scientific Literacy Skills

Table 4. Hypothesis test of scientific literacy

Independent Sample T-Test	Asymp. Sig (2-tailed)	t_{count}	t_{table}	Description
	.000	4.833	1.671	There is an Influence

Before the hypothesis test is carried out, the prerequisite test is carried out first, namely the normality test and homogeneity test with the condition that the significance value is >0,05. The normality test results show that the data is normally distributed with the significance value of the experimental class of 0,059>0,05 while the control class is 0,149>0,05. After the data obtained is normal, the next stage is the homogeneity test. The homogeneity test results showed homogeneous scientific literacy test data for both experimental and control classes with a significance value of 0,746>0,05.

Scientific literacy test data can be said to be normally distributed and homogeneous (prerequisite tests are met) so it can be continued in hypothesis testing. Hypothesis testing carried out on scientific literacy data, namely using the t-test (independent sample t-test). The results of the t-test (independent sample t-test) showed a significance value of 0,000 <0,05. The t_{count} is 4,833. The

value of Df = 61 then the t_{table} is 1,671 for the value of α = 0,05 (5%). It is known that the $t_{count} \geq t_{table}$ is 4,833 ≥ 1,671. From the acquisition of these results, H_1 is accepted H_0 is rejected (Rahayu, 2020). So it can be concluded from the explanation of the data, namely that there is a significant effect in the application of the model guided inquiry learning on chemical equilibrium material on scientific literacy of students of class XI SMAN 1 Kalidawir.

The difference in scientific literacy skills owned by control class students is lower than the experimental class. The factor that causes this is the use of conventional learning models that are dominantly teacher-centered. Learners tend to be passive because they only receive limited knowledge provided by the teacher. In learning, teachers provide a lot of information, students are lacking in expressing ideas, providing abstract experiences, giving less time to solve problems, and homogeneous learning (Rewalino et al., 2020).

The guided inquiry learning model is one of the learning models where the teacher guides students to carry out activities by giving initial questions and leading to a discussion. According to Tritanto, the guided inquiry learning model consists of several stages, including asking questions or problems, formulating hypotheses, collecting data, analyzing data, and making conclusions (Puspitasari et al., 2019). The most influential stages in improving scientific literacy skills in students, namely: 1) Formulating hypotheses, at this stage or step students can independently make assumptions and make scientific predictions. One example is that students are able to make hypotheses on online practicum activities related to factors that affect equilibrium (concentration and temperature) that will be carried out. One of the results of previous research states that at this stage the application of abilities in accordance with knowledge by making assumptions and formulating hypotheses is included in scientific literacy skills (Fitri & Fatisa, 2019). 2) Collecting data and analyzing data, at these two stages students collect various information through various sources both books and digital independently and then sort the data according to the topic needed. That way learners can read and explore knowledge scientifically. One example is that students are able to carry out practicum activities according to the steps and analyze the practicum data obtained. 3) Making conclusions, at this stage students load all the data obtained to be concluded. One example is after doing online practicum, students are able to conclude related to the direction of the shift in factors that affect equilibrium (concentration and temperature). One of the results of previous research states that students ability to make correct and appropriate conclusions is included in scientific literacy skills (Fitri & Fatisa, 2019).

Some previous research results that support this statement, namely the results of the first study stated that the results of student scientific literacy skills had increased significantly. Students gave a positive response to the application of guided inquiry learning model to train scientific literacy skills (Citra & Muchlis, 2017). In accordance with the results of the second study stated that the application of guided inquiry-based learning models effectively improved students scientific literacy skills with high categories (Yessi, 2019).

Guided Inquiry Learning Model on Chemical Equilibrium Material Affects Students Learning Outcames

Table 5. Hypothesis Test of Learning Outcames

Independent Sample T-Test	Asymp. Sig (2-tailed)	t_{count}	t_{table}	Description
	.001	3.340	1.671	There is an Influence

Before the hypothesis test is carried out, the prerequisite test is carried out first, namely the normality test and homogeneity test with the condition that the significance value is >0,05. The normality test results show that the data is normally distributed with a significance value of 0,074>0,05 for the experimental class. Mean while the control class is 0,060>0,05. After the data

obtained is normal, then proceed to the next stage of homogeneity test. The homogeneity test results showed homogeneous scientific literacy test data for both experimental and control classes with a significance value of 0,370>0,05.

The learning outcomes test data can be said to be normally distributed and homogeneous (prerequisite test is met) so it can be continued in the hypothesis test. Hypothesis testing carried out on learning outcomes data, namely using the T test (independent sample t-test). The results of the t-test (independent sample t-test) show a significance value of 0,001<0,05. The t_{count} is 3,340. The value of Df = 61 then the t_{table} is 1,671 for the value of α = 0,05 (5%). It is known that the $t_{count} \geq t_{table}$ is 3,340 ≥ 1,671. From the acquisition of these results, H_1 is accepted H_0 is rejected (Rahayu, 2020). So it can be concluded from the explanation of the data, that there is a significant influence in the application of guided inquiry learning model on chemical equilibrium material on the learning outcomes of students of class XI SMAN 1 Kalidawir.

Learning outcomes can be influenced by external and internal factors. External factors that have an influence in this study, namely how to deliver material, learning models, and the time of implementation of learning activities. The time of implementation of learning activities in the experimental class, namely XI MIPA 4 using the guided inquiry learning model coincided in the morning while the time of implementation of learning activities in the control class, namely XI MIPA 5 using the conventional learning model coincided in the afternoon before school hours. Internal factors that have an influence in this study, namely speed of thinking, motivation in learning, interest in learning, focus of attention, and readiness in learning. Both external and internal factors influence the process and achievement of learning outcomes.

The acquisition of learning outcomes that have been obtained by students it can be concluded that the learning outcomes of control class students are lower when compared to the learning outcomes of experimental class students. The difference in learning outcomes is due to differences in treatment applied in the control class using conventional learning models, students tend to be passive while in the experimental class using guided inquiry learning models, students tend to be more active.

Some previous research results that support this statement, namely the results of the first study state that the application of the guided inquiry learning model has a better effect than the conventional learning model on student chemistry learning outcomes on the subject matter of hydrocarbons in class XI PMIPA SMAN 1 Woha in the 2019/2020 school year (Asni et al., 2020). In accordance with the results of the second study which states that there is a significant effect of using the guided inquiry learning model on learning outcomes on chemical bonding material (Sulistyaningsih & Tengker, 2020). The guided inquiry learning model used for 2 meetings was well implemented. The percentage of relevant student activities is greater than irrelevant student activities. The completeness of student learning outcomes obtained 100% complete learning outcomes. Students also gave positive responses with very good criteria (Solikah & Novita, 2022).

Guided Inquiry Learning Model on Chemical Equilibrium Material Affects Students Scientific Literacy Skills and Students Learning Outcames

Table 6. Multivariate Analysis of Variance

Uji Multivariate Analysis of Variance	Posttest of Scientific Literacy	Posttest of Learning Outcomes
Asymp. Sig (2-tailed)	.000	.001

Before the first stage of hypothesis testing, the prerequisite test was carried out first, namely the normality test and homogeneity test with the condition that the significance value >0,05. Based on the test results multivariate normality derived from scientific literacy variables and learning outcomes obtained data with a significance value of scientific literacy of 0,059 and 0,150 while the significance value of learning outcomes is 0,074 and 0,060. These results can be concluded that the

overall data is normally distributed. The results of the homogeneity of variance test conducted obtained data with a significance value of scientific literacy of 0,746 while the significance value of learning outcomes was 0,370. These results can be concluded that if the scientific literacy and learning outcomes of both classes both experimental and control classes are declared homogeneous.

The results of the covariance matrix homogeneity test conducted obtained data of 6,868 while the significance value was 0,085>0,05. These results can be concluded that if the covariance matrix of scientific literacy and learning outcomes of both experimental and control classes is declared homogeneous/equal. The data obtained can be said to be normally distributed and homogeneous, so it can be continued with the next test, namely hypothesis testing.

The hypothesis test used at this time, namely using the multivariate analysis of variance. The multivariate analysis of variance results show the significance value of the scientific literacy posttest is 0,000 while the significance value of the learning outcomes posttest is 0,001. These results have a significance value <0,05 so that it can be stated that H_0 is rejected H_1 is accepted. Based on the results, it can be concluded that there is a significant influence in the application of guided inquiry learning model on chemical equilibrium material on scientific literacy and learning outcomes of students of class XI SMAN 1 Kalidawir.

Scientific literacy according to PISA (Program for International Student Assessment) is the ability to use scientific knowledge, identify questions, and draw conclusions based on scientific evidence in order to understand and make decisions regarding nature and its changes due to human activities (Sutrisna, 2021). In PISA 2006, the dimensions of scientific literacy were developed into four dimensional aspects, including context aspects, content aspects, competency (process) aspects, and attitudinal aspects. The ability of scientific literacy possessed by students can be improved by doing a treatment in the teaching and learning process associated with the problems around us. This is able to make students manage their knowledge to get problem solving. Increased scientific literacy will affect the improvement of learning outcomes.

Learning outcomes according to Bloom's taxonomy refer to the expected learning objectives with this taxonomy educators can know clearly and definitely whether the instructional objectives of the lesson are cognitive, affective or psychomotor. Learning outcomes are the knowledge possessed by students obtained after carrying out the learning process. The level of knowledge that students have depends on the way of learning and the material. Improved learning outcomes can be achieved with a treatment by using the right learning model.

The application of the guided inquiry learning model makes students excited and active during teaching and learning activities. The use of learner worksheet in accordance with the guided inquiry learning model emphasizes students being able to solve a daily life problem related to chemical equilibrium material. The teacher guides and directs students to gain concepts and knowledge independently. One of the new activities that attracts student enthusiasm when studying chemical equilibrium, namely conducting online experiments with the practice of students will be more embedded in understanding the concept. Then the material learned can be easy for students to understand so that it can improve scientific literacy skills and learning outcomes optimally. While the application of conventional learning models is different, students are less excited and tend to be passive when teaching and learning activities take place. In the application of this model, the teacher's role is to provide material in full, students only receive no opportunity to acquire their own knowledge. Learners only receive an explanation of the material and working on practice questions given by the teacher. Then the material learned is less to be understood by students so that scientific literacy skills and learning outcomes are not so optimal.

Some previous research results that support this statement, namely the results of the first study state that the relationship between scientific literacy skills and learning outcomes is known through Pearson correlation statistical testing (r = 0,032) indicating that there is a positive relationship

between scientific literacy skills and learning outcomes, meaning that the higher the scientific literacy skills, the higher the learning outcomes of students (Jufrida et al., 2019). In accordance with the results of the second study which states that there is an effect of guided inquiry learning model on the scientific literacy skills of class XI students of SMA Negeri 2 Poso (Rewalino et al., 2020).

CONCLUSIONS

Based on the data presentation above, it can be concluded as follows: 1) The application of guided inquiry learning model on chemical equilibrium material affects the scientific literacy skills of students of class XI SMAN 1 Kalidawir with a significance value of 0,000<0,05. 2) The application of guided inquiry learning model on chemical equilibrium material affects the learning outcomes of students of class XI SMAN 1 Kalidawir with a significance value of 0,001<0,05. 3) The application of guided inquiry learning model on chemical equilibrium material affects the skills of scientific literacy and learning outcomes of students of class XI SMAN 1 Kalidawir with a significance value of scientific literacy of 0,000<0,05 and learning outcomes of 0,001<0,05.

The findings of this study by applying the right learning model will affect the improvement of scientific literacy skills and student learning outcomes. This can contribute to chemistry education that is able to support and realize the fourth goal of the seventeen SDGs goals, namely quality education.

Suggestions for future researchers this study can be used as reference material and consideration. It is also expected to be able to conduct research carrying the renewal of data sources so that the results obtained are more complete and able to expand the study material more than this research.

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