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# Optimizing Inquiry-based Learning Activity in Improving Students' Scientific Literacy Skills

Iskandar\*<sup>1</sup>, Dedi Sastradika<sup>1</sup> and Denny Defrianti<sup>2</sup>

<sup>1</sup> UIN Sulthan Thaha Saifuddin, Jambi, Indonesia

<sup>2</sup> Faculty of Science and Culture, Universitas Jambi, Indonesia

\*Email: [iskandar@uinjambi.ac.id](mailto:iskandar@uinjambi.ac.id)

**Abstract.** The application of inquiry learning is one of the ways to improve the students' ability of scientific literacy. The difficulty of applying inquiry-based learning in physics learning gave a negative effect on scientific literacy skills. One way to optimize inquiry-based learning activities was to combine learning with the use of technology. The purpose of this research was to optimize inquiry learning through Edmodo in improving students' ability of scientific literacy on the material of Newton's Law. The method used was pre-post control design with 96 students of SMA Negeri 4 Kerinci as the research subjects. They were divided into three groups: experimental class 1 was given guided inquiry assisted by Edmodo, experiment class 2 was given guided inquiry learning and control class was given conventional learning. Instrument used was multiple choice questions and questionnaire. The data gathered were analyzed using Anova Mixed Design technique using significance level of 0.05 and effect size (ES). The results of the analysis show that guided inquiry learning assisted by Edmodo was more effective in improving scientific literacy of cognitive aspect (SLC) compared with inquiry and conventional models with  $t\text{-test}_{\alpha=0,05} = 0.000$  and contributed an improve of 0.847 with 'Big' category. In the scientific literacy of affective aspect (SLA) Edmodo-assisted inquiry study contributed an improve of 0.097 categorized as 'Small' with  $t\text{-test}_{\alpha=0,05} = 0.003$ . It means that guided-inquiry assisted by Edmodo is effective to improve SLA, but contribute to small improvements.

**Keywords:** Guided inquiry; Edmodo; Scientific literacy skills.

## 1. Introduction

Technological developments in the 21<sup>st</sup>-century very quickly resulted in changes in aspects of human life including in educational aspect. The use of technology in learning affects the process of transforming conventional education into a digital form, so that learning is presented to give learners the opportunity to probe the ability to use technology [1]. The use of technology is one of the ability needed to compete in the 21<sup>st</sup>-century. Education is the mainstay of preparing a society to get ready to compete in the 21<sup>st</sup>-century, education can be used to improve knowledge and technology, character and skills to adapt in many aspects of life in the future. Through education, several aspects and abilities of 21<sup>st</sup>-century can be developed in preparing society to compete in the 21<sup>st</sup>-century, one of them is the ability of science literacy [2].

Scientific Literacy is the main goal of science learning [3]. Scientific Literacy globally emphasizes on appropriate technology, environmental conservation, and aesthetic understanding of the earth [4]. The demands of the Scientific Literacy consists of several parts; the understanding of



terminology, scientific concepts, scientific principles, interaction of science, and technology and society [5]. In addition, Science Literacy is also a science and understanding of the concepts and scientific processes which is required in the economic productivity of a country [5]. The Citizens' Improvement in term of Scientific Literacy is not only an intrinsic demand in innovation-driven country development, but also a foundation project to create an innovative environment for cultivating innovative talent [6]. The importance of the Scientific Literacy ability in the 21<sup>st</sup>-century has brought a change in science education that functioned as an activator of science in providing a direction for more useful science learning with the aim of preparing society in 21<sup>st</sup>-century. Many surveys have been conducted to determine the ability of Scientific Literacy one of them was Programmed for International Student Assessment (PISA).

Based on PISA Survey in 2015, Indonesian learners' ability of scientific Literacy is still low [7]. That low achievement shows that learners have not been able to solve real-world problems and this also shows that Indonesian students have low learning motivation which can affect students' emotional intelligence to improve scientific literacy skills [8]. In addition, the low scientific literacy also shows that the Indonesian people are not ready to compete globally. The establishing of curriculum 2013 was motivated by the low achievement of the learners' scientific literacy ability in the event of *Programmed for International Student Assessment* (PISA) in 2012. One of the factors causing the low students scientific Literacy is a process of learning that rarely presents a scientific phenomenon, mathematics but does not explain its application in daily life, does not reveal misconceptions, analogous models used less precisely, narrow demonstration models [9]. Hence, a learning model is required to facilitate the learners in developing their scientific literacy skills.

Curriculum 2013 in Indonesia Country recommends learning models that can be used in science learning one of them is the Inquiry model which aims in improving the scientific literacy skills on the student. Inquiry learning is well suited to improve the ability of scientific literacy because through inquiry learning, the learners can engage in science activities directly [10][11][12][13]. Inquiry is a learning approach that involves students in discovering and using various sources to enhance a specific understanding of the material [14]. The inquiry model is divided into four levels: Confirmation Inquiry, Structured Inquiry, Guided Inquiry, and Open Inquiry[15][16][17][18]. From the four levels of Inquiry in accordance with the development of high school students is Guided Inquiry[19].

Guided Inquiry is a suitable model for improving scientific literacy skills as it provides an opportunity for learners to investigate and provide experience directly to science, while also improving the science and laboratory attitudes of learners [20][21][22][23]. Guided Inquiry is an active learning method, in which students learn in groups and conduct learning activities simultaneously [24]. However, there are some difficulties experienced by teachers in applying Inquiry-based learning such as the limited time to complete a single round of syntax in a single meeting [25]. It makes the teacher tend to use conventional method. They need a solution in optimizing the learning time to apply Inquiry learning model. The most effective way to optimize the use of learning time is to apply face-to-face and online learning (Landed Learning) [26]. It is a learning where teachers provide learning materials online and conduct inquiry activities at the time of face to face.

The combined learning is a way of learning that can prepare learners to compete in the 21<sup>st</sup> century, since in this case the student are asked to be directly involved in the use and utilization of technology in learning [27]. An effective strategy in online learning is to invite students to interact through communication, facilitate the application of concepts using problem-based learning strategies, use video demonstrations (to demonstrate tools and programs) and convey a strong social presence or a sense of community learning [28]. Online learning especially in physics learning is very effective because students can see the progress of their own learning and with online learning is not limited by teachers or other learners[29]. There are many media that can be used to facilitate Online learning activities one of them is Edmodo.

This research used Edmodo as a media in online learning. Edmodo is an application that is easy to be used by teachers and learners in learning especially in communication. Using Edmodo in learning is one way to use technology; Edmodo allows teachers to design and develop interactive online classes

and provide digital diving in interacting with learners [30]. Learning using Edmodo can be used to support students in blended learning and Inquiry-based learning [19][23]. The created Learning design in this study aimed in providing learning materials to learners through online learning and experimenting at face-to-face meetings in the classroom, so it is expected that learning activities with Guided Inquiry model can be implemented optimally and the students' ability of scientific Literacy can improve during the learning take place. The Increasing of science literacy in this study would be measured based on the aspects of scientific literacy.

The PISA 2015 measure the ability of scientific literacy based on three aspects; explain Phenomena Scientifically, evaluate and design scientific inquiry, interpret data and evidence scientifically. The scientific literacy ability measured by PISA 2015 was applied to learners aged 15 years [7]. However, the information given was still too general, Fives, *et al.*, devised detailed aspects which were developed based on the aspects proposed by PISA 2015: Scientific Literacy of Cognitive Aspects of (SLC) and science Literacy of Affective Aspects (LSA) [30]. In this study the aspects of scientific literacy were measured on the aspects that have been developed by Fives et al (2015). Scientific literacy of cognitive aspects (SLC) is Role of science, Scientific thinking and doing, Science and society, Science media literacy and Mathematics in science. Scientific literacy of affective aspects (SLA) is Value of science, self-efficacy for scientific literacy and personal epistemology of science.

The limitation of science literacy was only focus on the materials of Newton's Law. Newton's law is a material that has many applications in everyday life hence it is suitable to improve the ability of scientific literacy. this research is required to be conducted to provide reliable information in enhancing the ability of scientific literacy, the learning that provides the opportunity for the learners to be directly involved in investigation of building understanding, learning which is integrated with the use of technology in preparing the future of technology literacy and ready to compete in the 21<sup>st</sup> century. The implementation of inquiry learning with Edmodo assisted is a solution of the problems above. This research is limited to Newton's law material by taking samples of 96 students in grade X IPA SMA Negeri 4 Kerinci. The purposes of this research are described as follow:

- a. To study the improvement of cognitive aspect science literacy skill (LSK) through Inquiry Learning assisted by Edmodo.
- b. To study the improvement of the affective aspect in science literacy ability (LSA) through Inquiry Learning assisted by Edmodo.

The rest of this paper is organized as follow: Section 2 describes the proposed research method. Section 3 presents the obtained results and following by discussion. Finally, Section 4 concludes this work.

## 2. Methodology

The method used in this research was Quasi experiment with pre-post control design. The sample in this research was 96 public high school students 4 Kerinci class X IPA. The pre-test was administered before treatment to determine the learner's early ability and to determine normality and homogeneity. Treatment involved three groups treated with different treatments. Namely Class Experiment 1: Given learning Guided Inquiry assisted by Edmodo, Class of Experiment 2: Given Guided Inquiry, 3. Control Class: Given Conventional Learning.

### 2.1. The Learning Activity of Experiment Class 1

Learning activities in experimental class 1 was done after making sure all smart phones owned by students have been installed with Edmodo as online learning media. Teachers provided an understanding of Online learning to be achieved. The teacher as a facilitator guides students in the online learning in the orientation and conceptualization phase. at a face-to-face meeting the teacher guides students in doing collecting data, testing hypotheses and making conclusions.

### 2.2. The Learning Activity of Experiment Class 2

Learning Activities in experiment class 2 used Guided Inquiry model which applied face to face where teacher gave material and guide the learners doing experiment in one meeting. The teacher as a facilitator guides students from identifying problems, conceptualization, collecting data, testing hypotheses and making conclusions.

### 2.3. The Learning Activity of Control Class

Learning Activities in the control class is conventional. It is regularly method used in SMA Negeri 4 Kerinci. It used Scientific Approach method. As the facilitators, teachers guide the students in doing experiment. As students, they have to follow the experiment procedures which has been designed activity is started from observing, Questioning, Experimenting, Associating, and Communicating.

## 3. Result and Discussion

The purpose of this study is to improve the ability of scientific literacy through Guided Inquiry learning assisted by Edmodo. The teaching was done in four meetings on Newton's Law material at SMA Negeri 4 Kerinci. Data obtained from pre and post-test given before and after learning. Descriptive results of pre and post-test can be seen in Tables 1 and 2 below.

**Table 1:** Description of pre-post-test result of Science Literacy Cognitive aspect (SLC)

Scientific Literacy Cognitive Aspect (SLC)	Experiment 1		Experiment 2		Control Class	
	Pre-test	Post-test	Pre-test	Post-test	Pre-test	Post-test
Role of science	48	80	23	75	22	64
Scientific thinking and doing	38	77	35	73	27	65
Science and society:	20	88	36	75	59	71
Science media literacy:	39	82	43	74	37	74
Mathematics in science:	26	77	26	74	43	65
Maximum Score	48	80	43	75	59	74
Minimum Score	20	77	23	74	22	64
Standard Dev	10.3	9.03	10.5	8.24	8.01	9.12
Score Average	34.6	81.0	33.1	74.4	37.5	68.2
Normality	0.10	0.12	0.22	0.53	0.12	0.36
Homogeneity	Pre-test = 0.442			Post-Test = 0.492		

The descriptive results show that there are differences of pre and post-test score. It means that the treatment given to each of the class effects on the ability of SLC learners. The results of descriptive ability of SLA can be seen in Table 2:

**Table 2:** Descriptive Result of pre-post-test ability of Science Literacy Affective aspect (SLA).

Scientific Literacy Affective Aspect (SLA)	Experiment 1		Experiment 2		Control Class	
	Pre-test	Post-test	Pre-test	Post-test	Pre-test	Post-test
Value of science;	57.63	60.30	61.13	61.70	44.28	46.49
self-efficacy for scientific literacy;	57.47	64.10	54.31	59.75	59.53	59.53
personal epistemology of science	62.32	64.10	59.43	64.10	56.21	56.21
Maximum Score	62.32	64.10	61.13	64.10	59.53	59.53
Minimum Score	57.47	60.30	54.31	59.75	44.28	46.49
Standard Dev	10.01	14.03	11.12	10.21	7.43	8.70
Score Average	59.14	62.83	58.29	61.79	53.34	54.08

Normality	0.552	0.230	0.591	0.535	0.498	0.758
Homogeneity	Pre-test = 0.370			Post-test = 0.113		

Descriptive results of SLA indicate that there is difference between pre-test and post-test scores. This means that there is the affect of the treatment given in the learning. Furthermore, further analysis was done to find out the interaction between pre and post-test score. It is also intended to know the most effective treatment to improve the ability of SLC and SLA.

Further analysis used is anava mixed design to see the improvement of science literacy ability of the learners. Prior, the analysis was done to see the interaction between the types of tests provided and each independent variable. This is done by looking at the Mauchly's Test of Sphericity table by terms of significance (Sig.> 0.05) shown in Table 3 below.

**Table 3:** Mauchly's Test of Sphericity

Within Subjects Effect	Mauchly's W	Sig.
Time	.365	.000

The result of Mauchly's Test of Sphericity is (0,000 <0.05). It means that the result is significant. Then, it is proceeded by looking at Sphericity Assumed in the Tests of Within-Subjects Effects Table 4 to find out the interconnections of the enhancement [31].

**Table 4:** Tests of Within-Subjects Effects

Source		F	Sig.
Test Types * Class	Greenhouse-Geisser	3.443	.001

The result of the tests of Within-Subjects Effects shows the value of F = 3.443 with significance of 0.001. It means that there is interaction between pre and Post-test of group (experiment-control). The interaction is shown by the change of the score in pre-post-test in the three groups (experiment 1, experiment 2 and control). To know the change of Pre-test to Post-test score, the analysis of Pairwise Comparisons is done. It can be seen in the Table 5 below.

**Table 5:** Pairwise Comparisons

Class	(I) Time	(J) Time	Mean Different (I-J)	Std. Error	Sig.
<b>EC1</b>	Pre-test LSC	Post-test LSC	-46.406*	1.049	.002
	Pre-test LSA	Post-test LSA	-3.320*	2.790	.000
<b>EC2</b>	Pre-test LSC	Post-test LSC	-41.250*	2.790	.000
	Pre-test LSA	Post-test LSA	-3.151*	1.049	.003
<b>CT</b>	Pre-test LSC	Post-test LSC	-30.781*	2.790	.000
	Pre-test LSA	Post-test LSA	-663	1.049	.529

Where:

EC1 : Eksperiment Class 1

EC2 : Eksperiment Class 2

CC : Control Class

SLC : Science Literacy of Cognitive Aspect

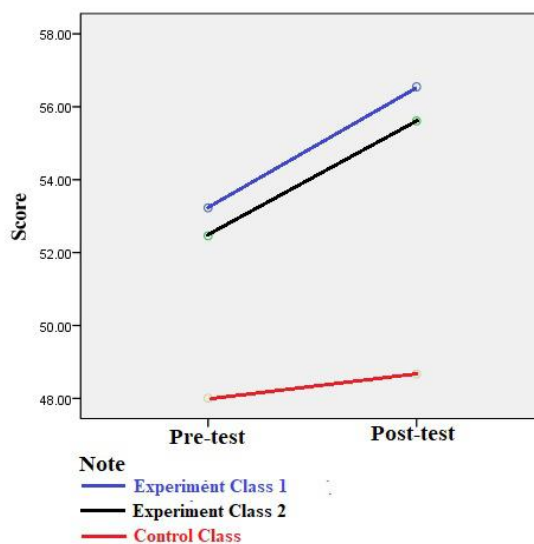
SLA : Science Literacy of Affective Aspect

Based on Table 5 above, it can be seen that the score is improve in all aspects starting from Pre-test to Post-test. this can be seen from table of Mean Different (I-J) which shows negative result which

means that the Post-test score is bigger than Pre-test score. The significance value of SLC in class EC1, EC2 and CC is (Sig. <0.05). It means that there is a significant difference between the pre and Post-test score in each of the class. The significance value of SLA in class EC1 and EC2 is (sig. <0,05) which means that there is difference of pre and post-test score in class EC1 and EC2. The significance value of SLA in control class is (0.529 > 0.05) which means that there is no significant difference, thus it can be concluded that teaching and learning using conventional method is not proper to improve the ability of SLA capability. Furthermore, a separate analysis was conducted to determine the improvement of the ability of SLA and SLC in detail.

### 3.1. Problem one; The Improvement of SLA

The improvement of SLA ability is measured based on pre-test score that change toward post-test and Effect Size (ES) or contribution of treatment improvement toward the improvement of SLA. The improvement of SLA in detail can be seen through the graphic shown in Figure 1.



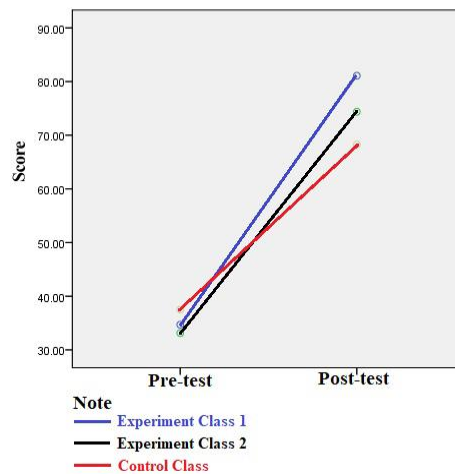
**Figure 1:** Graphics of SLA improvement

The improvement of LSA in pre to post-test score in both of the experiment class 1 and the experiment 2 is same. While control class obtained only a slight of score improvement from 48 in the pre-test to 51 in post-test.

Guided Inquiry learning assisted by Edmodo contributes much to LSA by 0.097, Guided Inquiry learning contributes 0.088 and conventional learners contribute 0.004. although ES scores in each treatment are small but ES score in experimental class 1 is greater than experiment 2 and control class, it can be assumed that Guided Inquiry learning assisted by Edmodo is more effective to improve LSA ability than Guided Inquiry and Conventional model.

### 3.2. Problem two; The Improvement of SLC

The improvement of LSK ability is measured based on pre-test score that change toward post-test and Effect Size (ES) or contribution of treatment improvement toward the improvement of SLC. The improvement of SLC in detail can be seen through the graphic shown in Figure2.



**Figure 2:** Graphics of SLC improvement

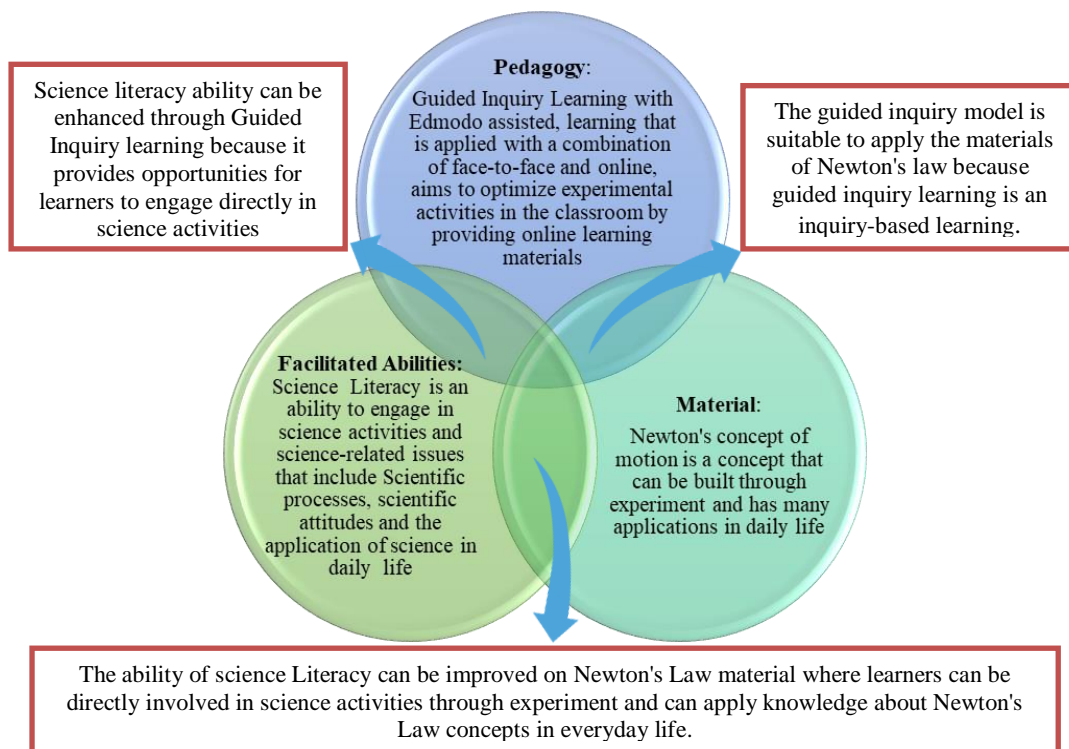
Pre-test scores of SLC ability in all classes are same in the range of 30-40. After different treatments is given in each of the group and post-test is given, there is a different score between the groups of the experimental class 1 that has a greater improve than experimental class 2 and control class. Based on the analysis using ES score, the experimental class 1 give a greater contribution in the improvement than the experimental class 2 and the control class that is 0.848 in the 'big' category.

### 3.3. Research Finding

Guided Inquiry learning assisted by Edmodo that was implemented in this research is a learning model that is developed based on student needs analysis, material analysis and analysis of students' science literacy. Guided inquiry learning with Edmodo assisted is designed to optimize inquiry activities in learning. The teacher gives material and initial understanding to students by using online learning in the first and second syntax. Students are asked to understand the material and to watch the video that the teacher has distributed through Edmodo. After that, the learners are asked to do the preliminary tasks aimed at knowing the learners' initial understanding and directing the students to make the research question and experimental hypothesis, so that learners already have background knowledge of the materials before the class is starting

Learning using guided inquiry model with Edmodo assisted in SMA Negeri 4 Kerinci is integrated with Newton's Law material characteristic and Indicator of Science Literacy in order to improve the achievement of science literacy ability of learners. The correlation between Edmodo's Guided Inquiry model with Newton's Law Material and Literacy of Science can be seen in Figure 3 below.





**Figure 3:** Correlation of Pedagogy, materials and Science Literacy Ability

Guided inquiry learning can improve students' scientific literacy skills because the guided inquiry learning model provides space to the students to build their understanding by conducting direct investigations [23]. In addition, guided inquiry learning is appropriate learning model to be applied to newton's law material because newton's law material requires daily applications so the learning model used to be needed is the model that provide direct experience to the students to construct knowledge [32]. By involving learners in science activities will improve other important aspects such as the knowledge of science, problem-solving skills and scientific procedural ability of learners[33][34]. Besides, guided inquiry learning integrated with the use of technology improves two important aspects as well as motivation in science learning and the belief in science. The Learning that is done with face to face and online has the advantage for learners in which they can monitor their own development in learning whether in the class or outside the class [27].

The implementation of mix learning models will encourage students and teachers to hold active discussions between learners and learners-teachers. In addition, to learning activities can be done anytime and anywhere without being limited by distance, space and time. The learning is flexible [35].

#### 4. Conclusion

The implementation of Guided Inquiry learning assisted by Edmodo provides opportunities for students to involve directly in science activities so that students' science literacy skills can be improved. Online learning aims at providing students with initial understanding of Newton's law so that face-to-face meetings can focus on experimental activities. The result shows that guided inquiry learning combined with online learning give great contribution to SLC and SLC ability than Guided Inquiry learning models and Conventional. In addition, Guided Inquiry learning with Edmodo assisted has the advantage that the learning will not be limited in time, and can take place anytime and anywhere. There are some things that have to be considered to apply Guided Inquiry learning with Edmodo assisted including the readiness of learners in accepting online learning. It can be detected by providing a questionnaire of e-learning readiness to the participants to know the knowledge of learners in using technology and understanding online learning.

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