

The influence of *mobile-NOS* model on students understanding on Nature of Science (NOS) and scientific literacy

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Abstract. The aim of this research was to evaluate the influence of mobile-NOS model of learning on students' understanding of Nature of Science (NOS) and scientific literacy on general chemistry course. The method employed in this research was quasi-experimental method carried out by *post-test only control group design*. The research subjects were 75 students participating in the General Chemistry course for the academic year of 2018-2019 selected by the saturated sampling method. Subjects were distributed into two groups, which were experiment and control groups. The experimental group was subjected to Mobile - NOS Model of Learning and the control group to NOS Oriented Learning. Data were collected by analysing the NOS questionnaire and scientific literacy test results. Data was analysed by independent samples t test. Research result showed that there are influence of Mobile - NOS Model of Learning to Students Understanding of Nature of Science (NOS) and Scientific Literacy.

1. Introduction

Revolutionary changes in the field of science and technology have occurred in the 21st century. This change has increased the quality of life of humankind through various breakthroughs in science and technology that spread throughout the world [1]. But the discovery and new developments that are very useful are accompanied by the emergence of alarming problems such as global warming, reduction of global energy resources, and pollution. In order to overcome these problems, it is necessary for citizens who understand science concepts, are able to think critically, creatively, reasoning, and care. It is they who can preserve the environment, health, and make decisions about social policies for themselves and their communities. This hope will be achieved if the community has scientific literacy [2]. The tendency of science education policy emphasizes the importance of scientific literacy as transferable outcomes in science education [3].

Building science literacy means focusing on building students' knowledge to use science concepts meaningfully, think critically and make balanced decisions on issues that are relevant to students' lives. However, it is often found that learning practices often ignore the social dimension of education and encourage the development of active participation skills in the community [4]. In order to build scientific literacy in students, students need to be equipped with an understanding of the nature of science (the nature of science / science). Nature of Science includes concepts about knowledge science, values and beliefs in gaining science knowledge, and their influence on society, culture and technology [5].



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According to [6] the average ability of new Indonesian students comes to the ability to recognize basic facts, but has not been able to communicate and associate these abilities with scientific topics. Students have difficulty in getting meaning and using science to solve various problems that occur in everyday life. The low literacy skills of Indonesian students can be influenced by the curriculum and education system, the selection of teaching methods and models by teachers, learning facilities and facilities, learning resources, and teaching materials. The results of the survey showed that the chemistry education students of IKIP Mataram still had scientific literacy with a low category when referring to student grades of study result in General Chemistry course. 25

Prospective science teachers such as chemistry need to be equipped with the understanding of Nature of Science in order to have good scientific literacy so that they will be able to adjust to curriculum development and the demands of educational goals in the future. This provision can be given to them through learning chemistry courses in one of them inorganic chemistry. Inorganic Chemistry learning material is rich in concepts that must be well understood that are useful in solving problems related to everyday life. The subject / material in science learning delivered correctly can contribute to achieving the goals of one's scientific literacy training. Learning chemistry contributes to particular chemical literacy, and scientific literacy in general [7].

More than that, the demand for the latest learning is the use of information technology in learning. Today mobile technology has introduced a new form of teaching and learning environment. The results of the research by [8] show that students really like interactivity, accessibility, and the convenience of mobile learning. The mobile learning system can be applied easily and cheaply as a complement in the learning process. In applying mobile learning motivation factors need to be considered as interactive and interesting. However, the main purpose of the mobile learning environment must be for education not for entertainment [9].

A mobile learning environment in a chemistry science course that contains many concepts such as inorganic chemistry is very necessary to be created in educational colleges so that prospective teacher students have the provision of experience in applying mobile learning. Mobile learning is not only limited to increasing interest and becoming entertainment but must be able to help students understand the nature of science and achieve good scientific literacy skills. Mobile learning must be packaged oriented towards the development of Nature of Science (NOS).

One model that can be applied to improve prospective teacher science literacy is Mobile Learning - NOS. According to [10], oriented learning NOS (Nature of Science) has six main steps, namely: (1) background readings, (2) case study discussions, (3) inquiry lessons, (4) inquiry labs, (5) historical studies, (6) multiple assessments. Whereas [11] have initiated the Mobile-NOS learning model, which is learning that applies the steps of NOS learning with the support of learning media in the form of mobile applications that can be applied in smart mobile phone phones. These mobile applications can be in the form of interactive module applications, teaching materials, social media, and learning websites that can be used by teachers and students both inside and outside the classroom. The stages of learning activities in the core part of the activity are reading the context of electronic articles, in-depth question and answer, case observation and intervention, procedure demonstration, literature search, carrying out procedures, communicating scientific knowledge, and authentic assessment. The implementation of the stages of learning activities must be accompanied by an explicit description of the characteristics of the NOS. Therefore, this study aims at analyzing the influence on Mobile - NOS Model of Learning to Students Understanding of Nature of Science (NOS) and Scientific Literacy on general chemistry course.

2. Methods 18

In quasi-experimental form, this was carried out by the posttest only control group design at the Faculty of Mathematics and Science Education of IKIP Mataram. The research subjects were 75 students participating in the General Chemistry course for the academic year 201-2019 that was taken by the saturated sampling method. The group consisted of 29 students who were treated by Mobile -

NOS Model of Learning as suggested by [11], while the control group of 36 students was treated with NOS oriented learning as suggested by [10].
 Data were collected by understanding the NOS questionnaire and scientific literacy test. Data was analyzed by independent samples t test. The understanding questionnaire of NOS has consisted of 39 items which are predictors of 10 aspects of NOS Understanding. The distribution of the number of items in each aspect of understanding NOS is presented in Table 1.

Table 1. Distribution of Questionnaire Item Understanding of NOS

NOS Aspect	Number of Item
Scientific knowledge is tentative	3
Scientific knowledge comes from empirical data	3
Scientific knowledge as a human inference product	3
Human creativity is needed to develop knowledge	5
Scientific method	6
knowledge is inseparable from theory / understanding of scientists (theory driven)	3
Scientific Law	4
Scientific theory	5
The social dimension of science	3
Science planting in social and cultural fields	4
TOTAL	39

Questionnaire understanding about NOS has been tested on 84 respondents. The test results show the validity of the questionnaire items with r count for each item, according to the product moment equation, greater than r table (N = 84; p = 5%) 0.215. The questionnaire reliability test results with the triple split technique on the alpha correlation test showed that the questionnaire Understanding of the NOS that had been compiled had reliability of 0.802 and was classified as very high. While the scientific literacy test is used as developed by [12].

The criteria from the results of the understanding of the nature of science and scientific literacy can be seen in Table 2. Data was analyzed by independent samples t test.

Table 2. Understanding Criteria for the Nature of Science and Science Literacy

Interval	Understanding of NOS Criteria	Scientific Literacy Criteria
81-100	Really understand	Very high
61-80	Understand	High
41-60	Understood enough	Enough
21-40	Not really understand	Low
0-20	Do not understand	Very low

3. Result and Discussion

Description of understanding of the nature of science and student scientific literacy is presented in Table 3 and the classification of understanding of the nature of science and student scientific literacy is presented in Table 4. It can be seen that the average understanding of the nature of science students in the experimental class is higher than the control class, meaning that students in the experimental class know better than the control class with the average number of students in the experimental class is 72.12 while the control class is 62.72. The significance value of the t test is 0,000 <0.05. This shows that there are significant differences in the understanding of the nature of students' science due to the applied learning. Therefore, it can be concluded that there is a media influence of the Mobile-NOS learning model on the Understanding of the Nature of Science students.

Independent sample t-test result using SPSS 16 for windows on data Understanding of NOS can be seen in Table 5, while the T-test results (independent sample t-test) with the help of SPSS 16 for windows on data Understanding of NOS can be seen in Table 6. It can be seen that the average value of scientific literacy of students in the experimental class is higher than the control class with the number of scientific literacy of students in the experimental class is 76.10 while the control class is 64.05. The significance value of the t test is 0,000 <0.05. This shows that there are significant differences in student scientific literacy due to the applied learning. Therefore, it can be concluded that there is an influence of the Mobile-NOS learning model on students' scientific literacy.

Table 3. Description of Understanding of the Nature of Science and science literacy of students

	Understanding of NOS		Scientific Literacy	
	Experiment	Control	Experiment	Control
N	29	36	29	36
The highest score	88,88	75,55	86,36	74,24
Lowest value	53,33	53,33	66,66	48,48
Average	72,12	62,73	76,10	64,05
Variant	67,22	32,29	29,62	46,37
St. Deviation	8,39	5,81	5,57	6,97

Table 4. Categories of Understanding of the Nature of Science and student scientific literacy

Category	Understanding of NOS		Category	Scientific Literacy	
	Experimen t	Control		Experimen t	Control
Really understand	5	0	Very high	7	0
Understand	18	13	High	19	15
Understood enough	5	14	Enough	3	11
Not really understand	1	9	Low	0	10
Do not understand	0	0	Very low	0	0

Table 5. Results of data on Understanding of NOS

		Levene's Test for Equality of Variances		T-test for Equality of Means						
		F	Sig.	T	df	Sig. (2-tailed)	Mean Difference	Std. Error Difference	95% Confidence Interval of the Difference	
								Lower		Upper
Underst anding NOS	Equal variances assumed	1.430	.238	4.315	42	.000	9.394	2.177	5.001	13.787
	Equal variances not assumed			4.315	37.394	.000	9.394	2.177	4.985	13.803

Table 6. Science Literacy Data t Test Result

	Levene's Test for Equality of Variances	T-test for Equality of Means								
		F	Sig.	T	df	Sig. (2-tailed)	Mean Difference	Std. Error Difference	95% Confidence Interval of the Difference	
									Lower	Upper
Scientific Literacy	Equal variances assumed	.282	.598	6.336	42	.000	12.052	1.902	8.213	15.891
	Equal variances not assumed			6.336	40.054	.000	12.052	1.902	8.208	15.897

4. Conclusion

The average value of scientific literacy of students in the experimental class was higher than the control class with the number of scientific literacy of students in the experimental class is 76.10 while the control class is 64.05. The significance value of the t test is 0,000 <0.05. This indicated a significant difference in student scientific literacy due to the applied learning.

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