Improving Science Process Skills (SPS) Science Concepts Mastery (SCM) Prospective Student Teachers Through Inquiry Learning Instruction Model By Using Interactive Computer Simulation

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Abstract: ***The low science process skills of students in middle school and there are many problems faced by science teachers in implementing learning science process skills oriented are the main factors behind this research. Thus, this research aims to improve science process skills and mastery of concepts for student teachers using a model of learning through interactive computer simulations. Data were obtained through tests conducted on respondents who covers science process skills test and test mastery of concepts. The results showed that the science process skills and mastery of the concept of student teachers can be improved through the implementation of the inquiry learning model using an interactive computer simulation. At the end of the study authors recommend that the learning model can be developed by teachers in implementing the learning of science in primary and secondary schools.***

Keywords: science process skill (SPS), science concept mastery (SCM), inquiry instruction model, interactive computer simulation, direct current circuit.

1. Introduction

Science is a compulsory subject in school that aims to equip students with knowledge about nature. Thus, students are expected to have the ability to observe, explore, and manage natural resources well and wisely. Therefore, the success of science learning in schools can be measured from two important aspects of the process of science and science products.

The process of science is a way in which the scientists to develop science products. The way it can mean an experimental activity that is try and error. According to Sund (in Sumaji, et al, 1996), experimental activities include the discovery of the problem and its formulation hypotheses, designing experiments, make measurements, analyze the data and draw conclusions. Therefore, to be able to do a quality science process skills of science needs a set of so-called science process skills (SPS). According Karamustafaoglu (2011) SPS in the top two groups, namely: basic SPS include: observing, asking questions, classifying, measurement, and predict. The second group is the integrated SPS include: identifying and defining variables, collect and transform data, create tables, graphs, and so on. The same thing is also conveyed by Harlen and Elstgeest, J (1993) " ... Thus process skills Consist of following skills; Observing, Question - raising, designing and making, predicting, hypothesizing, communicating effectively, devising and planning investigations, measuring and calculating, finding patterns and relationships, manipulating materials and equipment effectively ... "

While science products are produced everything from a science process conducted by scientists with the involvement of science process skills. Therefore, science products include hard and soft product. Which includes the hard product, such is the object of the development of science in the form of technology will, while soft products, such as a set of concepts of knowledge, a knowledge of the laws and theories.

Based on the above study, it is understood that the SPS and products of science are two very important things in science learning, so that learning science should be directed so that students can master the process of science involves science process skills (SPS) and science products through direct experience (MONE, 2005). In other words, that learning science should provide the opportunity for students to develop science process skills (SPS). With SPS quality, then students will be able to make the process of scientific quality and process quality science will produce a quality product. Thus the key to learning science is an increase in SPS students.

Nevertheless , the fact remains that many junior high school students who have not mastered properly SPS . Research conducted by Sukarno, Permanasari, Hamida (2013) showed that about 43,48% of junior high school students have the SPS scores are still relatively low. On the other hand, understanding of science teachers to SPS also still needs to be improved. This is evidenced by the acquisition score is still low, that is at 60.94, with a score range 0-100 (a case study in the city of Jambi) by Sukarno, Permanasari, Hamida (2013). Besides science teachers also still have various barriers in implementing SPS -oriented science learning (Sukarno, et al: 2013). This resulted in the implementation of development -oriented learning SPS students is still low. On the other hand, concepts, laws, principles of science as part of a product of science is also not well understood by the students. This is evidenced by the low number of Indonesian students earn science scores on TIMSS and PISA test.

One way to overcome the above problems is to equip student teachers (pre service science teacher) with the SPS-oriented learning and science products which in this case is knowledge of science which includes concepts, laws and principles and attitudes of science. By the way science student teachers are expected to have a high knowledge of the SPS, so that they can teach and develop students and also to explain the science products better.

One of model SPS -oriented learning and science products is inquiry learning model (Sund and Trowbridge in Sumaji. Et al:1998). These lessons integrate science learning with laboratory operations experience in understanding the concepts. According to John W. McBride, et al (2004) explains that the use of inquiry teaching student teachers can help improve the understanding of science concepts and science process skills.

Progress in the field of computer education is very helpful as a learning medium. Media is in addition to showing programs about the delivery of computer -based learning materials (shaped presentation, slides, or the like) can also display a virtual laboratory device. The advantages of the virtual laboratory or an interactive computer simulation can show abstract concepts that can not be displayed on a real laboratory equipment (real equipment). Besides being able to visualize abstract concepts, the use of computer simulations can also shorten the time practicum. In the mastery of concepts, students can make predictions, explanations and understanding concepts better than students who practice using real instruments (real equipment) (Zacharia, Z. and Anderson, RO, 2003).

Based on the above, then this article is aimed at enhancing mastery of science concepts and science process skills of science student teachers through the use of inquiry learning model using an interactive computer simulation. Through inquiry learning is expected to equip prospective teachers with the science true science concepts and science process skills are good, so that the teacher candidates are ready when teaching science in primary and secondary school level.

2. Research Methods

Quasi- experimental research method was conducted at one of the universities in Sulawesi Tengah province to take the subject matter of direct current electrical circuit. The sample of this study is the second semester students of Physics Education Program with one of the universities in the province of Sulawesi Tengah, the number of student teachers sampled 25 randomly selected science. In this study, researchers did not use a control group, because in this study the authors wanted more focus to observe how far the improvement of science process skills and mastery of the concepts of science student teachers to use inquiry learning model using an interactive computer simulation.

The data obtained from this study there are two types of SPS scores and mastery of science concepts. To collect the data, the researcher uses a research instrument concept test questions on the subject of direct current electrical circuits in the form of an objective test and a test of science process skills. Both types are given to student teachers in science experiment done just before (pretest) and after the experiment was completed (posttest). Thus the increase in SPS and mastery of science concepts seen an increase in the scores obtained by students of science teacher candidates. To determine how the score is calculated based on the increase in value of the gain is normalized (N - gain). Gain is normalized (N - gain) can be calculated by the equation: (Hake , 1999)

$$g = \frac{S_{post} - S_{pre}}{S_{maks} - S_{pre}}$$

Description :
g : gain normalized (N - gain) of the two approaches,
S*maks* : maximum score (ideal),
S*post* : final test score,
S*pre* : initial test scores.

High and low gain normalized (N - gain) can be classified as follows: (1) if g ≥ 0.7, the N - gain resulting in a higher category, (2) if g 0.7 > 0.3, then ≥ g N - gain generated in the medium category, and (3) if g < 0.3, then the N - gain resulting in a lower category .

3. Results and Discussion

Instrument tests, which test the mastery of science process skills and science concepts that have been given to the respondent that student teachers of science, the average score obtained as in Table 1 below:

Table 1: Scores protest, and N - posttest gain science student teachers

No	*Aspect*	*Pretest Skor*	*Postest Skor*	*N-gain*
1	SPS	23,54	58,86	46,20
2	SCM	38,9	64,45	40,1

Based on the above data obtained with a significance level of 0,05, as shown in Table 1 above, the increase in mastery of science process skills and science concepts science student teachers to increase the medium category. Thus it can be said that the inquiry learning model using an interactive computer simulation can be used as an alternative to increasing the SPS students and prospective students' mastery of science concepts by science teachers.

More in-depth analysis of the data associated with the prospective student science process skills of science teachers has increased for every type of skill that is studied. Type of skill that skill is observed, interference (concluded), predict, communicate, create hypotheses, planning experiments and apply the concepts. To view the acquisition improvement the initial test, final test, and N - gain for every type of skill can be seen in Table 2 below:

Table 2: The SPS Aspect Score

No	*Aspect of SPS*	*Pretest score*	*Postest Score*	*N-gain*
1	Observation	13,3	69,3	64,6
2	Inference	10,0	66,0	62,2
3	Prediction	26,0	82,0	75,7
4	Communication	31,8	46,3	21,2
5	Hypotesis	32,0	74,7	62,7
6	Experiment design	7,6	46,2	41,8
7	Implementation of concept	3,0	28,0	25,8

Table 2 above, shows that the science process skills of science student teachers has increased for all aspects of science process skills are tested. The increase is mainly on the biggest score predicts the type of skills, namely by 75,7 % while the lowest increase in communication skills is 21,2 %. These data prove that learning to use computer simulations in inquiry provides the opportunity for student teachers more flexibility to try and observe differences lights and power source (battery voltage value is clearly visible).

Improved high score next is the kind of skills interference (concluded) where N - gain the skills reached 62,2%. These data indicate that the use of inquiry learning model using an interactive computer simulation can give student teachers the opportunity to focus more observations (relating to the types of skills of observation on the previous question) and associate it with the concept of series and parallel. Series and parallel circuits on computer simulations with a very clear visible difference.

The increase in the types of skills of observation, planning experiment and implement the concept, the increase is not very large at around 63 %. As for the types of communication skills only reach 21,2 %. The low skills in aspects communication indicate that the use of inquiry learning model using interactive computer simulations have not been optimally develop the communication skills of student teachers. On the other hand, in-depth analysis was also conducted on the mastery of science concepts is the subject of direct current electrical circuit. The data obtained during the study can be seen in Table 3 below:

Table 3: Score mastery of science concepts science student teachers

No	*Sub concept*	*Pretest*	*postest*	*N-gain*
1	Electric Current	28,8	71,2	59,5
2	Resistance and Ohm law	33,2	55,8	33,8
3	Energy and electric power	37,5	58,7	33,8
4	Combination of resistor	49,2	60,8	22,7
5	Kirchhoff Law	32,7	69,2	54,3
6	RC circuit	15,4	34,6	22,7
7	Electric current tools	32,7	53,8	31,4

From the above data it can be seen that the highest increase achieved by the student teachers in the sub concepts is electric current, amounting to 59,5 %. These data suggest that prospective students using computer simulations in investigations can see the simulation of electron motion. Improved scores also occurred in sub concepts resistance and Ohm's law, energy and power, Kirchhoff's laws and sub concepts sub concepts electrical measuring instruments. With these simulations means that have strengthened the concept for student teachers of science. In other words it can be said that computer simulations can enhance the understanding of the electrical current.

Other findings indicate that appeared to score the test results for both sub concepts RC circuit at the beginning of the test and final test ranks the lowest. This suggests that the sub concepts RC circuit is the most difficult to master sub concepts students. However, student teachers have increased knowledge of science as indicated by a score of N - acquisition gain of 22,7 % . These data indicate that the use of computer simulations is less effective in increasing the understanding of the concept and sub concepts combination of resistor RC circuit.

The above description clearly confirm the results of previous studies that the use of computer simulations can enhance the ability to make forecasts (predictions), and understanding of concepts (Finkelstein et al (2005); Zacharia, Z. & Anderson, OR (2003)). However, in this study students who used the simulation does better in terms of explaining (communicating skills) in contrast to the results of research conducted by Zacharia, Z. & Anderson, O.R. Use of virtual lab has also been used by the University of Rio Salado and the Open University in Britain as virtually a chemical laboratory, telescope, microscope and the composition of the human frame. Virtual experiments in both universities is used in online learning and can be accessed anytime and anywhere as long as the computer is connected to the Internet network (Carol A. Twigg, 2004).

4. Conclusion

Based on the above it can be concluded that one way to improve the mastery of science process skills and science concepts for student teachers is to use science inquiry learning model using an interactive computer simulation. This model can significantly improve science process skills and mastery of the concept of direct current electrical circuits. Science process skills for this kind of observation skills, interference, predictions, planning experiments and apply concepts in inquiry learning uses interactive computer simulations to increase better than the communication skills and hypotheses. On mastery of concepts, for sub concepts electric current, resistance and Ohm's law, energy and power, and Kirchhoff's laws to increase better than the combination of resistors and the sub concepts RC circuit.

5. Recommendation

Based on the above results, the authors recommend foe the future are as follow:

a) Need to use inquiry learning model uses interactive computer simulations in teaching the concept of direct current on science student teachers. Due to the use of this model can be viewed improve science process skills and mastery of the concept of science student teachers.
b) Further research needs associated with some still not optimal science process skills and mastery of concepts by using this learning model.
c) Need further development in implementing inquiry learning model using an interactive computer simulation in elementary school, middle and upper to improve the mastery of science process skills and science concepts the students.

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