UNESA Journal of Chemical Education *ISSN: 2252-9454*
Vol. 5 No. 2, pp. 286-294, May 2016

IMPLEMENTATION OF PROBLEM SOLVING LEARNING MODEL TO TRAIN CRITICAL THINKING SKILL ON ELECTROLYTE AND NON-ELECTROLYTE SOLUTION MATERIAL AT X GRADE SMAN 12 SURABAYA

Diana Rahmawati and Harun Nasrudin
Chemistry Department, FMIPA, Unesa
e-mail: diana.rahmawati440@gmail.com, mobile phone: 087701164266

Abstrak

Penelitian ini bertujuan untuk mendeskripsikan keterlaksanaan pembelajaran, aktivitas siswa, keterampilan berpikir kritis, hasil belajar, dan respon siswa terhadap penerapan model pembelajaran *problem solving*. Metode yang digunakan dalam penelitian ini adalah metode pengamatan, tes, dan angket. Hasil penelitian menunjukkan bahwa keterlaksanaan pembelajaran melalui penerapan model pembelajaran *problem solving* memperoleh persentase keterlaksanaan pembelajaran pada pertemuan I, II, dan III masing-masing sebesar 87,50%, 91,67%, dan 95,83% dengan kategori sangat baik. Aktivitas melakukan percobaan mempunyai persentase yang paling besar pada pertemuan I dan II masing-masing sebesar 24,07% dan 23,77%, sedangkan pada pertemuan III aktivitas siswa dalam menganalisis data mempunyai persentase paling besar dengan persentase 23,46%. Keterampilan berpikir kritis siswa yang dilatihkan mengalami peningkatan dari sebelum dan sesudah penerapan model pembelajaran *problem solving* dengan skor *N-gain* sebesar 0,85 pada kriteria tinggi. Ketuntasan hasil belajar siswa secara klasikal melalui penerapan model pembelajaran *problem solving* mencapai 94,87%. Selain itu, respon siswa melalui penerapan model pembelajaran *problem solving* memperoleh persentase sebesar 98,54% dengan kategori sangat baik.

Kata kunci: *problem solving*, keterampilan berpikir kritis, larutan elektrolit dan nonelektrolit.

Abstract

The aim of this researchis to describe the learning feasibility, the students' activity, critical thinking skills, learning outcomes, and the response of students to the implementation of problem solving learning model. The method used in this research were observation, test and questionnaire method. The results showed that the learning process through the implementation of problem solving learning model to obtain the percentage of learning learning feasibilityat meeting I, II, and III respectively by 87.50%, 91.67%, and 95.83% onvery good category. Students' activity doing experiment had the greatest percentage at meeting I and II respectively 24.07% and 23.77%, while at meeting III students' activity of data analyzing had the greatest percentage with the percentage of 23.46%. Students' critical thinking skills that practiced had increased before and after implementation of problem solving learning model with N-gain score of 0.85 at the high criteria. The completeness of students' learning outcome in the classical through the implementation of problem solving learning model reaches 94.87%. Moreover, the response of the students through the implementation of problem solving learning model obtained percentage of 98.54% on very good category.

Keywords: problem solving, critical thinking skills,electrolyte and nonelectrolyte solution.

INTRODUCTION

Chemistry is one of the subjects taught at senior high school. Chemistry can establish, critical, creative, rational, dynamic, and logical thinking skills so it can establish new ideas that are useful for the purpose of technology with an important role for the improvement of human life. Correspondingly, the applied education curriculum in Indonesia now is Curriculum 2013 with the competence include attitudes, knowledge, and skills. The Curriculum 2013 is aimed to prepare the Indonesian human to have the ability to live as individuals and citizens who believe, productive, creative, innovative, and affective and able to contribute to the society, nation, state, and civilization of the world [1].

Education is the main link in the increasing process of human resources. The role of a teacher in education is very important to establish students who can learn effectively. Besides, the selection of appropriate learning methods will also be affecting the learning process which will be indicated by the learning outcomes of the students themselves. The purpose of education that expected is to develop students' potential to become human of faith and fear of God Almighty, morality, healthy, knowledgeable, skilled, creative, self-supporting, and become citizens of democratic and responsible in accordance with national education goals [2].

Implementation of learning tends to conventional that dominated by lecture methods and question and answer. During the learning process, it tends only to train aspects remembering and understanding, which is low order of thinking, even the learning process less attention to aspects of critical thinking and scientific activity of students, observation result indicate that student activity in learning remains low, students in learning tends to be more passive listeners [3].

Problem solving is model of learning in which students develop thinking skills and problem solving skills, thus learn the roles of adults and independent learners [4]. By implementing learning model of problem solving is expected that students were able to solve the problem so they can construct, establish knowledge that is more meaningful, and able to develop independence and confidence.

In problem solving, there are four steps that should be done, namely: (1) Understood the problem, (2) Devise a plan, (3) Carry out the plan, and (4) Look back. Four phase of problem solving of Polya is a unity that is essential to be developed. At this phase of problem solving Polya effective and efficient to give to the students, because the fourth phase of problem solving students are trained to be able to understand or analyze a problem, then plan a solution of the problem and implement plans problem solving or doing calculations if there are questions that require calculations and completion. After that, checking and rechecking the results of problem solving [5].

Along the development of Science and Technology at this time, greatly demanded the establishment of human resources to master of Science and Technology. The development of science and technology are changing very rapidly. This is because the people

of the world had been infected by the revolution in the field of science, technology and the arts as well as globalization, so that requires readiness of all parties to adapt to existing conditions, need to realize that with the development of science and technology, information that will get more and more variety, both the source and the essence of the information, to face technology change that rapid so the ability to critical thinking skill is an aspect that needs be emphasized in teaching.

Critical thinking is the thinking skills that should be developed and mastered students in the chemistry learning context. Critical thinking is thinking that is reasonable and reflective focused on deciding what to believe and be done [6]. In the learning process chemistry requires critical thinking skills to analyze the symptoms and phenomena that emerged. Ennis expressed twelve indicators of critical thinking skills, which were grouped into five groups of critical thinking skills, namely: (1) give a simple explanation; (2) construct the basic skills; (3) conclude; (4) give further explanation; (5) organize the strategy and tactics [6].

Based on the results of pre-research in grade of XI MIA-5 SMAN 12 Surabaya on 5 November, 2015, 73.0% of students considering that chemistry is a subject that is difficult to understand, they think it's difficult because of a lot of memorization and calculation. Student difficulties percentage of XI grade in material of electrolyte and non-electrolytes solution of 64.9%, the simple equation of 5.4%, and the redox reaction of 29.7%. This was amplified by Nuzula (2015), the research results show the student difficulties percentage of XI grade on the material of the electrolyte and non-electrolytes solution of 46.67%, the concept of oxidation and reduction reactions of 33.33% and material of compound nomenclature of 20.00%. The amount of memorization, counting and convey of teacher unattractive making materials of the electrolyte and non-electrolytes solution is difficult to understand, the teacher only use the lecture method [7].

Based on the results of pre-research in class of XI MIA-5 SMAN 12 Surabaya, to overcome difficulties in learning chemistry, as many as 81.1% of students want to learning chemistry in addition to learning theory also learn by doing experiments. In addition to student questionnaire results, obtained through interviews with the teacher of chemistry subject X grade that about more than 50% of students had not reached the KKM set by the school are 75. From the results of these interviews, in the classroom teaching methods implemented by teacher was lectures, question and answer and discussion. When implemented these learning methods enthusiastic students in learning chemistry was still less, more students who answered than asked.

Based on the results of pre-research, selected material based on the difficulty level of the students. Based on curriculum with regard Basic Competency (BC) in the curriculum can be identified that the material characteristics of the electrolyte and non-electrolytes solution are requires foresight in concluding the symptoms of electrical current in different solutions, classifying the solution into the electrolyte and non-electrolytes solution based on the type of bond. Those

material was that requires a experiment. So that students can find the difference between the characteristic of the strong electrolytes, weak electrolytes, and non-electrolytes. Experiment activity that requires observation of symptoms or phenomena will motivate students' thinking skills. According to constructivist learning theory is an attempt to do the students to construct knowledge in his mind. In order to engage more meaningful experiment, students work together in groups, this group distribution done in order to students can solve problems, answer questions, understand knowledge, and make a decision together [8].

Based on this background, research titled"Implementation of Problem Solving Learning Model to Train Critical Thinking Skill on Electrolyte and Non-electrolyte Solution Material at X Grade SMAN 12 Surabaya" will be conducted.

METHOD

The type of research that was used in this research was the Pre-Experiment, because it was only done on one group without comparison groups [9]. Goal of this research was grade of X MIA-7 SMAN 12 Surabaya.

The research design used in this research is one group pretest posttest design [9], which can be described as follows:

O_1	X	O_2

Description:
O1= Pretest
X = Treatment is learning by using learning model of problem solving
O2= Posttest

The device used in this research were syllabus, lesson plans and worksheets while the instrument used were the observation sheet of learning feasibility and student activities, sheet of test critical thinking skills and learning outcomes, as well as the student questionnaire responses.

Data collection methods include methods of observation, test, and student questionnaire responses. Methods of observation consists of observations of learning feasibility aimed to measure feasibility to the steps of problem solving learning model and students' activity to observe the students' activity during the learning process by usingproblem solvinglearning model.

The test method consists of critical thinking skills and learning outcomes test. Critical thinking skills test was used to know the critical thinking skills students individually during learning by using learning model of problem solving and tests used was description question, while learning outcomes test method used to know completeness student learning outcomes in the material electrolyte and non-electrolytes solution, the tests used in the form of multiple choice questions. The questionnaire method used to know the response of students in participating in learning by using problem solving learning model in the material of electrolyte and non-electrolytes solution.

Data analysis technique was used data analysis of feasibility problem solvinglearning model using the following formula:

$$\%\ \text{Implementation} = \frac{\sum \text{score of implemented phase}}{\sum \text{maximum score of overall phase}} \times 100\%$$

Students' activity were analyzed by using the following formula:

$$\%\ \text{Specific activity time} = \frac{\text{Time for specific activity}}{\text{overall learning time}} \times 100\%$$

Critical thinking skills data was analyzed by using the following formula:

$$\text{The value of critical thinking skill} = \frac{\text{score obtained in an indicator}}{\text{overall score in an indicator}} \times 100$$

The difference students' critical thinking skills pretest and posttest was analyzed by using N-gain score by calculating the difference in value pretest and posttest. The formula was used:

$$g = \frac{\text{posttest value} - \text{Pretest value}}{\text{Maximum value} - \text{Pretest value}}$$

The learning outcome obtained from the pretest and posttest was analyzed using the following formula:

$$\text{Students}'\text{score} = \frac{\text{Students}'\text{value}}{25}$$

The percentage of classical completeness was calculated from:

$$\text{Classical completeness} = \frac{\text{Amount of students complete}}{\text{Amount of student}} \times 100\%$$

Student responses were analyzed by using the following formula:

$$\text{Response} = \frac{\sum \text{answer of "yes" from all of students}}{\sum \text{answer maximum of "yes" from all students}} \times 100\%$$

RESULT AND DISCUSSION

The research results of problem solving learning model implementation on the electrolyte and the non-electrolyte solution material includes learning feasibility observation by using problem solvinglearning model, observation of student activity during the learning process, critical thinking skills and learning outcomes, as well as the students' response to learning that had been done.

Learning model feasibility of problem solving wasobserved by two observers consisting of one chemistry teacher and one student. Learning feasibility data of problem solving obtained from two observers observations through the observation sheet of learning feasibility of problem solving that had been made with a scoring rubric observation as a reference in observing learning feasibility. The average of learning activities feasibility at the meeting of I, II, and III respectively 87.50%, 91.67% and 95.83%, so that the implementation of the problem solving learning model during the three meetings can be done very well.

During the learning process using the problem solving learning model was closely related to students' activity. At the meeting of I and II, students' activity in the experiment had the greatest percentage that are, 24.07% and 23.77%, whereas in the meeting of III, students' activity in analyzing the data had the greatest percentage with the percentage of 23.46%. The percentage of each meeting was increasing, this is because students had been trained in answer the questions in the worksheet, so that students were able to solve the problem

correctly and the students were able to master the material taught using problem solvinglearning model.

Critical thinking skills were measured using pretest and posttest in the form of descriptive questions which consist of seven questions. Trained critical thinking skills to students during the learning process by using problem solvinglearning model. There are 7 sub-indicators of critical thinking skills trained that are formulate questions, formulate criteria for consideration of possible answer, consider the suitability of sources, consider the use of appropriate procedures, record the results of observations, use the correct evidence, conclusion from the result investigate. The N-gain score percentage of students'critical thinking skill is shown in Figure 1:

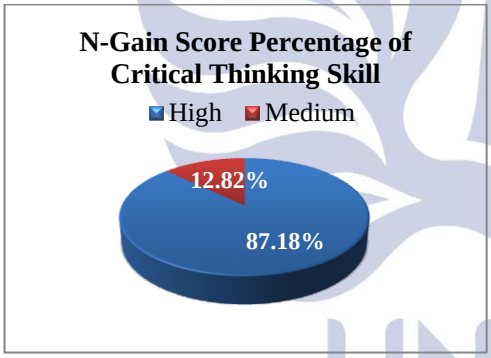

Figure 1 The Graph of N-gain Score Percentage of Students' Critical Thinking Skill

Difference critical thinking skills of students before and after implementation of problem solving learning model were known by using N-gain scores. N-gain score can be obtained by knowing the difference score between the pretest and posttest then divided by the difference between the maximum score for each sub-indicator of critical thinking skills and the pretest score. The results of analysis N-gain scores were shown in Table 1:

Tabel 1The Analysis Result of N-Gain Score

No	Pretest Score Average	Posttest Score Average	N-Gain Score	Criteria
1	31	89	0.84	High
2	29	79	0.70	High
3	43	94	0.89	High
4	53	98	0.96	High
5	37	93	0.89	High
6	30	91	0.87	High
7	30	88	0.83	High
	Average		0.85	High

Based on data in Table 1 indicate that the critical thinking skills trained increased after implementation of problem solving learning model on the material of electrolyte and non-electrolytes solution with N-gain score of 0.85 with high criteria. This indicates that the problem solving learning that had been done can train critical thinking skills of students so that the students' critical thinking skills can increase. This was appropriate with the expectations of curriculum 2013 that developed with the improvement mindset of passive learning becomes learning of constructivist and critical [1].

The completeness of student learning outcomes can be seen from the students' posttest value. It can be seen that the number of students who completed of 37 students so classical completeness after problem solving learning of 94.87%. Thus, the class stated complete classically. The Graph of classical completenesspercentage students' learning outcomes at pretest and posttest are shown in Figure 2:

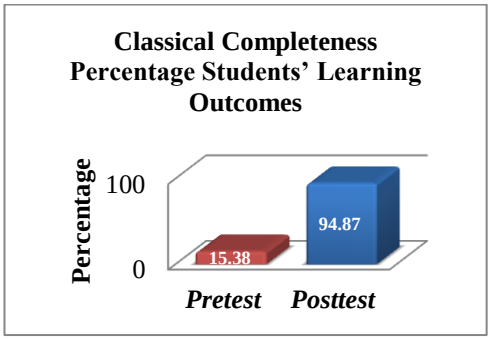

Figure 2 The Graph of Classical Completeness Percentage Students' Learning Outcomes at Pretest and Posttest

Based on the graph in Figure 2 can be seen that after the implementation of problem solving learning model classical completeness percentage increased from 15.38% becomes 94.87%. The increasing in the percentage makes classical completeness after problem solving learning becomes complete. Cognitive learning outcomes of students had increased because the students were actively in the learning process through problem solving learning model, so that the knowledge gained by the students more meaningful and students weremore understand. This indicates that the problem solving learning model can be said successful because it can improve the cognitive learning outcomes of students on the electrolyte and non-electrolytes solutionmaterial.

Improving student learning outcomes cannot be separated from social interaction between students and members of the group. When students tried to solve the problem in accordance with the worksheets provided, so the students will interact with members of the group. According to Vygotsky social interaction will motivate the development of new ideas and to enrich the intellectual development of students [8].

Students' response to the implementation of problem solving learning model on material electrolyte and non-electrolytes solution to traincritical thinking skills known through questionnaire responses were given to the students after learning by using problem solving learning model. Based on data from student questionnaire responses known that the implementation of the problem solving learning model on material electrolyte and non-electrolytes solution to train critical thinking skills grade ofX MIA-7 SMAN 12 Surabaya obtain very good response with the percentage of the overall response to the statement 98.54%. This wasbecause students feel happy, more habitual with the material that taught, and more active during the learning process. Besides the implementation of problem solving learning model can improve students' critical thinking skills.

CONCLUSION

Based on the results of research and discussion can conclude that:

1. Learning feasibility with problem solving learning model on electrolyte and non-electrolytes solution material has been performing very well. Learning feasibility at the meeting I, II, and III, respectively for 87.50%, 91.67%, and 95.83% on very good category.
2. Student activities in the experiment had the greatest percentage of the meetings of I and II respectively 24.07% and 23.77%, whereas in the meeting of III, students' activity in analyzing the data had the greatest

percentage with the percentage of 23.46 %.

3. The average N-gain score of students'critical thinking skills is 0.85 on high criteria of 0.85, it indicates that the problem solvinglearningthat had been done can train critical thinking skills of students so that the students' critical thinking skills can be said to be effective.Overall by 87.18% of students had increased critical thinking skills with high criteria and partly of students have increased critical thinking skills in the amount of 12.82% with medium criteria.
4. Learning outcomes had increased after implementation of problem solving learning model. Percentage of classical completeness increase of 15.38% becomes 94.87%. Classical completeness after implementation of problem solving learning model that is 94.87% so that the class stated complete classically.
5. Student responses to the implementation of problem solving learning model showed good results in interest in learning with percentage of 100%, the response of the students to understand the material of electrolyte and non-electrolytes solution percentage of 92.31%, and the amount of 97.44% students responded that the problem solving learning model can traincritical thinking skills.

SUGGESTION

Based on the research that had been done, there are some suggestions that should be considered by other researchers:

1. Learning by using problem solvinglearning modelrequires good time management, so that the learning in accordance with the specified time so that more optimal and meaningful.
2. In observationfeasibility of problem solvinglearning model, should the number of observers as much as 3 observers so that the data obtained is valid and the observation of students' activity should be the number of observers added to each group so that the observations done optimally.
3. In the score feasibilityproblem solvinglearning model should use score of 1-5 so that the range description more real with finer scale.

REFERENCES

1. Permendikbud. 2013. *Peraturan Menteri Pendidikan dan Kebudayaan Nomor 69 Tahun 2013 Tentang Kerangka Dasar dan Struktur Kurikulum Sekolah Menengah Atas/Madrasah Aliyah*. Jakarta: Menteri Pendidikan Nasional.

2. Depdiknas. 2003. *Undang-undang RI No 20 Tahun 2003 Tentang Sistem Pendidikan Nasional*, (Online), (http://www.dikti.go.id, accessed on 20th March 2015).

3. Sutama, I Nyoman, *et.al*. 2014. "Pengaruh Model Pembelajaran Inkuiri Terhadap Ketrampilan Berpikir Kritis dan Kinerja Ilmiah Pada Pelajaran Biologi Kelas XI IPA SMA Negeri 2 Amlapura". *e-Journal Program Pascasarjana Universitas Pendidikan Ganesha*. Vol. 4: hal.2-5.

4. Arends, Richard I. 2012. *Learning to Teach*. New York: McGraw-Hill Companies.

5. Rohmah, Siti. 2011. *Penerapan Pendekatan Problem Solving Dalam Meningkatkan Hasil Belajar Kimia Siswa Terhadap Konsep Mol Dalam Stoikiometri*. Skripsi. Jakarta: UIN Syarif Hidayatullah.

6. Ennis, Robert H. 2011. *The Nature of Critical Thinking: An Outline of Critical Thinking Dispositions and Abilities*, (Online), (rhennis@illinois.edu, accessed on 12nd December 2015).

7. Nuzula, Elfa Maghfirotin. 2015. *Penerapan Model Pembelajaran Kooperatif Tipe Number Heads Together untuk Melatih Keterampilan Berpikir Kritis Siswa Pada Materi Pokok Larutan Elektrolit dan Nonelektrolit Kelas X MIA SMAN Kesamben Jombang*. Skripsi tidak diterbitkan. Surabaya: Universitas Negeri Surabaya.

8. Nur, Mohamad, and Wikandari, Prima Retno. 2000. *Pengajaran Berpusat Kepada Siswa dan Pendekatan Kontruktivis Dalam Pengajaran*. Surabaya: Universitas Negeri Surabaya.

9. Sugiyono. 2011. *Metode Penelitian Kuantitatif, Kualitatif, dan R&D*. Bandung: Alfabeta.