

LEARNING CYCLE-7E MODEL TO INCREASE STUDENT'S CRITICAL THINKING ON SCIENCE

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ABSTRAK

Penelitian ini bertujuan untuk memperoleh model pembelajaran Learning Cycle-7E yang dapat meningkatkan kemampuan berpikir kritis siswa dan menuntaskan hasil belajar siswa SMPN 21 Semarang terhadap matapelajaran IPA. Penelitian PTK ini dilaksanakan dalam dua siklus. Siklus pertama belum menunjukkan peningkatan yang maksimum. Aktivitas bertanya kepada guru, keseriusan melaksanakan tugas, dan persiapan dalam mengikuti pelajaran masih pada kategori sedang. Ketuntasan belajar secara individual dan klasikal belum memenuhi kriteria yang ditetapkan. Oleh sebab itu, aktivitas ini menjadi fokus perbaikan pada siklus berikutnya. Hasil pada siklus ke-dua menunjukkan peningkatan yang signifikan. Kemampuan berpikir kritis telah tumbuh, aktivitas bertanya pada guru dan keseriusan dalam melaksanakan tugas meningkat pada kategori tinggi. Ketuntasan belajar klasikal sebesar 79%, melebihi kriteria keberhasilan tindakan yang ditetapkan pada penelitian ini yaitu sebesar 75%. Hal ini berarti bahwa model pembelajaran Learning Cycle-7E dapat meningkatkan kemampuan berpikir kritis siswa, tanpa mengganggu hasil belajar kognitifnya.

ABSTRACT

This research aimed to increase the students' critical thinking by designing Learning Cycle- 7E which is suitable with the criteria set out in SJHS 21 Semarang. This classroom action research was carried out in two cycles. In cycle-I, the students' critical thinking was growing but not maximum, their activity during learning process was in medium category. That is why there were several aspects of students' activity that need to be investigated. They were the students' courage to ask the teacher, their seriousness to do the assignments, and their readiness to learn as well as to prepare a question prior learning. The students' average cognitive learning outcomes and the classical learning outcomes were not very satisfied. The result of the cycle-II showed a significant improvements. The students' critical thinking was growing. The students' activity learning process was in high level. Activity aspects which improve in cycle-II were the students' willing to ask the teacher and seriousness in doing the task. The average of cognitive learning outcomes has obtained the determined criteria and the cognitive classical mastery outcomes reached 79% which was higher than the one determined for the class, 75%. In the other hand, the students' activity and critical thinking still develop without reduction in students' cognitive ability

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PENDAHULUAN

Science is one of main subjects delivered in Junior High School which has been included in the subject group evaluated by national examination since 2007/2008. This subject consists of mathematical concept and logical

reasoning material leading to the technology development. Studying science is not only memorising of particular formulas, but also applying the scientific concept on daily life activities.

In State Junior High School (SJHS) 21 Semarang, students' completeness achievement criteria is relatively high with the the minimum score is 75. However, its student's critical thinking is reported to be low. Interviews with

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teachers and students of SJHS 21 Semarang shows that learning science is carried out 70% by lecturing method and less than 10% is carried out by using instrument or learning media. Students were never trained in critical thinking. Although students of SJHS 21 Semarang has a high potential to be the outstanding students, their critical thinking has not been explored. Teachers still give information to students in a form of lecturing. They have not been explored student's critical thinking to apply the concept accepted by the students.

The increase of students' critical thinking is influenced by learning process. In order to increase students' critical thinking, there is a need of learning design which can accomodate these students' critical thinking. One of learning model which can increase students' critical thinking is *Learning Cycle-7E*. This model enables students to organize their assignment given by the teacher. This model also enables students to plan to create a particular work used for discussing problem given by the teacher. By having this kind of learning model, students can have opportunities to create a work related to science.

Based on the above background, the problems are stated as follows.

1. What is the *Learning Cycle-7E* model which can increase students' critical thinking which is suitable with the criteria set out in SJHS 21 Semarang?
2. What is the increase of activity, critical thinking and student's achievement in every research cycle?

The solution alternative can be planned in this research is by giving training to the students to be able to think creatively through the application of *Learning Cycle-7E* model. The stages of this learning model for increasing critical thinking of the students can be shown at Table 1.

Learning model shows the form of learning process from initial to final. This is a frame of application of a particular approach, method and learning technique. There is no learning model which can solve every problems in a class. The variation of learning process and its flexibility are expected can keep students' attention and increase the students' achievement. The learning model which can increase the students' critical thinking in designing science work is *Learning Cycle-7E*.

The *Learning Cycle-7E* model provides authentic and maeningfull learning situation which can give students easyness to do exp-

Table 1. Syntax of *Learning Cycle-7E* Model

LEARNING PHASE	TEACHER ACTIVITY
Phase 1 Elicit	Teacher shown more adept about prior understanding in ascertaining what students know prior to a lesson.
Phase 2 Engage	Teacher explains learning objectives and material needed and motivates students to involve in critical thinking of choosen problem solution.
Phase 3 Explore	Teacher guides students to define and organize the assignment related to the problem.
Phase 4 Explain	Teachers supports students to gather suitable information, do experiment, and to find explanation and problem solution.
Phase 5 Elaborate	Teacher guides students in designing and preparing the work.
Phase 6 Evaluate	Teacher helps students to share the assignment with their friends, evaluate and compare their understanding with their know prior.
Phase 7 Extend	Teacher guides students to extend and to do reflection about concept

(Adapted from Eisenkraft, A., 2003)

loration and inquiry (Arends, 2008). The roles of teacher in this model are stating a problem, facilitating the exploration and student dialog and supporting student learning process. This model is very effective to be used to teach the process of high level thinking ability, helping students to process gathered information and support the students to build their social and physical surrounding knowledge. This model is also suitable with the principles of *Contextual Teaching and Learning (CTL)*, those are inquiry, constructivism, and focussing on the high level thinking process. The main characteristics of *Learning Cycle-7E* are proposing problem or question, focusing interdisciplinary of study field, authentic exploration, cooperation of work, designing a work and presenting the work.

Learning Cycle-7E is not designed to help teacher to give too much information to the students. *Learning Cycle-7E* is mainly developed to help students to develop their thinking, problem solving and intellectual abilities. This learning model is also developed to help students to learn how to be an adult through their involvement in real or simulation experience and to be a self and otonom learner. Adopting a 7E model ensures that eliciting prior understandings and opportunities for transfer of learning are not omitted. The 5E learning cycle has been shown to be an extremely effective approach to learning (Lawson, 2001)

Critical thinking is the intellectually disciplined process of actively and skillfully conceptualizing, applying, analyzing, synthesizing, and/or evaluating information gathered from, or generated by, observation, experience, reflection, reasoning, or communication, as a guide to belief and action. In its exemplary form, it is based on universal intellectual values that transcend subject matter divisions: clarity, accuracy, precision, consistency, relevance, sound evidence, good reasons, depth, breadth, and fairness (Scriven & Paul, 1987).

Critical thinking can be seen as having two components: 1) a set of information and belief generating and processing skills, and 2) the habit, based on intellectual commitment, of using those skills to guide behavior. It is thus to be contrasted with: 1) the mere acquisition and retention of information alone, because it involves a particular way in which information is sought and treated; 2) the mere possession of a set of skills, because it involves the continual use of them; and 3) the mere use of those skills ("as an exercise") without acceptance of their results.

Critical thinking varies according to the motivation underlying it. When grounded in selfish motives, it is often manifested in the skillful manipulation of ideas in service of one's own, or one's groups', vested interest. As such it is typically intellectually flawed, however pragmatically successful it might be. When grounded in fairmindedness and intellectual integrity, it is typically of a higher order intellectually, though subject to the charge of "idealism" by those habituated to its selfish use (Ennis, 1996). Ideal ability critical thinking of the students can be shown at Table 2.

METHOD

This research is a class room action research with three cycles; each cycle consisting of the planning, action, observation, and reflection phases (Kemmis & Taggart, 1988; Mundilarto, 2004). The subjects in this study are eighth grader students of Semarang SJHS 21 in 2012/2013 school. Class VIII H is chosen as research subjects because it is an RSBI class that needs to be accelerated its potential for critical thinking.

This class room action research consists of several cycles, each of which consists of four stages, those are planning, action, observation and evaluation, analysis and reflection phases. The procedures of each cycle are as follows.

a. Planning

Activities undertaken at the planning stage are as follows: (1) Preparation and compilation of Lesson Plan (RPP) consisting of setting learning goals, determining the model and learning method in accordance with the material, (2) designing the worksheet, (3) designing assessment instrument preparing a questionnaire, designing observation sheet, and (4) preparing equipment and materials used in the learning process.

b. Acting

In this stage, the activity being done is applying the learning model of *Learning Cycle-7E*.

c. Observing

In order to know the success rate of the actions taken, teacher observes the students in the learning process. In observing process, teacher is assisted by colleagues. Student performance is observed using the observation sheet. The aspects observed are:

1. Readiness of students in following the lesson,
2. Activity of students in the lesson,

Table 2. Ability Critical Thinking in This Research

Aspects of ability Critical Thinking	Indicators
1. Focus on a question	a. Identify or formulate a question b. Identify or formulate criteria for judging possible answers c. Keep the situation in mind
2. Analyze arguments	a. Identify conclusions b. Identify stated reasons c. Identify unstated reasons d. Identify and handle irrelevance e. See the structure of an argument f. Summarize
c. Ask and answer questions of clarification and/or challenge	a. Why? b. What is your main point? c. What do you mean by ?
d. Judge the credibility of a source	a. Expertise b. Lack of conflict of interest c. Agreement among sources d. Reputation e. Use of established procedures f. Known risk to reputation g. Ability to give reasons h. Careful habits
e. Observe, and judge observation Reports	a. Minimal inferring involved b. Short time interval between observation and report c. Report by the observer, rather than someone else

3. Students' critical thinking, and
4. Cooperation of students in group work.
 Observer also observes teacher performance when teaches Energy materials.

d. Reflection

Activity in this reflection phase is to analyze the data gathered during the action phase in both qualitative and quantitative one. The result of this analysis is used to determine or design the activities to be carried out on the next cycle.

In the second cycle, activities of designing, implementing, observing and evaluating, as well as analyzing and reflecting are still being done, but for different material. Implementation on the second cycle will consider the weakness occurred in cycle I. So forth, the cycle will stop when the target has been achieved.

Data collection techniques used in this research are observation, interviews, daily notes, and science tests. The success of these actions will be done by analyzing data taken by

the observers in the learning process and then discussing the observation with the observer to determine the action on the next cycle.

Data are collected using test and non-test techniques. Test technique is used to determine students' level of understanding of the concept of Optical Instrument material. The data collection instrument for this is in the form of formative test item. Formative test form is a description/essay test suitable with the concept being studied.

Non-test technique is carried out by using two ways, namely:

1. Observation, using the observation sheet to know things related to the critical thinking of students in learning. Observations are carried out on each cycle of a number of cycles to be performed. Cycle I as the beginning of the cycle gives the action, followed by a second cycle and so on, until the reached of the target set. Last cycle is performed as strengthening of the use of action.

2. Student opinion polls, using a questionnaire sheet. This technique is used to determine the impression of students towards the presented lesson.

In this data collection the researcher was assisted by teacher / peers who make observations/observations during the action or learning activities both in the first cycle and subsequent cycles. In addition, peers also provide input or suggestions from observations when the researcher engaged in reflection.

Data analysis techniques used have been set based on the research problems to be solved. The increase of students' critical thinking is defined by using normalized *gain* formula, a modified version of the *g*-factor as formulated by Savinainen & Scott (2002). The formula is as follows.

$$\langle g \rangle = \frac{S_{final} - S_{initial}}{100\% - S_{initial}}$$

S_{final} dan $S_{initial}$ show average score of final and initial activities expressed in percent. Criteria of *g* are: high if $g \geq 0,7$; medium if $0,3 \leq g < 0,7$; and low if $g < 0,3$ (Hake, 1998; Savinainen & Scott, 2002)

Instrument of the research used are as follows.

1. Teacher observation sheet for measuring teachers' performance, whether it is suitable with learning model or not.
2. Student observation sheet for measuring students' critical thinking and activity in learning.
3. Students' worksheet as a learning instrument to be used during the learning process.
4. Student questionnaire for gathering criticism, suggestions and opinions of students towards learning activities undertaken.

Efforts to improve the critical thinking of students in designing science work through the application of learning model of *Learning Cycle-7E* in science class in SJHS 21 Semarang is successful, if:

1. More than 75% of students are active in discussions and group work both in designing experiments and modeling instrument that apply the principles of Energy.
2. Classical mastery learning outcomes $\geq 75\%$ and students have obtained a mark of ≥ 7.5 .
3. Critical thinking of the students is located minimally on the medium category.

The category of group critical thinking in this study are as follows:

$X < 11$ – low

$12 \leq X \leq 18$ – medium

(Ennis, 1996)

$X > 19$ – high

Scoring criteria of this research are as follows.

- Score **1** if the answer of students satisfies indicator is $< 25\%$
 - Score **2** if the answer of students satisfies indicator is $25\%-50\%$
 - Score **3** if the answer of students satisfies indicator is $50\%-75\%$
 - Score **4** if the answer of students satisfies indicator is $\geq 75\%$
4. Activity of the students is located minimally on the high category. The category of group activity in this study are as follows:
 - $10.0 < X \leq 20.0$ – low
 - $20.0 < X \leq 30.0$ – medium
 - (Ennis, 1996)
 - $30.0 < X \leq 40.0$ – high

RESULT AND DISCUSSION

Results

The results are reported for each cycle. Each cycle consists of four stages, those are planning, action, observation and evaluation, analysis and reflection phases. The complete results are as follows:

Result for Cycle I Planning

The results for planning stage are lesson plan, students worksheet, and evaluation instruments such as instruments assessment, observation sheet, and questionnaire sheet about students' activity and creativity.

Acting

In Cycle-I aiming for phases of (1) elicit (2) engage (3) explore (4) explain, (5) elaborate, and (6) evaluating. The teacher activities are: (1) shown more adapt about prior understanding in ascertaining what students know prior to a lesson, (2) explains learning objectives and material needed and motivates students to involve in critical thinking of chosen problem solution, (3) guides students to define and organize the assignment related to the problem, (4) supports students to gather suitable information, do experiment, and to find explanation and problem solution, (5) guides students in designing and preparing the work,

Table 3. Critical thinking, Activity, Mastery of Cognitive Learning Outcomes

Number	Observation Aspects	Score	Criteria
1	Critical thinking	11.8	Medium
2	Activity	27	Medium
3	Cognitive Learning Outcomes	average = 27.5 Classical Mastery Outcomes = 27%	not obtained

Table 4. Gain Students' Critical Thinking of Cycle-I

Number	Assessment Aspects	Gain	Criteria
1	Focus on a question	0.41	Medium
2	Analyze arguments	0.47	Medium
3	Ask and answer questions of clarification and/or challenge	0.32	Medium
4	Judge the credibility of a source	0.37	Medium
5	Observe, and judge observation Reports	0.37	Medium

(6) helps students to share the assignment with their friends, evaluate and compare their understanding with their know prior, and (7) guides students to extend and to do reflection about concept.

Observation and Evaluation

The result of observation and evaluation for cycle-I consist of critical thinking, activity, mastery of cognitive learning outcomes. The result is presented in Table 3. Students' critical thinking is presented in Table 4.

Analysis and Reflection

According to the observation results, it can be concluded that the students' critical thinking is growing but not reach maximum criteria. The students' activity during learning process is still categorized in medium level. Aspects of students activity that need to be concerned are their courage to ask the teacher, seriousness to do the assignments, readiness to learn as well as to prepare the question prior learning. Assessment of the students' cognitive learning outcomes cannot reach the determined criteria, 75. The classical learning outcome is obtained only 27%. This percentage is still far from the determined criteria, 75%.

Based on the observation results of the teacher activities it can be reported that the learning process was focus on organizing students to make a critical thinking but not on concept mastery. That is why it is important to do an improvement effort for the next cycle.

The learning stage should be improve in the cycle-II is organizing students to learn. In

this phase the concept mastery is more stressing than critical thinking. It can be done by directing the students to learn the important concepts that will be discussed in the next meeting.

Result for Cycle II Planning

The results of the planning stage are pre test form of the experiment; lesson plan of the constructivism learning based using *Learning Cycle-7E* model; and observation sheet which already made in the cycle-I. In cycle-II, the teacher directs the students to learn the important concepts that will be discussed in the next meeting.

Acting

Implementation in Cycle II was focus on supports students to gather suitable information, to do experiment, and to find explanation and problem solution. Completely implementation in cycle-II are: (1) shown more adapt about prior understanding in ascertaining what students know prior to a lesson, (2) explains learning objectives and material needed and motivates students to involve in critical thinking of choosen problem solution, (3) guides students to define and organize the assignment related to the problem, (4) supports students to gather suitable information, do experiment, and to find explanation and problem solution, (5) guides students in designing and preparing the work, (6) helps students to share the assignment with their friends, evaluate and compare their understanding with their know prior, and (7) guides students to extend and to do reflection

Table 5. Critical thinking, Activity, Mastery of Cognitive Learning Outcomes

Number	Observation Aspects	Score	Criteria
1	Critical thinking	22.8	High
2	Activity	32	High
3	Cognitive Learning Outcomes	average = 76.2 Classical Mastery Outcomes = 79%	Obtained

Table 6. Gain Students' Critical Thinking of Cycle-II

Number	Assessment Aspects	Gain	Criteria
1	Focus on a question	0.47	Medium
2	Analyze arguments	0.55	Medium
3	Ask and answer questions of clarification and/or challenge	0.41	Medium
4	Judge the credibility of a source	0.71	High
5	Observe, and judge observation Reports	0.69	Medium

tion about concept.

Observasi dan Evaluasi

The result of observation and evaluation for cycle I consist of creativity achievement, activity, science work, mastery of cognitive learning outcomes. The result of observation and evaluation of cycle-II is presented in Table 5. Students' critical thinking is presented in Table 6.

Analysis and Reflection

According to the observation result it can be concluded that the students' critical thinking is growing better than in cycle I. The students' activity during the learning process is growing to a high level. Activity aspects which improve in cycle II are the students' willingness to ask the teacher and seriousness in doing the task. Activity aspects which still need to improve are readiness to join the class as well as making questions before joining the class. Assessment of the students' critical thinking obtained a good category. The average of cognitive learning outcomes has obtained the determined criteria. The average of learning achievement is 76.2. The average that is determined for the class is 75. The cognitive classical mastery outcomes reached 79%. It is higher than the one determined for the class, 75%.

The result of teacher activity observation reports that the Learning Cycle 7E model which focuses on stressing essential concepts before organizing students to do an experiment, and to find an explanation and problem solution can in-

crease the mastery of learning individually and classically. On the other hand, the students' activity and critical thinking still develop without reduction in students' cognitive ability. That is why the same improvement efforts for the next cycle are still important. The effort is needed to investigate the consistency of the implementation of the learning model.

The learning stage that needs to improve in the cycle is organizing students to learn. These improvement efforts consist of stressing essential concepts, assigning students to do an experiment, and to find an explanation and problem solution that will be discussed in the next meeting.

Discussion

In cycle I, the students' critical thinking is growing but not maximum. Students' activity during the learning process is still in a medium category. Aspects of students' activity that need to be concerned are their courage to ask the teacher, seriousness to do the assignments, readiness to learn as well as to prepare the question prior to learning. The students' average cognitive learning outcomes, 27.5, cannot reach the determined criteria, 75. The classical learning outcome is obtained only 27%. This percentage is still far from the determined criteria, 75%. Based on the observation results of the teacher activities it can be reported that the learning process was focused on organizing students to make a science work but not on concept mastery. That is why it is important to do an improvement effort for the next cycle. The learning stage should be improved in the cycle.

II is organizing students to learn. In this phase the concept mastery is more stressing. It can be done by directing the students to learn the important concepts that will be discussed in the next meeting.

The result of the cycle-II show a significant improvements. The students' activity during learning process is growing better than in cycle-I. The students' activity in cycle-II in high level. Activity aspects which improve in cycle-II are the students' willing to ask the teacher and seriousness in doing the task. Activity aspects which still need to improve are readiness to join the class as well as making questions before join the class. The average of cognitive learning outcomes has obtained the determined criteria. The average of learning achievement is 76.2. The average that determined for the class is 75. The cognitive classical mastery outcomes reached 79%. It is higher than the one determined for the class, 75%. The result of teacher activity observation reports that learning cycle 7E model which focus on stressing in essential concepts before organizing students to make a science work can increase the mastery learning individually and classically. In the other hand, the students' activity and creativity still develop without reduction in students' cognitive ability. That is why the same improvement efforts for the next cycle is still important. The effort is needed to investigate the consistence result of the implementation learning model. The learning stage that need to improve to the cycle is organizing students to learn. These improvement efforts consists of stressing of essential concepts, assigning students to do experiment, and to find explanation and problem solution, and assigning students to make questions regarding with the material that will be discussed in the next meeting.

Based on the result in cycle-I and cycle-II it can be conclude that implementation of Learning Cycle 7E model can develop the students critical thinking. It is suitable with Puspo, *et al.* (2012) statement that by Learning Cycle 7E model, the students critical thinking will be developed.

The Learning Cycle 7E model applied is not only to improve the students' critical thinking but also to increase the students' learning outcomes. In this research in the end of every cycle the formative tests is done to measure the cognitive mastery outcomes. The result of the test is always changing for every cycle. In the cycle I the average of the students learning achievement is 27.5 and it become 76.2 in the

cycle II. In the cycle I, there were so many students which have scores less than the classical mastery outcomes, 75. But, in the cycle II the classical mastery outcomes is 79%, it means that the class has pass over the determined classical mastery outcomes. It is suitable with result of researchs' Birisci & Metin (2010) and Puspo, *et.al.* (2012).

CONCLUSION AND SUGGESTION

Conclusion

The application of Learning Cycle 7E model in teaching Energy of eighth grader students of Semarang SJHS 21 is proven can improve the critical thinking. Through the model, the critical thinking score are increase, the activity score are increase too, and the students's cognitive mastery outcomes are improve. This condition have a good agreement that the model is suitable to apply in this classroom action research.

According to the result of the research it can be proposed as follows: (1) basically, collaborative work in classroom action research is a means of increasing teacher professionalism in teaching and learning (2) classroom action research is need to be applied continuously in order to find solutions for problems of improving learning quality.

Suggestion

Based on the result of the research it can be suggested that the teacher should vary the learning model in explaining science concept. The choosen model should be a model which can increase the students' critical thinking and students' cognitive capability. The teacher should accustomed the students to critical thinking by assigning them to do experiment, to find explanation and problem solution, and to make questions regarding with the material that will be discussed in the next meeting to understand the concepts.

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