# Application of Learning Cycle 5e Model Aided Cmaptools-Based Media Prototype to Improve Student Cognitive Learning Outcomes

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## Abstract

The research was motivated by the lack of students's learning ability caused by their difficulties in understanding abstract physics concepts. Cmaptools-based media prototype aided 5E Learning Cycle (5EPMBCT) learning method may be an alternative solution to this problem, because it can help students learn from his own experiences so that they can apply the concepts and also by using CT-based media, it is possible to visualize abstract Physics concepts. This research used a pre-experimental design method with one group pretest-posttest research design implemented in one of class VII at the Junior High School in West Bandung regency. The purpose of this study is to find out how the improvement in student cognitive learning outcomes after the implementation of 5EPMBCT learning model. The results showed that cognitive learning outcomes with normalized gain <g> valued at 0.58 with moderate category. This research produces learning models product and CmapTools-based learning media for straight motion. However, there are still many things that need to be improved, such as content development of PMBCT teaching material.

Keywords: 5E Learning Cycle, CmapTools-based media prototype, student's cognitive learning outcomes

## 1. Introduction

Learning outcomes is abilities possessed by students after receiving their learning experiences (Sudjana, 2009). Based on observation done by Utami (2011), in learning process in class, Physics concepts was cannot be visualized by students so that they have difficulties in understanding the underlying concepts which is reflected in students's low study achievement and motivation. Based on Physics (IPA) learning questionnaire, it is known that 70,6% of students face difficulties in understanding Physics concepts and thus lowering their learning outcomes (Alfiani, 2012). Analysis result shows that student's daily examination average mark at 50.4 is lower than the standard Kriteria Ketuntasan Minimal (KKM) at 65. Based on that fact, a new learning model is needed which gives a meaningful learning process for students, so that they can grasp the concepts and in turn will increase their learning outcomes. One of such learning model is 5E Learning Cycle model.

5E Learning Cycle model is born from learning constructivism paradigm which is part of Vygotsky social constructivism and Ausebel meaningful learning theory (Akar, 2005). This learning model consist of *engagement, exploration, explanation, elaboration* and *evaluation* phase (Bybee, 2002, 2009; Bybee et al., 2006a, 2006b; Bybee, 2002; Chiapetta & Koballa, 2006; Coe, 2001; Ergin et al., 2008; Turk & Calik, 2008; Volkman & Abell, 2003). Every "*E*" in *Learning Cycle* shows a part from sequential process to help students learning from their experiences and then linked it to a new concetps (Calik & Mehmet, 2008). According to Colburn and Clough research (Akar, 2005), they showed that *Learning Cycle 5E* is an effective way to assist students, enjoying knowledge, understanding contents, and applying scientific concepts and process for authentic situation.

The lack of learning media that can visualize complex Physics phenomenon can be overcome by using ICT. With the help of ICT tools such as computer and software, complex Physics concepts can be visualized statically or dynamically (graphic animation). Institute for Human and Machine Cognition (IHMC) has developed *CmapTools* (Canas et al., 2004), which is a client-server software for easily construct and visualize concept maps. *CmapTools* can be used to utilize internet network so that students can use it anywhere. *CmapTools* provides

facility to develop a "comprehension/understanding model" which is a component or concept map set and associate all data source related to that topic (Canas et al., 2003b). Novak (1985) said that concept map is a systematic and concise knowledge.

*CmapTools* based media prototype is example model or a model from CmapTools based learning model. Inside the prototype, there are teaching materials that can visualize Physics phenomena to help students understants the underlying concepts of the phenomena. PMBCT can be made into a good learning media because it can explain the whole concepts. Media can give stimulus in form of moving or static pictures, recorded writings or sound, or their mixing as learning source. Thus, learning media used in learning process takes effect to learning effectivity (Jamaludin, 2011; Sudrajat, 2008). Usage of media in learning is making it easier for students to understand abstract concepts. This corresponds to Jerome S Bruner opinion that students learn through three phases, that are enactive, iconic, dan symbolic (Supriatna, 2009). Learning phase principle from Jerome S Bruner can be applied in "*cone of experience*" which is proposed by Edgar Dale in 1946 (Supriatna, 2009).

#### 2. Methodology

Method used in this research is *pre-experimental design*. Research design used is *one group pretest and posttest design*. This design is shown in Table 1.

Table 1. One group pretest and posttest design scheme (Arikunto, 2010)

| Pretest        | Treatment | Posttest       |
|----------------|-----------|----------------|
| T <sub>1</sub> | Х         | T <sub>2</sub> |

Population in this research is all class VII students in one of SMP (Junior High School) in Kabupaten Bandung Barat. Number of sample is 30 students and sampling is done using purposive sample method. Data processing technique used in this research is shown in Table 2.

Table 2. Data processing technique of research instrument

| Type of Data                | Instrument   | Data Processing<br>Technique   |  |
|-----------------------------|--|--------------------------------|--|
| Cognitive Learning Outcomes | Multiple choice objective tests about straight<br>motion. Cognitive learning used includes<br>recitation (C <sub>1</sub> ), comprehension (C <sub>2</sub> ),<br>application (C <sub>3</sub> ), and analysis (C <sub>4</sub> ) according<br>to Bloom. Questions used have been judged<br>and trial tested. Result of the trial shows that<br>questions reliability is at 0.88 by using<br>KR-20 calculation. After trial, valid<br>questions consists of two questions<br>measuring (C <sub>1</sub> ), 13 questions measuring (C <sub>2</sub> ),<br>eight questions measuring (C <sub>3</sub> ), and five<br>questions measuring (C <sub>4</sub> ). | Normalized Gain<br>(Hake,1998) |  |
| Model Feasibility           | Observation format   | Percentage Interpretation      |  |
| Students response to PMBCT  | Questionaire   | Percentage                     |  |

Normalized gain score can be stated in the following formula (Hake, 1998)

$$< g > = \frac{\% < G >}{\% < G >_{maks}} = \frac{(\% < S_f > -\% < S_i >)}{(100 - \% < S_i >)}$$
(1)

Table 3. Learning effectivity criteria (Hake, 1998)

| Percentage          | Effectivity |
|---------------------|-------------|
| $0,00 < g \le 0,30$ | Low         |
| $0,30 < g \le 0,70$ | Moderate    |
| $0,70 < g \le 1,00$ | High        |

5E Learning Cycle has several phases consists of engagement, exploration, explanation, elaboration, and evaluation. In 5E Learning Cycle learning model, PMBCT is saved on engagement and explanation phase on each learning session.

Table 4. PMBCT used in 5E Learning Cycle phases

| 5E Phase    | Learning Activity by Using PMBCT  |
|-------------|---|
| Engagament  | Teacher gives lecture using PMBCT media such as videos and pictures that can raise students's interest and explore their initial concept.                             |
| Exploration | Students can prove their hypotheses by performing experiments. In this phase, Teacher shows PMBCT to explain experiment procedures and directions how to fill up LKS. |
| Explanation | Teacher gives detailed explanation by using PMBCT in form of learning videos.   |
| Elaboration | Students are trained to apply the concepts in different contexts.   |
| Evaluation  | Teacher gives several questions to students about the teaching material they just learned and gives chance to them to evaluate their comprehension.                   |

#### 3. Result and Discussion

#### 3.1 Cognitive Learning Outcomes

Improvement in cognitive learning outcomes after applying 5E PMBCT is determined by the value of average normalized gain (<g>) according to Hake (1998). Generally, research data of this cognitive learning outcome can be summarized in Table 5 below.

Table 5. Research data of cognitive learning outcome

| Test      | Average Score | Gain | <g></g> | Category  |
|-----------|---------------|------|---------|-----------|
| Pre-test  | 6,57          | 12.5 | 0.58    | Moderate  |
| Post-test | 19,07         | 12,5 | 0,50    | Wioderate |

According to Table 5, it is known that *pretest* average score obtained by students is 6.57. After learning, their posttest average score is 19.07. This is a hint that there is improvement from *pretest* to *posttest* with gain 12.5, and normalized gain 0.58 which is in moderate category. If every aspect is analyzed then cognitive learning outcome result is summarized in Table 6.

Table 6. Every aspect of cognitive learning outcome result

| <b>Cognitive Area</b> | C1       | C2       | C3       | C4       |
|-----------------------|----------|----------|----------|----------|
| <g></g>               | 0,45     | 0,59     | 0,57     | 0,59     |
| Category              | Moderate | Moderate | Moderate | Moderate |

From Table 6, it can be seen that there is improvement in every area used as variable in this research. Normalized gain value of every aspect is different but still in the same moderate category. Normalized gain from  $C_2$  and  $C_4$  is higher than other aspects, meanwhile lowest normalized gain value is on  $C_1$  aspect.

## 3.2 5E PMBCT Learning Model Feasibility

5E learning model with the help of PMBCT is applied in one of class VII in a state Junior High School (SMP) in Kabupaten Bandung Barat during three class sessions. In 5E learning model, PMBCT is saved in *engagement* and *explanation* phase. Generally, feasibility percentage of PMBCT Aided 5E Learning Cycle implementation in every session is shown in Table 7.

|              | Session |        |        |        |        |        |
|--------------|---------|--------|--------|--------|--------|--------|
| Learning     | 1       |        | 2      |        | 3      |        |
| Phase        | AG      | AS     | AG     | AG AS  |        | AS     |
|              | (%)     | (%)    | (%)    | (%)    | (%)    | (%)    |
| Engage-ment  | 85,70   | 85,70  | 83,33  | 83,33  | 94,44  | 88,89  |
| Exploration  | 86,67   | 93,33  | 93,33  | 91,33  | 93,33  | 86,67  |
| Explana-tion | 91,67   | 83,33  | 83,33  | 83,33  | 91,67  | 83,33  |
| Elabora-tion | 100     | 66,67  | 100    | 66,67  | 100    | 66,67  |
| Evaluati-on  | 100     | 66,67  | 100    | 66,67  | 100    | 66,67  |
| Total        | 464,04  | 395,70 | 459,99 | 391,33 | 479,44 | 392,23 |
| Average      | 92,81   | 79,14  | 91,99  | 78,27  | 95,89  | 78,44  |

Table 7. Feasibility percentage of pmbct aided 5e learning cycle implementation in each session

Highest feasibility percentage of Teachers and Students activity is in *exploration* and *explanation* phase. In *exploration* phase, the feasibility percentage is the same for both teachers and students because in this phase students actively proposing hypotheses about problems given by teachers and collecting data. Teachers were only give feedbacks and suggestions when students raise questions. Teachers's activity percentage is higher than students's in *explanation* phase. Actually, students supposed to be more dominant than teachers in this phase, but in fact students is still shy to communicate their experiment result.

PMBCT is a set of teaching material that developed based on concept map. Teaching materil set used in this research is in form of video, learning animation, experiment guide, and evaluation questions set of cognitive learning about straight motion. Straight motion PMBCT used in this research is presented in Picture 1.

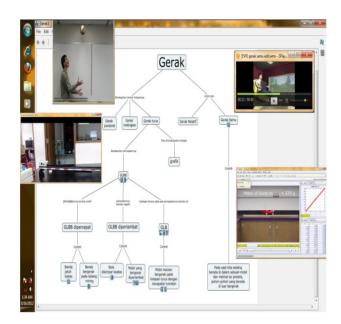


Figure 1. Straight Motion PMBCT Media

#### 3.3 Student's Response to PMBCT

Students's respons to the use of PMBCT can be evaluated from questionnaire result. The questionnaire consists of 13 questions where two questions (number 2 and 4) are about the clarity of video and animation in PMBCT, four questions (number 5, 6, 8, and 9) are about content in PMBCT, and seven questions (number 1, 3, 7, 10, 11, 12, and 13) is about PMBCT that can motivate students's learning outcomes. Generally, students's response to PMBCT can be seen in Table 8.

| Statement  | Normh an im Ourastian sins | Number of Students (%) |      |     |     |
|--|----------------------------|------------------------|------|-----|-----|
| Statement  | Number in Questionaire —   | SS                     | S    | TS  | STS |
|  | 5                          | 50                     | 43,3 | 6,7 | 0   |
| Contant in <b>DMDCT</b> is a set                     | 6                          | 37                     | 60   | 3,3 | 0   |
| Content in PMBCT is good.                            | 8                          | 27                     | 73   | 0   | 0   |
|  | 9                          | 30                     | 60   | 10  | 0   |
| PMBCT can give motivate students's learning outcomes | 1                          | 16,7                   | 83,3 | 0   | 0   |
|  | 3                          | 26,7                   | 70   | 3,3 | 0   |
|  | 7                          | 46,7                   | 50   | 3,3 | 0   |
|  | 10                         | 30                     | 60   | 10  | 0   |
|  | 11                         | 43,3                   | 53,3 | 3,3 | 0   |
|  | 12                         | 23,3                   | 66,7 | 10  | 0   |
|  | 13                         | 43,3                   | 46,7 | 10  | 0   |
| The clarity of video and                             | 2                          | 26,7                   | 70   | 3,3 | 0   |
| animation in PMBCT                                   | 4                          | 23,3                   | 70   | 6,7 | 0   |

Table 8. Students's response to PMBCT

According to Table 8, most of students give positive response to the statement "Content in PMBCT is good". Most students also give positive response to statement "PMBCT can give motivate students's learning outcomes". This is shown by the improvemen in students' cognitive learning outcomes. Lastly, most of students give positive response to the last statement, with only one animation that cannot be seen clearly.

Based on the result of the research it can be noted several findings. Findings, discussions and solutions for the next learning process is as follows:

- The result shows that there is improvement in student's cognitive learning outcomes from *pretest* to *posttest* after applying 5E Learning Cycle learning method with PMBCT assistance. Normalized gain for the cognitive learning outcomes is 0.58 in moderate category. Such moderate gain achievement is caused by below optimum activities performed by teachers and students during each phase of learning process. Teachers' activities are more dominant compared to that of students. Student learning outcomes analysis for every cognitive aspect is presented below:
- a) In  $C_1$  cognitive aspect, normalized gain at 0.45 with moderate category was obtained. In this aspect, students are still weak in ability to recall or remembering concepts.
- b) In  $C_2$  cognitive aspect, we got normalized gain at 0.59 with moderate category. Int this aspect, students are still weak in ability to make interpretation. For example, students cannot explain in detail the meaning of or interpretation of a concept or principle.
- c) In C<sub>3</sub> cognitive aspect, normalized gain at 0.57 with moderate category was obtained. In this aspect, students have lack of ability to elaborate a problem. In elaboration phase, problems given to them have medium level of complexity so that it cannot explore students' abitily deeper.
- d) In C<sub>4</sub> cognitive aspect, normalized gain at 0.59 with moderate category was obtained. In this aspect, students' have lack of ability to analyze organized principles. For example, students are still weak in deciding the meaning or interpretation of graph.

Learning process that must be done to improve above results is as follows:

- a) Information conveyed to students in learning process has to be transferred not retentioned so that students can connect that information with their own knowledge, which in turn make the process more meaningful. According to Mayer and Wittrock, transferring is an ability to use what has been learned before to solve new problems, answer new questions, or make it easier to learn new lessons (Anderson & Kartwhol, 2010).
- b) Procedural knowledge have to be trained to improve the execution ability. According to Bransford, Brown, and Cocking, an expert is one who not only understands his/her own science dicipline but also "practice" to use his/her knowledge so that they know when and where to use it (Anderson & Kartwhol, 2010). In 5E process there is *elaboration* phase where given problems in this phase should be exploring students' ability so that students can apply their concept understanding and their analytical ability can be trained. In elaboration phase, students apply concepts and skills in new situation through activities such as advanced experiment and problem solving (Dasnah, 2007).
- 2) In learning process, a lot of time wasted in finishing or filling up LKS. This is because time and class management was not done properly during learning process by teachers. Solution for next learning process is to have teachers managing their time and class better. Time management should be prepared well before learning process commenced and expect the unexpected during learning process.

## 4. Conclusion

Based on data analysis, findings, and discussion, we can conclude the followings points:

1) Improvement in students' cognitive learning outcomes after applying PMBCT aided 5E Learning Cycle 5E obtains moderate category normalized gain at 0.58.

2) Implementation of CmapTools based media prototype aided 5E Learning Cycle model in learning process is successfully conducted.

3) Students' response to the use of CmapTools based media prototype in learning process is good. This shown in questionnaire result from students where most students agree that PMBCT contents can motivate them for achieving better learning outcomes and praise the clarity of the videos and animations in PMBCT.

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