

# Computer Assisted Teaching and Learning (CATL) to Improve Academic Achievement and Skill in Physics Education

Mustafa Alibasyah<sup>1</sup>, Abdullah Husin<sup>2\*</sup>

<sup>1</sup>Department of Physics Education, Syiah Kuala University Banda Aceh Indonesia

<sup>2</sup>Department of Information System, Islamic University of Indragiri Tembilahan Riau Indonesia

## ABSTRACT

Computer assisted learning (CAL) has been implemented in schools to improve the quality of education. However, the application of CAL without the assistance of teachers is unsatisfactory. This study introduces computer assisted teaching and learning (CATL) with the teacher's assistance. A test which involved 68 students and 12 observational learning activities for physics learning session at 2 junior high schools in Aceh province Indonesia was conducted. On average, students scored 74.79 when learning physics using CATL, compared to using CAL which scored only 71.23. Teachers' assistance in CATL can provide a meaningful impact on improving academic learning achievements. Based on interviews, 16 students and 4 teachers noted that CATL is better, easier, and more fun. 87.5% of students and 100% of interviewed teachers want CATL to be applied in the physics subject. Thus CATL can improve skills and academic achievements in teaching and learning physics.

*Keywords: Computer, Teaching, Learning, Academic achievement, Skill, Physics*

## 1. INTRODUCTION

The advancement of information technology (IT) provides convenience in learning process [1]. The use of computers in learning processes has a positive influence on learning thus improving academic achievements [2-4]. The use of video in learning physics is efficient and productive. It can be used for improving academic skills and the creation of a pleasant classroom environment [5-6]. The use of audio, text and images in the form of graphs, illustrations, photographs and maps can involve auditory and visual modality in students' memory. The cognitive processes in Computer Assisted Learning (CAL) [7] are shown in Figure 1.

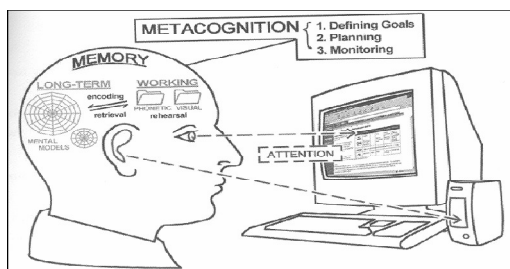


Figure 1. Cognitive Processes in Computer Assisted Learning (Clark & Mayer, 2003)

Based on students' responses to CAL, the following findings were obtained: (1) students feel comfortable with the learning environment, (2) students express their opinions, ideas and arguments actively, (3) students are able to understand concepts easily, (4) students are

motivated to improve their skills and (5) CAL helps teachers to make learning process effective and efficient [8]. According to cognitive theory [9] CAL is based on three assumptions: (1) active learning, (2) learning through two channels namely, Word channel and the visual channel, and (3) Integrated learning experience in long-term memory. Physics is a subject that must be studied in secondary schools. This course is the foundation for studying natural sciences disciplines. The lowest score of 7 (seven) in a scale of 10 (ten) is the academic achievements target set by the Directorate General of Secondary Education of Indonesia [10]. However, academic achievements of students in the Aceh province are currently still lagging compared to other provinces in Indonesia. Therefore, the Aceh province requires improvements in education, particularly the teaching and learning process of physics. Based on the overall evaluation results of national examinations in 2006, Aceh is ranked 13<sup>th</sup> in 33 provinces in Indonesia. However, Aceh's academic achievement particularly in physics is ranked 36<sup>th</sup> of 45 countries in the world [11]. The average score for physics in two (2) junior high schools (SMP) within the city of Banda Aceh (SMP A and B) and two (2) junior high schools in the district of Pidie Jaya in Aceh province (SMP C and D) between 2009 and 2011 is tabulated in Table 1:

\* Corresponding author: E-mail: abdialam@yahoo.com.

Table 1: Average score for physics subject at 4(four) SMP in Aceh Province.

YEA R	SMP A	SMP B	SMP C	SMP D	AVERA GE
200 9	74.5	66.8	60.6 5	64.6	66.64
201 0	58.7 5	62.6 4	57.8	58.6	59.45
201 1	72.8 4	68.4 8	62.8	66.8	67.73

Table 1 shows the average score for physics in the year 2009, 2010, and 2011 are 66.64, 59.45, and 67.73 respectively. Based on this result, it is evident that academic achievement of physics has not reached the targeted standard.

This study aims to determine the effects of computer assisted learning (CAL) without the assistance of teachers and computer assisted teaching and learning (CATL) with the assistance of teachers to academic achievements, academic skills and efficient use of learning time.

## 2. METHODOLOGY

To achieve the objectives of this study, two study groups which comprise of 68 students from two junior high schools in Aceh province are used as sample in this study. Each group consists of 34 students. CAL and CATL are applied to both groups.

The instrument used in this investigation are: (1) Post-test questions to determine the level of improvement in academic achievements, (2) interview protocol to capture the perceptions of students, (3) observation protocol to measure the effectiveness of proposed method. Two methods of data analysis which are quantitative and qualitative analysis were carried out in this investigation. Both methods were used to ensure a more accurate analysis. This method corresponded to the mixed-method design [12-14] which combines quantitative and qualitative method. The experimental design uses pre-test, post-test and control groups [15] in this investigation

To determine the increase in academic achievements for physics studies, the post-test evaluation is performed after each learning session. Post-test, interview and observation are conducted in both groups. The post-test were conducted 12 times, where each group will undertake the post-test six times after the study session. To ascertain the perception of

students in learning physics, the interview was conducted. A total of 16 students and 4 teachers were randomly selected and interviewed separately. To measure the effective use of learning time, 12 observations were carried out in both groups. Structured observations were performed, where researchers recorded observation based on several aspects of learning activities.

## 3. RESULTS AND DISCUSSION

The average and standard deviation of academic achievements of physics studies after the post-test in each group are shown in Table 2

Table 2. Academic achievements of Physics Lesson

Model	n	Average of Academic achievements	Standard Deviation
CAL	34	71.23	2.67
CATL	34	74.79	5.26

The average of academic achievements was normally distributed. We want to compare the averages of normally distributed for two independent groups. Therefore t-test was performed to test whether the hypothesis that CATL better than CAL significantly. T-test was performed with the 5% significance level. The t-test results are shown in Table 3 below.

Tabel 3. The t-test Results

Model	t	df	Sig. (2-tailed)
CAL	3.487	48.531	0.001
CATL	3.487	66.00	0.001

Table 3 shows the 0.001 of significance level which is less than 0.05, where the  $\alpha$  level is 0.05. Thus it can be concluded that differences between academic achievements of CAL and CATL is significant. The average of academic achievements using CATL is 74.79 while using CAL is 71.23. Therefore CATL outperformed CAL and can be used to improve academic achievements.

A 21-item questionnaire to measure students' understanding on physics was distributed to the respondents. Results showed that the application of CAL interval score is between 4.35 and 4.79, where the average is 4.61 and standard deviation is 0.63 when CAL is

applied. The highest average score is 4.79 and standard deviation is 12.48. The lowest score is 4.35 and standard deviation is 0.69. This shows that students who attend CAL, can obtain higher academic skills. Conversely, the interval score of academic skills of physics is between 4.38 and 4.79, where average is 4.61 and standard deviation is 0.64 after CATL is applied. High academic scores can be observed in all aspects, where the average is greater than 4.68. The highest score is 'understanding' and also "easy to remember", where the average is 4.79, and standard deviation is 0.48 respectively.

The results of observation for six learning sessions using CATL can be summarized as follows: the use of time for each learning activity is more effective. Aspects of student activities in the first session to fourth session is less effective. While the sixth session is more effective, because time consumed is lesser than the maximum time allocated. While the results of observations for 6 learning sessions using CATL can be summarized as follows: the time used for all aspect of learning activity was very effective. Overall the results of the sixth session of observation are effective.

The results of the interview conducted on eight students in the CAL group are as follows: (1) learning by CAL is effective, (2) CAL facilitates understanding of learning physics in the group, (3) very beneficial to help students in remembering the lessons, (4) learning material is suitable, (5) easy to follow and (6) more easily to understand. While the results of interview conducted on eight students in the CATL group, are given as follows: (1) learning by CAL is more effective, (2) a lot of benefits are received in the group learning (3) easier to complete the assignment task, (4) can make students feel challenged and provide new knowledge, (5) students can conduct conversation and share knowledge among students, (6) learning materials are suitable for junior high school, (7) easy to understand and (8) easy to remember lesson.

#### 4. CONCLUSION

Based on post-test, it can be concluded that both the use of CAL and CATL can improve academic achievements, particularly in physics studies among students in secondary schools in Aceh Province. CATL provides better results than CAL method in producing the academic achievements. Based on observations, it can be concluded that the use of time for every

aspect of learning activities on CATL is more effective. Based on the interview can be construed that CATL: (1) makes learning easier, (2) facilitates students in understanding the lesson, (3) facilitates the students to remember the lesson that has been learned (4) there has been increased activity the group, (5) facilitates the students in discussion and sharing of knowledge, (6) facilitates the students in completing their assignment, (7) students feel fun and challenged. Most of the students (87.5%), and 100% of interviewed teachers want to apply CATL in all subjects. The CATL helps to improve academic achievements, improve academic skills and produce effective learning.

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