

HOW INTERACTIVE MULTI MEDIA (IMM) AFFECTED STUDENTS' COGNITION IN LEARNING BIOLOGY AT THE MIDDLE AND HIGHER EDUCATION LEVEL?

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Abstract -- The aim of this research is to analyze the effect of interactive multi media (IMM) in learning biology towards students' cognition at the middle and higher education level through descriptive methods. Students' cognition consist of generic skills, concept attainment, and retention. The result at junior high school showed that IMM can raise concept attainment of "Organization of Life" and developed generic skill as well between individual IMM and conventional class. The result at senior high school showed that IMM can raise concept attainment of "Nervous System" at "fair" category level, difference significantly ($\alpha=0.05$) between individual IMM and classical IMM class. Concept mapping test showed that concept attainment raise at "fair" level but there was no significant difference between those classes. Students' retention at both classes was quite high: 109.1 % for individual IMM class and 105.65 % for classical IMM class, different significantly ($\alpha=0.05$). The using of IMM at university level on concept "Genetics substance and Protein Syntheses" showed concept attainment was raising at "fair" level, but "low" level on concept mapping. Both tests couldn't reach the mastery learning level but students' retention was quite "high" for objective test and concept mapping as well.

Key words- concept attainment, concept mapping, generic skills, students' retention

I. INTRODUCTION

The rapid developments in science and technology area have to be wisely anticipated by the teacher in terms of the usage of multimedia system in teaching, especially in science teaching. The currently applied curriculum in middle education level aims at a student centered learning condition which demands teacher's creativity in managing the teaching process. In different level of education, started from the junior and senior high school, until university level, there are some abstract concepts on biology that demand creativity of the teacher. In order to make sure that these abstract concepts to be understood by the students, both teacher and lecturer have to present their topics in an easy to understand way. One of the methods is to make use of interactive multimedia in education.

In the 7th grade (junior high school), the concept "The organization of life" is one of an abstract concept. Some concepts are difficult to be explained through

practical activity and conventional method in class. Interactive multimedia technique is chosen to enhance the comprehension of the abstract concept and also the practical skill of the students. The practical skills that are going to be tested includes: (1) comprehension about cause and effect law, (2) the awareness of measurement units, (3) logical inference, (4) conceptual building. All of these skills are going to be tested using written test and observation of student's performance. The teaching model that was applied is learning cycle model which consists of three phases: exploration, concept introduction and concept application phase (Carin, Arthur, 1997:72).

At high school level, interactive multimedia was implemented in the teaching of the concept of "Neural System" which is an abstract concept for 11th grade. In the learning process of neural system, interactive multimedia is employed to increase the student's comprehension and retention. Student's comprehension is tested by using written and concept map test. Retention is performed three weeks after written test.

At university level, interactive multimedia was implemented in Open University (Universitas Terbuka, UT-Ind.) which employs *Long Distance Education System* and individual lecturing system with modular system in which interactive learning process is not easy to be implemented. Therefore, teaching material is the primary component in Long-distance Education System. In order to overcome student's difficulties in understanding the teaching materials, UT has prepared several additional learning facilities such as Computer Assisted Interactive Learning (CAI) which enables student to give response, receive feedbacks, choose the materials to study, accept corrections, have the opportunity to make corrections and obtain support from the advisor. "Genetic Substance and Protein Synthesis" concept is chosen because it is an abstract concept with complicated process. Those concepts can be visualized in forms of images, charts, animations and even simulated using computer software. In this study, interactive multimedia is employed to increase the students' comprehension and retention on the concept of Genetics substance and protein synthesis and also to produce interactive PBK program which is suitable with the characteristic of Long-distance Education

System and lessen the students' effort to learn the concept of heredity substance and protein synthesis. Concepts' comprehension is measured by written test and concept mapping test. Students' retention was measured by written test three weeks after the first test.

In general, the problem was "How is the role of IMM towards students' cognition at junior high school, senior high school and university level?" Students' cognition that will be analyzed are concept attainment, generic skills, and students' retention.

The objective of this study is to analyze the role of IMM in biology teaching at the level of junior high school, senior high school and university level. In general, the problems that will be further discussed in this paper are: How much interactive multimedia-based teaching can improve student's concept understanding and generic abilities for junior high school student? Also, how much this method can increase concept comprehension and retention for senior high school student and university students?

According to the study that has been performed in each education level, there are several differences in the usage of multi-media. At junior and senior high school, the role of the teacher is still dominant in order to guide the students through teaching in the classroom (face to face). In classroom teaching, the process of knowledge reconstruction is assisted by the teacher through various technique and teaching strategy for establishing interaction between teacher and students. Interactive multimedia, either it is individual or classical is carried out under teacher's supervision. For the current time, interactive multimedia is a new thing in school which needs comprehension and skill of both teacher and students in using computer, therefore the implementation in teaching process is attractive for students and teachers. However the drawback is teacher has to spent longer time for preparing teaching materials. This condition is different compared to distance-education system with the aid of teaching modules which is carried out by the Open University (UT). The position of interactive multimedia is to initiate and establish Computer-based learning.

The interaction of the students with teaching materials in remote learning process can be achieved using interactive media. Computer aided teaching materials has the potential to create interaction. Heinich, et.al. (1996) suggest several form of interaction that can be developed using computer media such as practical experiment and exercise, tutorials, games, simulation, problem finding and solving. The position of Computer-based system in distance teaching in Open University (UT) is as the supplement of teaching materials that can widen student's insight and understanding about materials

provided in primary teaching modules, especially to help the students to understand difficult and abstract concepts.

Interactive learning process has been considered to be able to improve the quality of distance learning. Therefore the existence of this learning process is highly demanded and become a prerequisite. Moore in Padmo (1999:172) discussed three kinds of essential interaction i.e. interaction between student and teacher, student and teaching materials, and also interaction between students. Meanwhile, Bates in Padmo (1999:172) proposes two types of interaction that can be achieved in long distance learning process i.e. interaction that is individual or isolated activity (interaction between students and teaching materials) and social interaction (interaction between two or more people about the studying material that is currently being studied). These types of interaction types which are proposed by Bates and Moore are fundamental concepts that when linked together with media usage can be translated into several thoughts which are able to be implemented in long distance learning.

Computer-assisted learning curriculum that are developed in this research has a higher ability to explain materials compared to modules because of the ability to present abstract concept using animation. Computer's features can be utilized to teach concepts, rules, principles, and complicated calculation and also the ability to explain the concept in a simple way by combining audio and visual animation is suitable to be implemented in self learning activity.

According to Dahar (1996:110), learning is useful when students are able to link the old concept and new concept to form a solid concept. Information that is kept as concept can be used in different situations includes some which are totally different with the one that is implemented in learning process. Conceptual learning is an important thing for human especially in education field because conceptual learning is the primary result of education. Concepts can be obtained by two ways, by concept formation and concept assimilation (Dahar, 1996:79). Purwanto (1990:44) stated that concept understanding is a level of ability that expect students to have the ability of understanding the meaning or concept, situation as well as known facts and able to explain with their own words with the knowledge of their own without changing the meaning.

Deese (1959:237) stated that retention is one of the primary aspects in human learning and the working attitude that is acquired from experiment method. Retention is part of phases that can be found in learning process in school. These phases consists of motivation phase, concentration phase, processing phase, retention phase, digging phase, achievement

phase and feedback phase (Winkel, 1996:451). Winkel (1996:449) said that retention phase occur between fixation and evocation time. Something that is being memorized is called as the retention. The complete form of retention is not clearly known but there is only something that is kept in the memory for future use. According to Deese (1959:343) a person that has a lot of concepts to be memorized will lead to low retention. Meanwhile a person who has only few concepts to be remembered will lead to high retention.

According to Novak and Gowin (1985:15) concept map such as schematic drawing is a mean that can be utilized to represent meaningful relationship between concepts in form of propositions. Propositions are a combination of two or more concepts that can be combined by a conjunctive words. The simplest form of a concept map is formed by two concepts with one conjunctive word to build a proposition. In education, concept map can be applied for different objectives i.e. investigate what the students have learned, to observe how students learn, to reveal concepts that are incorrectly understood by the students, and as an evaluation tool. Until now, the evaluation tool that is used to measure student's comprehension is written test in form of objective test or essay test. Concept mapping is one of evaluation techniques to measure student's comprehension about concepts that they have learned.

Related Studies

O'Day Danton (2007) studied the Value of Animations in Biology Teaching: A study of long-term memory retention on Advanced Cell Biology indicated that the students who viewed the animation without narration scored higher than those who viewed the graphic. For the retention, the scores were highest for the animation group. Animations provide a valuable way to communicate dynamic, complex sequences of biological events more effectively than text or a static graph.

Gibbons, Nicola J. et al. (2004) studied Computer Simulations Improve University Instructional Laboratories, reported that the evaluation of two computer-based simulations of chromosomes analysis and bioinformatics can provide significant time savings to students. Under certain circumstances performance can be improved by the use of simulations by 7% of their case study. They concluded that the introduction of the simulation can significantly enhance student learning and can offer significant benefits to teaching staff.

II. METHODS

The method that use was comparative analyzes, that is descriptive study (non-experimental), i.e. study

to investigate the relationship between one variable to the other variables by analyzing the role of independent variable to dependent variable in different groups (McMillan and Schumacher, 2001:287). In this case, the role of interactive multimedia for concept comprehension was analyzed, so did the generic skills and student's retention as well.

This research was conduct in:

- (1) Junior high school, samples 68 students of class VII -using Static group pretest-posttest design
- (2) Senior high school, samples 172 students of class XI – using Static group pretest-posttest design
- (3) Open University (UT), samples: 20 biology students – using Pre-experimental design.

III. RESULT AND FINDINGS

A. Junior High School Level

According to the calculation of normalized gain between experiment and control class for concept "Life Organization" at junior high school level, there are different mean value (\bar{X}) as follow:

- The mean (\bar{X}) for experimental class (interactive multi-media based learning) was $0,53(\pm 0,22)$ and The mean (\bar{X}) for control class (conventional learning) was $0,37(\pm 0,19)$.
- The z-test result shows that there was a significant difference on concept comprehension ($\alpha = 0,05$) between the two groups. The relation is shown in Figure 2.

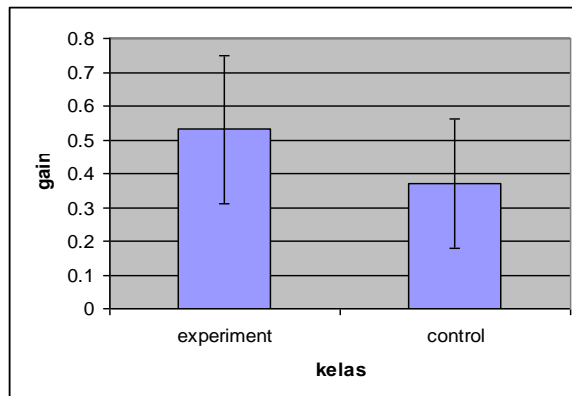


Fig 1. Mean score of the normalized gain on concept "The Organization of life", significantly difference

Generic skills that were measured after learning process in the two different classes were limited at (1) causality, (2) sense of scale, (3) development concept and (4) logical inference. The difference test result by using Mann-Whitney U test show that there was a significant difference between the two classes for every aspect of generic skill with mean result that is shown in Figure 2

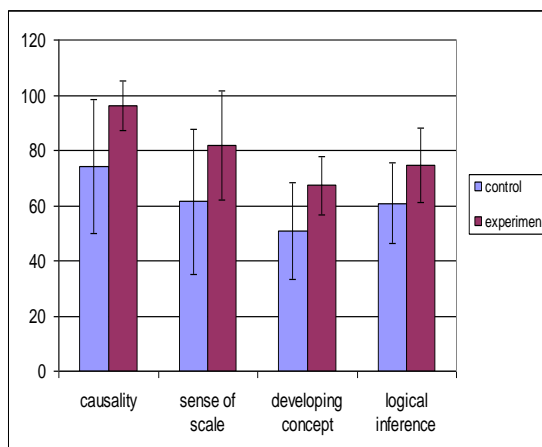


Fig 2 Comparison of generics skills between experiment and control class on concepts "Organization of Life" Significantly difference

Interactive multimedia based learning was preferred by the students because they found this method is useful for them to understand concepts. The presentation of the concept through animation, pictures, text, colors, quizzes, and also symbols that is shown in the program, stimulate students to think and motivate them to learn the concept as well. But nevertheless, interactive multimedia-based learning requires teacher's skill to use and operate educational media equipments. This is one of the obstacles that were found in the reality that need to be resolved immediately.

B. Senior High School Level

At senior high school level, concept comprehension was evaluated by using objective test and concept mapping test. Statistics gain calculation result shows the gain criterion was in "intermediate" level, for objective test and concept mapping. The achievement of concept comprehension test that was evaluated by using objective test and concept map is shown in Figure 3. There are four classes used in this research, two control class (conventional teaching using chart, slides, discussion, and tutorial) and two

experiment class (individual interactive multimedia and classical multimedia)

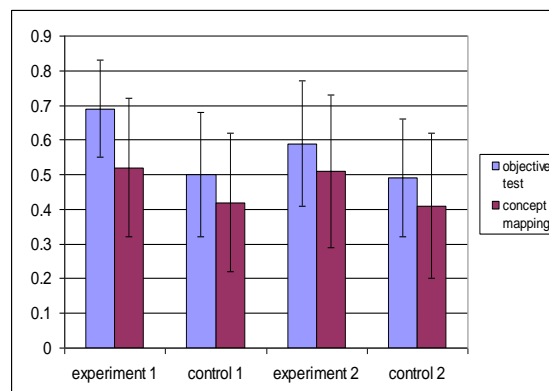


Fig 3. Comparison of the *statistics gain* on objective test and concept mapping test on Neural System in High School (class XI)

After performing normality test, the data shown in Figure 4 has a normal distribution, therefore the test can be continued with Z test. The result was improvement of concept comprehension in each group i.e. experimental class 1 with control class 1 and experimental class 2 with control class 2 showed a significant difference ($\alpha = 0, 05$). However, there are no significant difference between experimental class 1 (individual multimedia) and experimental class 2 (classical multimedia).

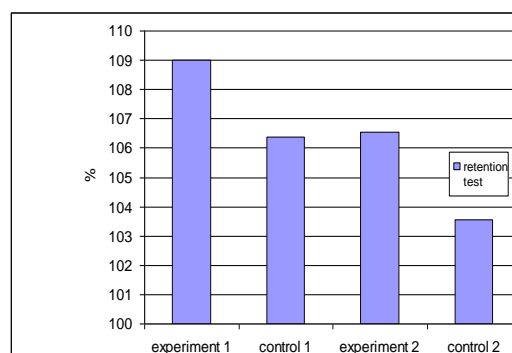


Fig.4. Concept retention test (%) of "Neural System" that was taken three weeks after the post-test

Observation result shows that in general students didn't have difficulties in learning the program. In individual multimedia classes, students showed their enthusiasm and seriously learning the material because they use computer individually and the teacher as facilitator in learning. In classical interactive multimedia, teachers play an important role besides being a facilitator. In controlled class, students also showed their enthusiasm because teachers present the subject in an attractive way with the help of media, discussion, and tutorial.

Retention test (post test 2) which was given three weeks after post test 1 showed a significant increase in four classes, i.e. the experimental class 1 (individual IMM) = 109.01 %; experimental class 2 (classical IMM) = 106.56%; control class 1 = 106.59%; and control class 2 = 103.54%. This result shows that learning with individual IMM reach its highest retention compared with the other learning method. The complete result is shown in Figure 4.

C. University Level

Respondents at university level are students in Biology Education department of Open University (UT). Open University uses distance education system with teaching materials in form of modules. In distance education system, learning interaction happens between students and modules. Individual learning using modules for concept "Heredity Substance and Protein Syntheses" found to be difficult by the students because this is an abstract concept. Therefore, additional modules are given as supplement in form of interactive multimedia and packaged as Computer Interactive based learning. Interactive multimedia was tested in Open University (UT) with 20 students that have been chosen as samples for the research.

Concept understanding was tested using objective and concept mapping test. Meanwhile, retention test was performed three weeks after post test. In long-distance learning system, there is a mastery learning criterion achievement score, above 80%. In objective test, there were only three students who can achieve 80% in post test, while the other students cannot achieve that score. The result is shown in Figure 5

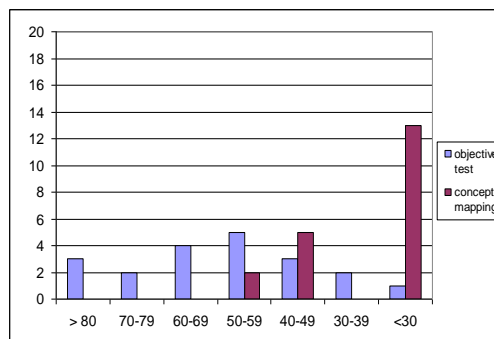


Fig 5 The achievement using mastery learning criterion on post-test that were taken through objective test and concept mapping test.

After implementing Computer-based learning, there was an improvement of student's comprehension about the concept of heredity substance and protein synthesis as shown in Figure 6, but the objective test cannot achieve the criteria of mastery learning both in pre-test and post-test

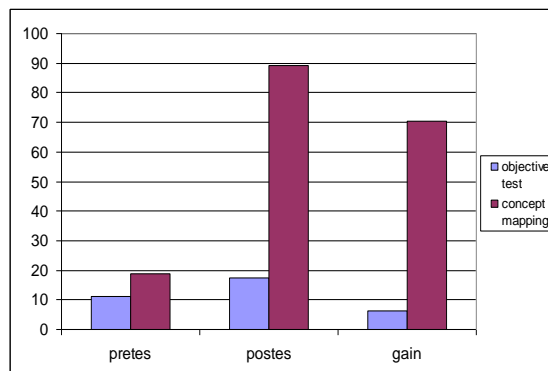


Fig 6. Improvement of students' concept comprehension on "The heredity substance and protein syntheses" after using Computer-based learning

The retention test result shows that concept comprehension test which obtained from objective test is 86% (good), and the one that was obtained from concept mapping test was 247% (very good). The difficulty that faced by students with Computer Based learning was they are not familiar in learning by computer-based. Only 15% of the students that were familiar in using computer in their working place; 65% students stated that the frequency of computer usage in their office was unscheduled, and 20% of the students stated that they have never used computer before.

IV. DISCUSSION

At junior high school level, it is obvious that there was an improvement in student's comprehension. For interactive multimedia based learning, there was a significant improvement. This condition meets with the point of the constructivism view, that studying is a process to assimilate and connecting experiences, or in another way between the materials that they studied and the understanding that they have so that the comprehension is improved (Suparno, P. 1997). This learning has constructed the value that is invented by the students through what they see, hear and feel.

Implementation of Interactive Multimedia (IMM) in teaching "Diversity in Life Organization" also has a positive impact to the development of generic skills. This can be proved by comparing the average score of generic skill test in the class where Interactive Multimedia was applied with the control class. However, the distribution of that score didn't follow a normal distribution while in control class the distribution of the score follows normal distribution. This result showed that students' ability and experience of using computer varies a lot, so that students who are skillful in using computer obtain higher score compared to those who are not.

At High School Level, concept of Nervous System is a difficult and abstract concept when only taught by conventional method. The score of objective test and concept mapping test in experiment class (1) was higher than the experiment class (2) and both the control class (1 and 2) where the teacher's role is dominant. This fact shows that individual Interactive Multimedia based learning gives bigger opportunity for students to do exploration and simulation in order to build their understanding about concept. This activity is categorized as endogen constructivism. Interactive Multimedia based learning also has a positive effect to student's retention.

Concept understanding achievement at university level which was tested using objective test shows an unsatisfactory result because of many obstacles that is faced by students. Most of the obstacles are lower skill in using computer due to seldom usage or not familiar in using it. In fact, motivation and independent of students in using Computer based learning is high, but due to limitation of time they cannot repeat the materials presented in Computer based learning. Even if some read the materials repeatedly, they didn't have enough time for the other materials because most of the students are employees. However, Computer based learning has no effect to the independence of students either in objective test or concept mapping test which was shown by retention test.

Due to limitation of computer-literate and students difficulties it seems rather contrary to O'Day Danton (2007) studied for the retention, because in this case animations not provide a valuable result. There is also seem contrary as well according to Gibbons, Nicola (2004) that reported two computer-based simulations of chromosomes analysis and bioinformatics can provide significant time savings to students can significantly enhance student learning and can offer significant benefits to teaching staff. In this study students need more time to enhance their computer skill and more time for the lecturer to give instructions.

Generally speaking, Interactive Multimedia based learning is interesting, not boring and can be read through repeatedly. However the difficulty is the limitation of teachers in utilizing Interactive Multimedia learning and the limitation in making the Interactive multimedia program.

V. CONCLUSION

Interactive multimedia based learning and Computer based learning is very good to be applied, but in the reality, concept understanding is not always improving along with their implementation. The reason is because there are many factors that affect student's learning result.

Implementation of IMM result significance in junior and Senior High School to improve concepts achievement, generic skills, and retention.

Interesting findings that the implementation of IMM in university level, did not result significance improvement, because the average of individual achievement through Computer based learning didn't reach the mastery learning criterion.

In general, the retention test result which can be categorized as high (>80%) shows that Interactive Multimedia can increase student's independence by repeating and simulation process available in IMM and Computer based learning. The retention test results obtained from high school level and the generic abilities test result in junior high school level also confirm that Interactive Multimedia and computer based learning is interesting and efficient.

VI. RECCOMENDATION

The development of Interactive Multimedia and Computer based learning should be improved continuously especially for abstract concepts in different education level. Therefore teachers should be trained to enable the utilization and development of program using interactive multimedia technology.

However, the utilization should be well anticipated because there are some concepts that are better to be understood through hands-on activity or the other activity.

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