Application of Information Computer-based Learning in Calculus Package Learning

Mathilda Lasut*

*Department of Mathematics, Faculty of Mathematics and Science, Manado State University, Indonesia

Abstract- This study aims to determine the effectiveness of Information Computer Technology (ICT)-based learning packages focusing on calculus courses among college students, and to find a tested learning package model in the ICT-based learning of calculus. This study was developmental research which includes requirements analysis, designing learning packages, and evaluation of the learning package. Design research uses literature study, survey, application of learning packages, evaluation and content analysis. Overall, 35 college students of Department of Mathematics, Faculty of Mathematics and Science, Manado State University who take calculus courses were participated. Data were analyzed using descriptive analysis argumentative. After applied of this model, the results showed that there was increased in learning outcomes and level of understanding of the concept of differential and integral. It was influenced by the type of learning media that applied to the ICT-based learning package, namely the application program camtasia on power point programs. ICT-based learning was a contextual and based on the philosophy of constructivism learning so this study suggests that this model would become very well implemented in calculus. Therefore, more research on the effectiveness of ICT-based learning model is also needed for other majors. (*This finding has been presented in the 3rd International Seminar on Quality & Affordable Education, November 2014, in University of Malaya, Kuala Lumpur*)

Index Terms- Calculus, ICT, package learning, development, camtasia

I. INTRODUCTION

Developments in science and technologies are rapidly, as with most new approaches-based technologies used in education demanding quality human resources (Oliver 2005). In the educational systems, personalization that is governments, teachers, parents and school communities' proses is growing importance (Campbell 2007). Improvement of personalization learning process particularly academic communities become leaders in the application of technologies is also a requirement for achieving development goals to provide a different kind of learning approaches (Laurillard 2002, Green & Brown 2002).

Nowadays, many integrated packaged learning have been developed and applied to the students. Most of the systems used to increase the students' motivation, which can be increased using the cognitive tools model that has the following functions: as an information seeking, information presentation, knowledge organization, knowledge integration, and knowledge generation (Figure. 1)

Tool Category	Tool Function	Tool Type
Information seeking	Identify, locate, retrieve relevant information	Digital libraries, keyword searches, websites, wikipedia, online dictionaries
Information presentation	Present relevant information in variety of formats to enhance interpretation	Discussion boards, blogs, spreadsheets, Google docs/ maps
Knowledge organization	Establish conceptual relationships, reconstruct and manipulate information	Concept maps, powerpoint, graphic organizers, smartboards
Knowledge integration	Connect existing with new knowledge, test relationship between them, process at deeper levels	Simulation tools, concept maps, games
Knoeledge generation	Mirror knowledge generation process, generate and manipulate new knowledge, represent new knowledge flexibility and meaningfull	iMovie or MovieMaker Web Page development

Figure. 1: The cognitive tool categories and their functions and types (Iiyoshi 2005)

Globally, revolution technology, especially computers and the international network have fundamentally changed the way of looking and thinking in a practical and efficient of academics environment to deliver online learning (Coaldrake 2000, Heinich 1989). In order to improve education, knowledge and the environment available to learners, we are now facing with a threshold gate-based technologies transition, where the speed of give and capture the information become very important (Goodyear 2001). Therefore, academics would need to be ready for preparing optimally to face the dynamic society or the era of dynamic communities that we expect to be realized in the coming years. Recently, adoption of the Information and Communication Technology (ICT)-based learning, such as online learning have widely used in some universities on professional development programs and reported these to be of substantial benefit (Weaver 2006).
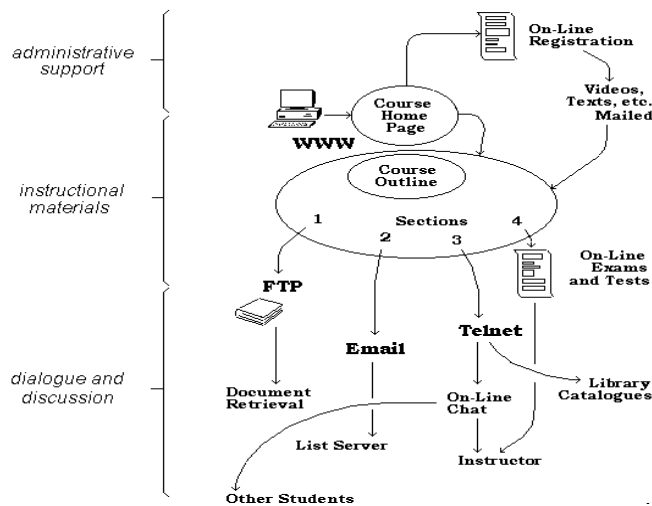
Figure 2: Schematic model of ICT-based learning

Most of developed countries have adopted and made ICT-based learning (Figure. 2) as an integral part of the education system, because education of a nation in the 21st century will be difficult to develop and progress, if the ICT is not integrate in the system (Becker 2007). Moreover, ICT-based learning in line with the current educational paradigm is shifting from a system of teachers' education and training oriented to the students' system oriented.

The growth of long distance education, the more the web site content in the international network which providing guidance or learning materials, the more conscious people life long learning, the establishment of international schools stating the importance of ICT in modern education. Based on this fact, the academics must be able to implement a qualified and modern learning system, and providing greater opportunities for students to engage and reflect on their own experiences through ICT-based learning.

In Indonesia, utilizing information and communication technology in schools is one of the efforts to improve the quality of education. In line, various education studies in the world showed that the utilization of instructional materials is packaged in the form of medium development based on ICT can improve the quality of education (Shovein 2005). On the other hand, our academic resources have basic problem such as English proficiency, which usually used in the technology

Calculus is one of the courses that are difficult to understand by the students. It needs methods and approaches for effective learning the formulas, particularly, in calculus courses. ICT-based learning is contextual and based on the philosophy of constructivism learning, therefore, this is may be the best system to apply in calculus courses. Therefore, this study aims to determine the effectiveness of ICT-based learning packages of calculus courses among college students of Department of Mathematics Education, Faculty of Mathematics and Science, Manado State University and to find out a tested learning package model of ICT-based learning of calculus courses.

II. RESEARCH METHOD

Study design
This was a development research study focusing on implementation of a learning design with the use of ICT. It included requirements and resources analysis, design of learning packages, and their evaluation. Stages of the research conducted were literature study, survey, application packet learning, evaluation and content analysis. The study sample was set among college students who are prospective teachers that studying in Department of Mathematics Education, Faculty of Mathematics and Science, Manado State University, which consists of three classes that follow the course of calculus. Overall, 35 college students who take calculus courses were participated.

Materials
The instruments used in this study were the observation worksheets (questionnaires), ICT-based learning packages of calculus courses, LCD, international network, and laptops or personal computers. The observational worksheets were research-made, which were theoretical part to measure students' content knowledge of differential and integral subjects of calculus courses.

Learning packages development
The procedure used in the development of this ICT-based learning tools of calculus consists of four steps: (1) expert review, (2) the evaluation of individuals knowledge, (3) evaluation of the group of learning, and (4) the trial court, which was operationalized through the following procedure: 1) Conduct a survey among student of Department of Mathematics Education those attended calculus class about information technology textbooks used by lectures and students was conducted; 2) Review the syllabus and contents, and standard of competency of calculus courses; 3) Draft a learning package of calculus syllabus, content standards and competencies; 4) Perform content analysis by distributing a draft learning package of calculus, questionnaire, and a spreadsheet to four lecturers consisting of two calculus and IT two lecturers to get feedback in improving ICT-base learning package; 5) Implement discussions with experts as a validation of the draft learning package. The results of experts' analysis showed that the learning package in accordance with the characteristics of the material being taught and does not contain misconceptions, and readily accepted and applied to the students; 6) Revise the draft of learning package on the basis of experts' recommendations; 7) Write the report.

Learning package was prepared in appropriating to differential and integral subjects of calculus courses. Power point and Camtasia programs were used in preparing of learning packages of these subjects. Prior to the implementation of ICT-based learning package, a pre-test was conducted to get the data of students' prior knowledge of differential and integral subjects of calculus courses.

Learning package analysis evaluation form

In order to improve the learning package that have prepared and to measure the validity of the test, experts evaluated 1) the observational worksheets of content knowledge that prepared for participants; 2) learning packages; and 3) evaluation forms. On the evaluation forms, the experts were asked to provide their feedbacks, included comments or suggestions. The worksheets and evaluation forms were categorized in five group questions, namely: 1) Content standards (concept); 2) Competency standards (competency to be achieved); 3) Learning process standards (learning process in the use of learning packages); 4) Enrichment materials; 5) Potential needs and implementations analysis.

Data analysis
Data were analyzed using descriptive analysis argumentative. The results of the analysis were used as the basis for developing a draft of ICT-based learning package of calculus courses.

III. FINDINGS

Application of ICT-based learning package
All of the participants successfully completed the pre- and post-tests. Table 1 contained their mean scores for contents knowledge based on traditional learning process. Although the highest value was at score 3,25, but about 50% of students were at score less then 2 with the lowest score of 1,25. Of students, only 18% have finished read the materials of learning trough the traditional learning approaches. 67% of participants reported that they did not understand well about the concept of differential and integral subjects that they have learned previously through the lecture method. Overall, the results of preliminary tests showed that the students' understanding of differential and integral subject that has been studied was low. These data showed the need for action or alternative learning approach to increase the level of students' understanding of differential and integral subjects.

Table 1. Preliminary result of students' prior knowledge before application of learning package

No	Parameters	Score / Percentage
1	The highest value*	3,25
2	The lowest value*	1,25
3	Students have not been thoroughly studying	82 %
4	Students finished read the learning material	18%
5	Responses about the difficulty of test	23 %
6	Responses about the difficulty to understand the learning materials	67%

*value score : 0 - 4

After completing courses in which the ICT-based learning package was applied to prospective teachers, the results of the written test showed any increased in learning outcomes and level of understanding of the concept of differential and integral. The lowest level value was extremely increased to 2,95 from 1,25, and all the participants (100%) reported that they finished read the learning materials through the ICT-based learning approach. The passing rate of students has met the standards of mastery learning, which were planned in the syllabus of calculus courses (Table 2).

Table 2. The test results after applied the ICT-based learning package

No	Parameters	Score / Percentage
1	The highest value*	3,85*
2	The lowest value*	2,95*
3	Students have not been thoroughly studying	0 %
4	Students finished read the materials	100%
5	Responses about the difficulty of test	0 %
6	Responses about the difficulty to understand the learning materials	2%

*value score : 0 - 4

It was suggested that the ICT-based learning package affected and provided to assist learners in improving their learning outcomes and level of understanding, particularly in differential and integral subjects of calculus courses. Nevertheless, this learning packages need to be assessed by the lecturers in the class to further enhance the quality of these packages.

Evaluation of the contents
Table 3 showed the result of experts' feedback. Content standards, competency standards, learning process standards, enrichment materials, and potential needs analysis were evaluated.

Table 3. Analysis of experts' evaluation

No	Description	Average (%)	Qualification
1	Content standards	100	Good
2	Competency standards	100	Good
3	Learning process standards	85	Enough
4	Enrichment materials	95	Good
5	Potential needs analysis	90	Enough

All of the experts agreed on the leading position of these valuable criterions, in the order of priority. Although some experts believe that the role of learning process standards should not be diminished, with only some of the students rating this criterion as very important during the study, the result of post-test has revealed that it can be viewed as necessary.

Based on the average percentage in each question group, it appears that for the first group, namely content standards and the second group specifically if the material meets the competency standards, all respondents gave the answer of

100%. While for third group whether the material meets the learning process standards, on average 85% confirmed that the material was in conformity with the learning process standards. For the fourth groups, when asked about the materials enrichment, on average 95% said there was, and 90% of respondents in fifth groups confirmed if the material based on the experiences and needs of students. Overall, experts' evaluation concluded that the draft of ICT-based learning package for differential and integral subjects of calculus courses can be considered quite good.

The results of this study found that the implementation of ICT-based learning was effective in enhancing college students' content knowledge particularly in differential and integral subjects. The findings were substantially in line with those of Gulsecen (2006) found that ICT-based learning skill throughout the problem based learning as an effective learning tool in motivating prospective teachers' involved in the learning process and solve their learning problem (Gulsecen 2006). A study conducted among pre-service teachers in Singapore reported that participants in this study were able to understand the importance of problem based learning and ICT-based learning integration (So 2009). Consistently, a study that aimed to produce a reusable learning model for assisting the academics in higher education in Australia indicated that ICT-based learning have potential to foster high quality learning. Moreover, this model has become commonplace as one of the practicum medium for academics' learning in Australia universities, as well as for reducing costs of universities (Agustinho 2002).

IV. CONCLUSION

The findings of this study highlighted the importance of effective method and design of technology and online learning, and its implementation. This study demonstrated the effectiveness and extremely importance of camtasia on MS Powerpoint program and its capability as a ICT-based learning approach in increasing the prospective teachers' prior knowledge, autonomy and leadership especially in calculus courses. ICT-based learning was a contextual and based on the philosophy of constructivism learning so this study suggests that this model would be very well implemented in learning process, particularly in mathematics. Considering the result of this study, some suggestions were made for implication of this finding. First, future researchers on the effectiveness of ICT-based learning scenarios with larger sample size is needed not only in calculus courses but would be neccesary for different couses as well. Secondly, it is important to conduct studies comparing the use of ICT-based learning model and without any model or other methods. Thirdly, some suggestions are also made as to how academics may provide on the best opportunities offered by this learning medium. Furthermore, to how universities as learning institutions to ensure that all those involved are supported by high quality infrastructure, processes of designing and professional development.

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AUTHORS

First Author – Mathilda Lasut, Associate Professor, Manado State University, Indonesia, mathildalasut@gmail.com

Correspondence Author – Mathilda Lasut, mathildalasut@gmail.com, +62-82188334950