

Instructional Design and Learning Theory on the Development of a Multimedia Courseware

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Abstract- This paper discusses on the possibility of taking advantage of the well-served Gagne's theory of learning and combining it with the benefits of instructional design. Such potent combination can surely be extended further with the integration of advanced multimedia is undoubtedly helpful in today's education realm. The best of all these factors may have a positive impact on the teaching and learning scenario. Hopefully it has an optimistic bearing on the study of computer programming for non-computer science students when an interactive multimedia application is developed based on Gagne's theory of learning.

Keyword: Gagne's theory of learning; e-learning; instructional design; multimedia courseware

I. INTRODUCTION

Human capital development is considered as one of the main thrust in the implementation of the 9th Malaysian Plan (RMK9), emphasizing on the second thrust of National Mission which is enhancing the knowledge and innovation as well as to encourage first class mindset. For this reason, e-learning exists to help improve the quality of work and study experience, knowledgeable and high-skilled to be a virtue in achieving that objective. e-Learning is to provide disclosure in respect of the use of digital email and the use of ICT in education and the aspects to be emphasized in the development of human capital as

well as implementing lifelong learning and values in society. The existence of new technology has provided opportunities and extensive facilities in the field of education. It is not surprising if many educational institutions, and government agencies have applied the use of ICT in government efforts to develop human capital. A study of Website development in analyzing the use of scenario-based learning methods use the website in learning C++ programming can reflect that one of the ways to improve the learning is to have the elements of multimedia-based graphics (MohdZaid, 2010). The objective of this study was to produce a method of making the e-material development courses in multimedia design for C++ programming subjects.

II. STATEMENT OF PROBLEM

e-Learning makes teaching and learning more effective. In class exercises conducted to build the skills to use it. Level of students in this acquisition can be supported and enhanced through computer and internet based teaching. Students can review, understand new material, assess the level of mastery, making training, stimulate memory and enhance their efficiency. Thus, lack of learning materials in a systematic programming especially involving materials based on Gagne's theory of learning programming encourage a more comprehensive study should be carried out so that:

- the provision of learning materials that are more suitable to the course content.
- dissemination of knowledge related to the course will be more systematic, efficient and effective.
- meet the needs of students who are less interested in learning programming.
- acquisition of students in the class can be developed and improved.
- a source of reference and source of various activities can be shown to coincide with the course.

III. MULTIMEDIA STUDIES IN EDUCATION

Multimedia is the combination and integration between text, graphics, sound, animation and video. This creativity concept has started been given attention and become a necessity in a software. The word multimedia itself helped accept the current changes, which is now also commonly known as a multimedia interactive multimedia to show how interactivity is considered as one element that is emphasized in any multimedia application (Tasir et.al, 2005).

Thus, multimedia messages to the general public today can generally be defined as an interactive communication process based on the use of computer technology include the use of audio-visual media such as text, graft, audio, video and animation (Tasir et.al, 2005).Multimedia technology can be seen easily through individual that owns a set of computers equipped with CD-ROM drive, audio card and speakers. Total homes with multimedia computer system is much higher when compared to previous years. According to a study in the United States, in 1992, the amount of multimedia program issued in the form of a compact disc (CD-ROM) and is registered is about 5 thousand unit and it rose up to more than 15 thousand units by the end of 1996 and reach tens thousand units in early 2000. The same thing happened in Malaysia, where a growing number of local companies that publish and distribute multimedia applications in accordance with the local culture, particularly in education, training and entertainment

(Tasir et.al, 2005).

Similarly, in education, multimedia technology can provide effective results in teaching and learning. This approach is capable of transferring a static information to the learning patterns that are interesting, dynamic and interactive. As multimedia is dynamic, so when it is embedded in education, a new learning concept exists with a combination of education and entertainment approach called edutainment (education + entertainment). Transfer the contents of the traditional learning to design games and entertainment will make the learning process more fun and interesting to the student. Thus, multimedia can facilitate effective knowledge transmission process, particularly for distance education program or part-time.

In developing an application, Harun et al (2001) present interesting models and systematically in the development of multimedia software. The project undertaken should be carefully organized from the beginning, which involves the process of planning and analyzing software requirements, software design process, the process of software development, software implementation process, and the software evaluation process. Lack of study of teaching and learning that involves programming in accordance with the theory of multimedia interactive teaching and learning are made. Based on the phenomenon of lack of research and development of e-materials in programming according to Gagne's theory of learning in the form of interactive multimedia, the authors think it is taking the initiative to invoke theory of multimedia application development practices through Gagne's learning theory for the introductory course in Computer Programming. Development of this aspect is very important to help students improve their acquisition of computer programming. To design a plagiarism detection system is then carried out an analysis of system requirements that will be built. Requirements of the system requirements are divided into two, namely the functional requirements and non functional requirements.

IV. DESIGN MODELS AND THEORY

There are many design models that can be used as a guide in the process of designing and developing multimedia software. Some of the models are:

- ADDIE model
- ASSURE model
- Hanaffin& Peck model
- Dick & Carey model
- Robert Glasea model
- Waterfall model

A. ADDIE Model

This model is the model of instruction design, which often used as a principle to their models of other forms of instruction (McGriff, 2000). In general, it may be represented by the ADDIE model of workflow as shown below:

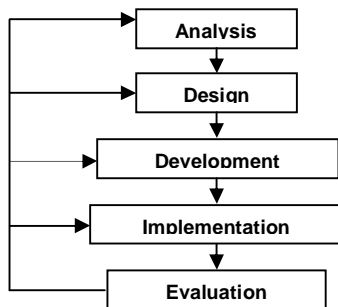


Fig. 1. ADDIE Workflow Model

B. Gagne's Theory

According Gagne theory as described by Flynn (1992), the nine key elements of the lesson are:

- draw attention
- specify learning
- foster the process of recalling past content
- materials that could pose a boost student
- providing guidance
- the tasks and questions
- evaluate the level of student
- maintain and develop students' knowledge and skills.

In designing the software, the approach of using cognitive theory above can be applied as follows:

- This software should attract the attention of consumers to create this environment, software development is included with several graphic elements that are appropriate to a multimedia presentation designed to get attention of the users.
- Statement of teaching objectives. According to Gagne theory, this statement objective is a motivation for students to know what are the learning task to be achieved. Statement objective delivered with some interesting ways either through text or in the form of an attractive animation. In this software, what goals and objectives to be achieved from the end user of this software will be specified later. This situation will give a boost to the user to continue using and try this software to learn and acquire the knowledge and skills of programming methods as found in computer programming education syllabus.
- Presentation in software can also increase stimulus for students to continue using it. This is why some elements are also included so that it can create an inviting atmosphere in this software such as the use of certain icons to provide information and support and provide guidance to users about certain things required during use.

- Training in the form of questions or tasks objective, subjective and challenging quiz minds of consumers are also included in this software. The aim is to track progress or proficiency level of students, to evaluate and assess the progress that has been achieved by the user, especially in certain topics while using this software. All answers to questions will be provided with a positive feedback, in the form of computer graphics, text, and audio visual equipment. This positive feedback would create interest, impetus and motivation for consumers to continue to improve their knowledge and skills as well as be able to apply the knowledge learned. Users will be given the opportunity to demonstrate mastery of a skill before moving into other skills. There are several ways that can be used by users of this software to provide responses. Answers can be given through the use of the mouse or pressing a button on the keyboard. The answer given is more challenging. Users are also required to give an answer or response to questions in the required time frame. If the user can not answer or respond within the prescribed period, the computer will instruct the user to use the help button or give permission to proceed to answer the question or answer other activities.
- The software is also taking into consideration the final evaluation of teaching and learning events, through training activities objective and subjective answer questions and quiz software. Software will be developed to provide feedback, diagnose student strengths and weaknesses. Assessment and feedback that the students can strengthen memory and help students to apply knowledge in a more challenging learning experiences.

C. Cognitive Theory

Cognitive theory is related to the long-term and short-term memory (Bigge & Shermis, 2003). One of these memories is the cognitive theory of information processing used in the teaching of computer learning. This theory also provides an active learning where students actively act to acquire, restructure and investigate the knowledge to make it meaningful. Students need to transfer learning and knowledge. This theory is more pressing to knowledge and knowledge of the past now. To help students acquire the information, software design shall be in the form of symbols and other channel, so that information is more organized and easily accessible.

V. RESEARCH DESIGN

There are two stages used by the author to complete this study. First, the design and development of interactive multimedia applications that will use laboratory study method, and secondly, the analysis of the application that will use a method based on quantitative research poll. According to Shamsuri (2004), quantitative studies always make our observations more clearly. In other words, the percentage of the number makes it easier for the reader understanding and interpreting the facts for numbers involving arrangements. It's also easier to make the collection, comparison and summation.

Both the above method has undergone several frameworks, namely:

i. Design method with laboratory studies.

The author uses a computer, some software such as authoring software, graphic design software, audio and video software, software e-material providers, and Internet technologies to build interactive multimedia applications. Here is the framework set;

- Planning process and analysis obtained from the analysis phase of the application requirements, the construction of concepts and applications related to data collection from computer introductory course syllabus according to Gagne learning theory. Included

in this category is the provision of computer system requirements and related software.

- The processes of designing an application, which determine the implementation, define specifications, and produce a flow chart, and storyboard.
- Application development process, which is based on the contents of the building step storyboards, prototypes and a programming.
- Implementation process applications, which run applications created for learning purposes.
- Application assessment process, which is to test and evaluate applications that meet the specification as interactive multimedia applications according to Gagne's learning theory in teaching and learning.

ii. Survey Research Methodology

Once the first stage is completed, the author will use the survey method to gather opinions about interactive multimedia applications that have been built. According to Shamsuri (2004) study using the survey method should be handled through the use of questionnaires or interviews. Responses from questionnaires or interviews are the primary data. Whether it is the questions or statements to questionnaires or interviews, to be clear, and therefore respondents are not difficult to respond to the questions.

In the opinion of this is very important to verify that the design is developed according to Gagne learning theory and behavioral theory to applications developed in the next phase will follow the proposed theory.

For this study, the author will only use only questionnaires to collect data according to the following framework:

- Formulating and disseminating questionnaires, completed a set of online questionnaires
- Identify respondents who are experts in the Cognitive and Gagne theory
- Collecting data from questionnaires
- Data analysis

- Findings for discussion
- Make conclusions and recommendations

From the above framework, the authors obtained information from the data collected to assess the implications of the use of the application in the learning process.

A. Research Method

In this study, Sampling method used is simple random sampling (Sulaiman, 2004). Target population for this study is students who are taking Foundation of Computer in Universiti Teknologi Mara. However, the author will focus on the respondents in the Faculty of Applied Science only to obtain more accurate data and achieve the goal of an application evaluation.

B. Preparation of Online Questionnaires

After the main data are set in the form of interactive multimedia, the author will prepare a set of questions using online form using Gagne's theory. The questionnaires will be used to assess the effectiveness of resulting application.

In order to generate online evaluation, set of questionnaires will be configured using database software. The results of the response will continue to be stored before being manipulated and analyzed by the author. Both the main data will be accessed by the respondents through the portal provided.

C. Instruments

During data collection, there are two important instruments which relate to each other, which are based on interactive multimedia applications of Gagne's learning theory and data from respondents' opinion survey through online questionnaire.

D. Gagne's Theory of Multimedia Interactive Learning Applications

This application is the most important instrument of study that emphasizes on the use of multimedia

technology in learning C++ programming based on Gagne's theory of learning. The implication towards the use of this application depends on the capabilities of developing the applications that have characteristics that refers to multimedia interactivity and Gagne learning theory. The author needs to develop the application based on proficiency and creativity to attract an audience to learn the related course material. The results of the application will be used for the purposes of improvements to fulfill audience requirements.

E. Questionnaires

The second instrument is important to assess the product. Survey was conducted to analyze the opinions of students in the first semester who are taking Introduction to Computer Programming in the Faculty of Applied Science. The answers from the questionnaires will provide information to academic experts and investigators about the form of learning in programming using interactive multimedia based on the theory of learning and teaching.

Questions provided are based on presentation on the actual content that is done online. Here are the information that will be included:

a) Background

Once the respondents access the site, they are required to register. Registration information includes their particulars such as, username and password which aims to capture data for the reliability purposes. Personal information recorded includes name, faculty, gender, email, phone and date of the list, followed by the user name and password registration.

b) Evaluation of Application Presentation

Before the evaluation can be made, respondents are required to use multimedia applications based on Gagne's learning theory at least 2 months prior to evaluation

This section relates to the process of application development involving the use of multimedia

elements and interactivity elements found in the application. The assessment, are made based on the use of text, graphics, color, audio, video, and animation as mentioned in the theory of learning by Gagne. The results of the assessment will help to improve the application.

In completing the questionnaire, respondents are required to choose either strongly agree with the questions provided, or agree, or not agree, or disagree, or strongly disagree. Here are the questions proposed:

- a) Attractive screen designs
- b) Clear text and can be read
- c) Attractive and effective graphic
- d) Effective use of colors
 - a. Effective use of audio
 - b. Effective use of video
 - c. Animation used support learning
 - d. Adequate interactivity
 - e. Icons are clear and understandable
 - f. Presentation does not need facilitators

c) Evaluation of Application Content

This section is related to the course content in applications involving syllabus of Introduction to Computer Programming subject. The content is divided into several topics according to the syllabus. Respondents' assessment framework focused on the content, objectives, accuracy with the existing syllabus, descriptions, examples and a few other things.

In completing the questionnaire, respondents are required to choose either strongly agree with the questions provided, or agree, or not agree, or disagree, or strongly disagree. Here are the proposed questions:

- a) Clear content framework
- b) Clear learning objectives
- c) Delivered content meets curriculum
- d) Content arranged in order and clear
- e) Sufficient content explanation
- f) Sufficient content examples
- g) Additional material / support provided
- h) Contents help to better understand the lesson

- i) Content enables to easily revise lessons
- j) Overall applications satisfy you

Having selected the answer, the data of the respondent will be sent to the database before being processed by the author.

F. Data Processing and Analysis

After data collection is done, the author processes the data using the Statistical Package for the Social Sciences (SPSS) version 11.5 as a procedure in data analysis. Data will be presented in the form of tables, graphs, pie charts and bar charts. Authors also use Microsoft Excel 2007 to create a more attractive graphical data. Once the data is generated, the process of data analysis began by analyzing the data to produce a summary and conclusions. The discussion of the findings and observations made to develop recommendations and proposals are to be presented at the end of the study.

G. Evaluation

Evaluation can be defined as a method to collect, record, analyze, and use it to help the learning process. The implications for the assessment of the students are to increase student awareness about the level of achievement in a course and to increase student involvement in the teaching and learning process.

Formative assessment is seen as a system or method that can help provide appropriate feedback and follow-up action to the students in the use of developed application. This is to make sure the coil is closed and the students get the maximum possible from the testing or examination conducted and most importantly, to improve learning and results in the future.

In general, the implementation of this evaluation will be made during the learning process through student performance in quizzes, tutorials, training, laboratory reports or intermediate examination. Performance assessment has been made to provide early feedback to students through the quiz. Results for

the quiz are given as early as possible for follow up purposes. This helps the student in assessing the level of students' initial understanding and the effectiveness of the delivery of e-learning materials development programs using multimedia applications based on Gagne's learning theory.

VI. MANAGEMENT OF CONTENTS: UiTM MODEL

UiTM started e-learning development project in early 1990s with the development of the first phase with the full involvement by *Mesiniaga*. This was followed by a second phase with different vendors and their location on branch campuses. It is then followed by a third phase using the method of cooperation with the lecturer responsible as subject specialists, graphic designers and instructors, programmers, animators, typists and so on. First and third phase cost very large expenditure of which only a few courses have been successfully developed after swallowing more than hundreds of thousands of dollars.

Hussain (2006) found that the development of e-learning methods in Malaysian higher education institutions still rely on the professional expertise of ICT rather than academia that lead to a techno-centric nature than pedagogical or andragogical. But this is not the case in the development of LMS in UiTM which focuses on functional academics and developers to contribute to a more andragogical approach. In the fourth phase, UiTM switched to Open-source technology by developing applications portal of learning management (LMS) in collaboration with vendors who are trained in-house with a much cheaper cost. This solves the main problems in the development of every LMS concerning financial limitations (Hussain, 2006). Apart from low cost, it also provides an edge to academia exposure to instructional technology applications in a comprehensive and yield enhancement in the form of academic professionalism thus meets the criteria for e-learning applications to be outstanding and effective. Since mid 2005 until June 2012, almost 80% of the 7000 university lecturers have been using online of

learning materials to access 1400 of the entire course offered by the university.

The initiatives of development that focused and standardized according to SCORM compliant has reached 133 code. This achievement is something to be proud of by adopting in-house expertise from academicians who are more knowledgeable in the concept of education, teaching and learning. It is thus a solution to the concerns of the development of e-learning was more focused on techno-centric nature. LMS University was developed to be cost affordable which include almost the entire course done comprehensively with the involvement of academic staff to the maximum but not burdensome. Open-source applications are used to suit the interface required by the University. At the same time, it is designed according to the principles of a systematic and comprehensive instruction to simultaneously meets the needs of e-learning (Smith, 2005) as well as selection criteria Macromedia, The World Summit of Information Society and Open Source itself. At the corner of the application system, this LMS is directly linked to student registration system (ISIS), a scheduling system (ICRESS), student portal system (i-Student) and staff portal (i-Staff) of the university. Among the future developments include the creation of a wireless network on campus (collaborative project with the Ministry of Higher Education and UiTM staff), ongoing training related to learning technologies across the board in all campuses in Malaysia, server capacity expansion at each faculty and campus branches and some other strategic plan to improve the existing system.

VII. CONCLUSIONS

It is hoped that this study will meet the latest learning approach to enhance the learning of students' acquisition in learning Introduction to Computer Programming. Theoretically findings can be applied to produce other software that can help students to be more interested in learning the courses taken at Universiti Teknologi Mara.

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