Development of Learning Object for Engineering Courses in UTeM

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***Abstract*—This paper views e-learning initiative in UTeM with a focus on the development of learning object for engineering courses in UTeM. Having a learning management system called SPeL, UTeM further promote e-learning culture by encouraging knowledge sharing through SPeL's learning object repository. UTeM is gradually building a collection of reusable learning objects to be shared across faculties. The paper discusses the concept of learning object in UTeM context, roles of Subject Matter Expert (SME), UTeM's learning object design strategy and the development stages of learning object in UTeM. The paper further stated briefly on the benefits of learning object to UTeM.**

Keywords-e-learning; learning object; subject matter expert; SPeL; engineering courses

I. INTRODUCTION

The advent of e-learning has created a new educational trend among Malaysian universities. Most of the universities in Malaysia have started to utilize learning management system (LMS) as an effort to facilitate teaching and learning process. E-Learning initiative in Universiti Teknikal Malaysia Melaka (UTeM) has started around 2006 since it is called Kolej Universiti Teknikal Kebangsaan Malaysia (KUTKM). To further encourage the use of e-learning, UTeM has adopted a learning management system called SPeL (Sistem Pengurusan E-Learning). SPeL offers a blended learning solution, where conventional method is integrated with the use of virtual instructional environment to facilitate teaching and learning process. SPeL also allows collaboration between lecturers and students in the form of online discussion and content sharing. One of SPeL's mission is to promote knowledge management and knowledge sharing culture in UTeM's community by having lecturers from various faculties contributing to the development of learning objects. The plan is to gradually build a repository of sharable and reusable learning objects across faculties.

There are few stages/processes involved in developing learning object in UTeM. The processes include content chunking, learning object design and development of MML (Multimedia Lesson). Various parties from UTeM's community are involved in the development cycle including lecturers as SME (Subject Matter Expert), Instructional Designer, Graphic Designer, Multimedia Developer, Voice Over Talent as well as Language Editor. The roles of UTeM's academician as SME is critical throughout the learning object development. Apart from being a content expert, the SME also takes part in other stages of development to ensure content quality of the learning object. SME's involvement in the quality assurance process is crucial to ensure that the learning object being developed is reliable in content, reusable in other domain as well as ensuring that the learning object really achieves its intended learning outcome.

II. LEARNING OBJECT CONCEPT

There are various definitions of learning object. Wiley [9] defined learning object as any digital resource that can be reused to support learning. Boyle [2] stated that learning object should be tied to only one learning outcome to allow reusability between disciplines where one learning object can be used to achieve the same learning outcome in different disciplines. IEEE Learning Technology Standard Committee [5] defined learning object as a digital learning resource that facilitate a single learning objective and which may be reused in a different context. In UTeM context, learning object is defined as the smallest lesson unit with a single learning outcome as shown in Figure 1.

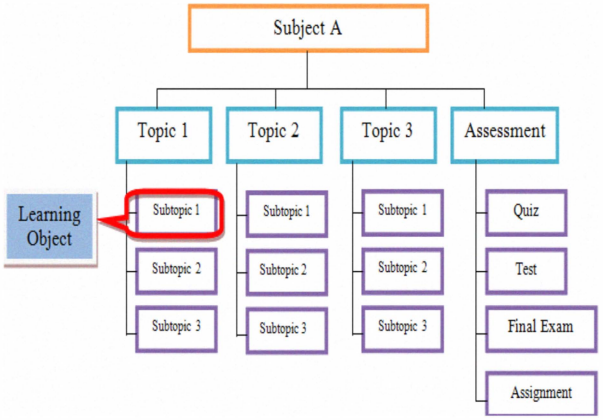

Figure 1. Learning Objects

In the initial stage of learning object development in UTeM, subject is broken down to smaller topics and further down to smaller learning unit called Learning Object (LO). Figure 2 shows example of two different subjects offered by two different faculties which has been broken down to a list of LO for each subject. Each of the LO listed is attached to a single learning outcome. It can be seen that, some of the LO from different subjects have similar title and share similar learning outcome. Therefore, in this case, only one LO is being developed and can be shared among common subjects.

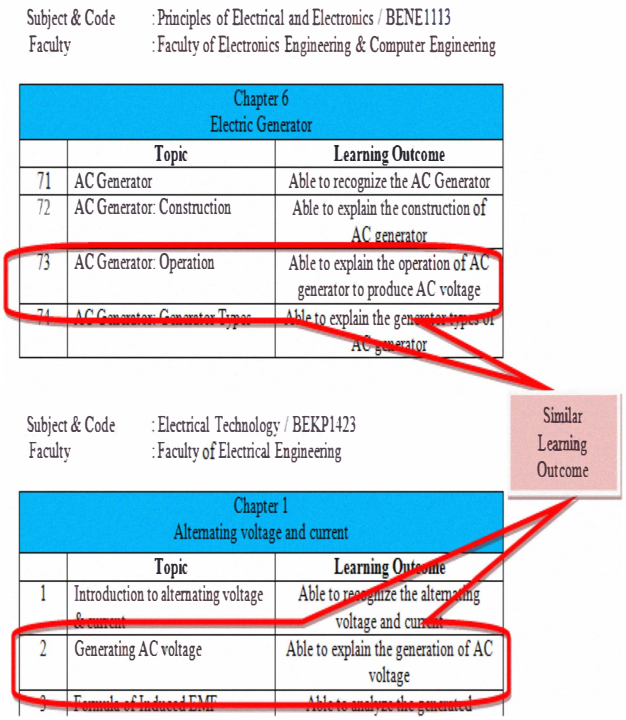

Figure 2. Learning Object List

III. SUBJECT MATTER EXPERT ROLES

Subject Matter Expert (SME) is a person who is an expert in a particular subject area. In e-learning environment, particularly in learning object development, SME is someone who has specific expertise and knowledge in certain field such as engineering. In development process, SME is responsible to review, improve and approve technical work, to guide others, and to teach.

In UTeM context, SME refers to the lecturers who are expert in their field and involved closely in teaching and learning activities. SMEs play an important role in the development of learning object. They help to craft the learning outcomes, create content, review the content for accuracy and provide valuable feedback.

During the initial development process, SME is responsible to chunk the content of subject into smaller learning units and produce specific learning outcome for each unit. These learning units are known as learning objects (LO).

After the process of identifying list of LOs to be developed, the SME will then work on each LO by selecting suitable content with appropriate instructional strategy for the LO. In this design stage, SME is responsible to ensure that the LO will be independent, reusable in other relevant subjects and could promote self learning.

In the next stage of development process, SME works closely with Instructional Designer (ID) by reviewing the storyboards produced and also the final product, learning object in the form of Multimedia Lesson (MML), to further improve the quality of the LO. The collaboration between SME and ID is important to enable sharing of ideas and views to achieve a reliable evaluation [4, 8].

IV. LEARNING OBJECT DESIGN STRATEGY

Prominent educators [6, 7] claimed that learning is better influenced by the instructional strategy used in the learning materials than by the type of instructional technology used to deliver instruction.

The purpose of e-learning is to promote interactive learning, self learning and to enhance student's understanding. Hence, learning objects should be designed with appropriate instructional strategy to encourage learning and knowledge transfer. Learning activities crafted in learning objects could encourage active processing of information and facilitate storage of information in long-term memory [6]. Since learning objects have content, context, and structure, the content of the learning objects should be presented to the learner in a clear manner, its structure adapted to the context, and its context should reflect the learning needs [1].

In developing mass repository of learning object, time and SME participation is the main concern. In order to expedite and simplify design process, the following common instructional strategy is used in UTeM:

- Introduction (gaining learner's attention)
- Content Presentation
- Activity (allowing the learner to recall things they have learned from content presentation)

Introduction is a crucial component of a learning object. A well designed introduction could attract learner's attention and motivate learners to learn. An introduction may contain statement of learning outcome, a general outline of the LO's content , prerequisite of the lesson, problem statement and also other engaging form of related content such as video montage or animation. Figure 3 shows an example of the introduction part in a learning design document for a specific LO.

Introduction

Rationale :
This unit introduce basic concept of generating AC voltage. It shows how AC is generated using electromagnetic induction and shows simple AC waveforms.

Learning Outcome :
At the end of this lesson unit, you should be able to understand simple mean of generating AC voltage

Assumed Pre-knowledge :
Before starting this lesson unit, you should be familiar with Faraday's Law.

Figure 3. Example of Introduction Part in a Learning Design Document

In the content section, learning information is presented using various strategy integrating various multimedia elements, for example, simulation, interactive animation, and problem solving lesson. Learning information is being summarized (chunked) to allow faster processing of key information and encourage learners to explore and learn on their own. Example of content presentation part in a learning design document is shown in Figure 4.

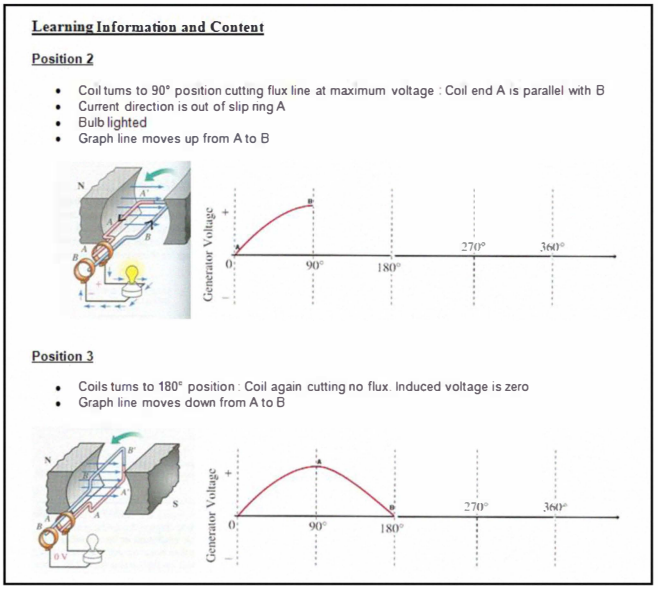

Figure 4. Example of Content Part in a Learning Design Document

In the practice/interactive activity section, suitable activity is designed, allowing the learners to recall the information presented in the content section. Activities crafted at the end of a lesson could promote new knowledge acquisition [4] and provide learners with a self assessment tool to self measure their achievement. Figure 5 shows an example of activity part in a learning design document.

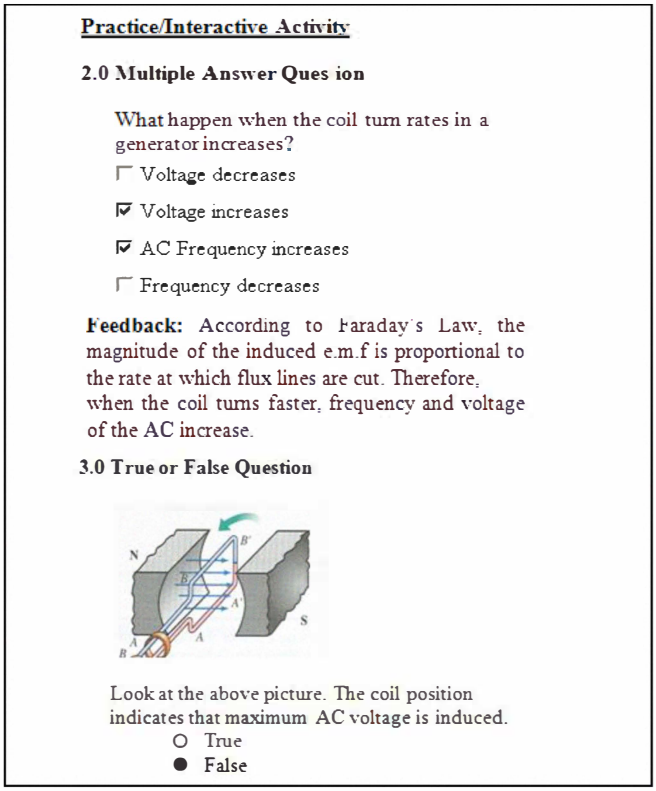

Figure 5. Example of Activity Part in a Learning Design Document

V. LEARNING OBJECT DEVELOPMENT PROCESS FLOW

The process flow chart in Figure 6 shows the process of developing engineering learning object in UTeM. Key processes are producing learning design, storyboarding and multimedia authoring (development). The process of developing LO started with lesson chunking where SME is responsible to break down their lesson/subject into independent learning units identified as learning objects. The list of learning objects will then be refined by the SME by attaching each of the learning objects with appropriate achievable learning outcome.

The SME is also responsible to produce learning object design document for each of the learning object. Learning object design document is an outcome of a critical process where SME carefully design and plan a suitable instructional strategy, appropriate level of content detail, engaging activities as well as attention-grabbing introduction to be included in the learning object. Normally, in common practice of instructional design, instructional designer (ID) will be responsible for all the design process, where SME is only responsible to provide content. However, in UTeM case, SME is strategically involved in part of the design process. Soon, the SME will be included in each of the development process to gradually educate them in developing their own multimedia learning object.

The next process of developing learning object is storyboarding. Storyboard is a document containing the

flow/sequence of learning object produced by instructional designer (ID) based on learning object design document. In this process, ID is responsible to plan the lesson flow, layout and navigation design, placement of appropriate multimedia elements as well as producing voice over script for the multimedia lesson.

Based on the storyboard, a team of multimedia developers will then develop a fully functional multimedia learning object using multimedia authoring software. There are many sub processes involved at this stage such as image editing, sound editing, video editing and voice over recording using various tools such as image editing software, sound and video editing software. Finally, the learning object is then packaged using SCORM (Sharable Content Object Reference Model) standard. SCORM standard specify on how a learning object should be packaged to ensure reusability of the learning object.

The whole development process also includes quality assurance measures in the form of formative evaluation (evaluation conducted during the development process) and summative evaluation (evaluation of end product). Learning object is evaluated on 3 criterias; content accuracy, presentation design and usability. Content accuracy includes review on appropriate level of content details and achievement of learning outcome. Presentation design includes review on appropriate use of visual and auditory elements (text, graphic, animation, video, sound). Usability review includes review on program functionality, clarity of instruction and clarity of media elements. Suitable criterias are used selectively in review processes at every level of development such as storyboard review and MML(Multimedia Lesson) review. Language review is another essential review conducted by appointed language editor after the storyboarding process. The purpose of language review is to check on language accuracy of the text and voice over element in the storyboard.

The final product, MML, will then be uploaded to SPeL's learning object repository. From the repository, lecturers from various faculties will select suitable LO to be included in their online classroom.

From the flow chart, it can be shown that SME is highly involved in the whole LO development. The SME in UTeM takes part in most of the development stages from designing and planning to review processes. The beauty and uniqueness of LO development process in UTeM lies in the strong collaboration among UTeM academician (lecturers and students). Apart from being SME, they also contribute as language auditor, voice over talent, designer as well as being part of the multimedia development team.

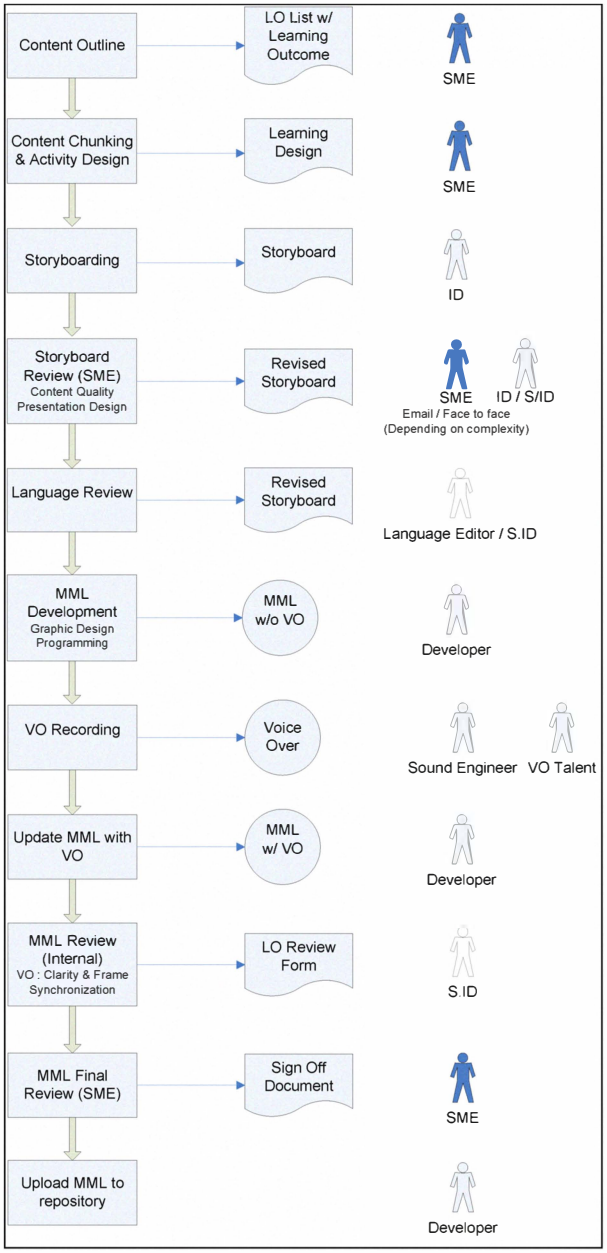

Figure 6. Learning Object Development Flow Chart

VI. BENEFIT OF LEARNING OBJECT

Learning objects has the potential to significantly change the way instructions are delivered. By having a learning object repository, students and instructors are able to share and access learning objects at anytime and anyplace. Reusability implies that learning objects may be used in multiple contexts for multiple purposes. Instructors across faculties will be able to select, reuse and assemble learning objects to create their own learning path in their virtual classroom. A centralized repository of learning object also allows easier maintenance of learning object and promotes an efficient version control.

VII. CONCLUSION

A good learning management system is meaningless without content. This paper has looked at UTeM initiative in developing a collection of learning object to fully utilize one of the most important components in SPeL, which is the learning object repository. The university stressed on the importance of having a collection of learning object to promote knowledge sharing culture in UTeM. Therefore, in UTeM, instructors are encouraged to design learning objects related to their content expertise and participate in the learning object development process. In the development process, subject matter expert (SME) plays an important role, not only as content provider but also to ensure the overall quality of learning object. SME ensures that the learning object is carefully designed to achieve desirable learning outcome. Hence, the SME cooperation is definitely crucial to ensure the success of e-learning in UTeM.

SPeL offers an instructional alternative to support teaching and learning process. Apart from the benefits of sharable and reusable learning objects in the repository, SPeL also encourage self paced learning, collaboration and self assessment. To fully benefit from SPeL, constraints and limitation in implementing the system have to be overcome or reduced. Apparent problems include lack of SME participation, low level of e-learning awareness as well as problems in supporting network facility (slow access to SPeL).

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