 Adaptive E-Learning Tools for Numbering Systems

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Abstract
Due to the growth within Internet-based technologies as well as human competencies in the use of these technologies, E-learning today allows students to try things out, participate in courses, tests and simulations like never before, and get more out of learning than before. This paper introduces an environment for adaptive e-learning in data representation and other fields. That used to be learnt in a traditional way. The presented model generates suitable courses for each student in a dynamic form. Even the choice of effective e-learning tools is seemingly endless. The proposed environment is designed by using Visual Basic for modeling and Microsoft word for creating materials

Keywords: Numerical Systems, Active Learning, Adaptive E-Learning

I. Introduction
The sustained growth in e-learning helps to provide a powerful mechanism to enhance learning depth, and involve learners with the material [8-13]. In traditional lecture methods, the professor talks and students listening in a passive way, unlike in active learning students doing, observing and communicating, so they become more interactive by finding better ways to engaging them in learning process. Blended learning is defined as learning that combines instruction lead learning with online learning activities leading to reduced classroom contact hours. It has the potential to increase student learning while lowering attend rates compared to equivalent fully online courses [14]. Blended learning is the learning paradigm that attempts to optimize both traditional learning and distance learning advantages, potentials, and benefits while eliminating both learning paradigms shortages and challenges. Nowadays blended learning is commonly referred to as E-Learning. When compared to traditional learning paradigm, blended learning is found to be consistent with the values of traditional learning paradigm adopted in almost all higher education learning institutions for decades, and has the proven potential to enhance both the effectiveness and efficiency of meaningful learning experiences [8-15].

This paper introduces an environment where learners participate in learning process effectively, and teachers have an instructive role, instead of transmitting information in materials to learners directly. Adaptive e-learning is always focusing on the learner, although it sometimes involves tutors. Our proposed model can be used as an adaptive e-learning tool for active learning not for numerical systems course only but also for all educational courses as image processing, logics design, and other fields. Nowadays, the concept of number systems course has important role in a wide range of applications as data representation, internal operations of the computer, performing calculations, and comparing amounts.

Before writing this paper, multiple tests have been done in the classroom for the framework as a model of adaptive active learning tool. The preliminary results were clear in improving the learners understanding, performance, and increase their motivation. It is proved that the proposed model is easy to use and attractive for learners.

II. Related Work
Several models have been developed to be useful tools for learners, as in [1] which developed an applet simulates Huffman code. But Mohamed Hamada's environment [2] allows learners building coding process step by step and they can get help at any step of learning process using hints or help buttons. In [3] the authors use an interactive learning tool in the theory of computation course. Also [5] supports active learning to improve learning in computational models, where [2] provide a single interface java applet as a web-based tool in information theory. Due to importance of virtual reality, [4] provides automata learners with a web based virtual environment for automata theory as an example introduced, and owing to the importance of active learning in higher education universities. Mariko-susumu [6] proposed a simple and effective model to represent a framework for adaptive e-learning systems. Also a web Services based e-learning architecture is proposed in [7]. In that paper, the authors designed a function to modify sequence of learning materials automatically due to learner’s learning style. This function provides learner-adapted contents, which is incapable of conventional e-learning architecture.
III. The Proposed Model

It is not an easy task to teach the computer systems internal operation, learners usually found computer architecture materials boring and complex. The main reason of that is that learners find materials difficult to visualize or interact with. Especially when material includes coverage of low level electronics, Boolean logic and data representation then learners can lose interest or perceive higher levels of complexity. So, this paper supporting active e-learning in data representation specially numbering systems, and provide a converter to convert automatically between these systems. It also provides educational course and testing system to generate exercises automatically. The choices of effective e-learning tools are seemingly endless, according to availability of multiple tools. We use visual basic 6 as an example of simple active learning tools that improves the learner's performance in classes. The implemented framework contains of three parts as shown in Fig. 1. The framework generates the module course according to the understanding level of students. Here, teacher has an administration role in education process, but they also must construct the standard course material and other courses included in framework.

We split the course material into 3 partitions which implemented as text file as shown in Fig. 2, and Fig. 3:

1. Standard course: it represents main units ordered in an ordinary way that learners can be master successfully.
2. Review course: should be studied when a learner makes wrong answers in the examination.
3. Special course: course material should be studied when learner makes popular mistakes in the examination.

The converter is the second part of the framework, it convert automatically between any two numerical systems, to assist learners enjoys, learning and trying what was studied in educational courses as in Fig. 4. Decimal, binary, octal, and hexadecimal are 4 numbers systems so we have 4 systems to convert from, and 4 systems to convert to them. Therefore, the relations among them are complicated. So the framework can help teachers to manage the relations by information visualization.

Some learners master a material course by studying it once. Other learners may not understand a material from the first time, so the situation must be different. Therefore our framework provides an examination mechanism which is shown in Fig. 5. Such mechanism leads to other situations according to the exam results.

The framework provides examination within 10 questions as a multiple choice questions that selected randomly from database contains lots of questions and their answers. A learner may fail to passes the same examination more than one time, or may be multiple learners examined at same time and place. So, the system generates different examination pages each time. It checks the answers by comparing the learner’s answer to the correct answer in the database. It displays "Wrong" as a message in case of invalid answer, and if the answer is true "Correct" message will be displayed. The displayed messages according to answers are shown in Fig. 6 and Fig. 7. After the termination of the exam, the system counts passed and failed questions. It displays the final result in a score sheet and gives a comment on results.

According to the result of the examination, the system decides the next course that will be learned. The system decides that special course material will be suitable as shown in Fig. 8.

The system decides the next unit according to the following four cases:

- If a learner's pass percentage of the examination of a unit is 50% or less, then next unit is a unit which the student has tried but never passed (learner returns to the same course that never passed by him).
- If a learner's pass percentage of the examination of a unit is 60% or 70%, then next unit is the review course
- If a learner's pass percentage of the examination of a unit is 80% or 90% because of frequently wrong answers, then the special course materials will be provided.
- If a learner's pass percentage of the examination of a unit is 100%, then the next unit will be provided

IV. Experimental Results

Experiments were carried out to evaluate the effectiveness of the proposed environment tools on the learning process. Forty students were randomly selected from different classrooms. They were divided into two groups. The students of first group have already completed the numeric systems course and done their exams in a traditional learning process. Then each one of the first group was given the questionnaire as shown in Table 1. The questionnaire measure four criteria named as enjoyable, fairness, flexibility, and pinpoint weakness. Five options were given for responses: (N)No answer, (1)Poor, (2)Below average, (3)Good, (4)Excellent. The responses are shown in Table 2. We demonstrate our model and visual examples for the second group of students. They have been allowed to use self assessment testing system, and each of them has been given the same questionnaire. Their responses are listed in Table3.
The questionnaire indicates that 95% of the students found the experience enjoyable, one student did not like the experience at all, and 90% of the respondents agreed the marks awarded by the system were fair. The result also shows that 85% of the respondents thought of flexibility of the system. Finally 85% of respondents think the system could help them pinpoint their weaknesses in numeric systems course.

We compare results of the first group without using our model, and the other group used our model. For Choices N, 1, and 2, if the number of response decreased, it indicates a positive response, which is what occurred. While for choices 3, and 4, the increasing numbers of responses indicates positive response, which also occurred as in Fig. 9.

V. Conclusion

An adaptive active e-learning framework has been presented. The proposed framework consists of three parts, self learning material, visualization in an interesting way, and self testing. The framework is simple and easy to be implemented using simple tools to support adaptive e-learning systems for numbering systems educational material, and it could be also used in other courses such as logic design, image processing, computational models, information theory, information engineering and digital communications. The framework finds a better way to engaging learners in the learning process. Through the results of our experiment, it has been shown that our proposed model improves the learning process, and affects the students in a positive way. In future work, we plan to develop our tools by adding more features and more visual examples.

References


Remember

All of conversions follow certain patterns that you need to remember:

- When converting from decimal you always use divide and when converting to decimal you always multiply.
- Converting between hexadecimal and binary as well as octal and binary as a bit easier to remember. Just remember that hexadecimal is $8421$ and octal is $421$.
- The only thing you need to know about converting between hexadecimal and octal is that you must always convert to binary first.

Fig. 3: review course

Fig. 4: Converter to convert between numbering systems

Fig. 5: Examination

Fig. 6: displayed message if answer is wrong
Fig. 7: displayed message if answer is correct

Fig. 8: Score sheet and pass percentage

Fig. 9: A comparison between the results of the two groups.