Context-Aware Customization E-Learning System with Intelligent On-Line Examination Mechanism

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ABSTRACT

With the fast development of distributed network technology and speeding increase of network bandwidth, it has now become one of the hottest issues as how network can be used to enrich the living quality of people. This paper will focus on the e-learning and On-line examination domain, and would like to make use diverse functions of *Multi-agent* as found in every Distributed Database or AP Server, and through the Data Mining technology to arrange the latest learning procedure and test recording of each learner. And after analysis, the results will be provided to the *Recommending Learning AP Server* as the suitable level of customization learning program suggested to learning under current level based upon system evaluation. Thus, learner can enjoy the fun of learning with sequential progress. Moreover, we have resorted to the technology of various Agents, and recorded the information of browsing and learning processes of learner in every stage, and it would then arrange and organize possible current level of learning for among learners from Database and Data Warehouse so as to provide learners to conduct judgment as they choose degree of difficulty with test-paper for online test, achieving the objective of integrate learning and test. Hence, it can efficiently improve defects of traditional e-learning and online test. At the end, we have put forth Context-aware technology to integrate intelligent online examination system so as to achieve the relevant learning content of students for extension as well as mastery of teacher for learning extent of students. Then, it can have designed the test that accommodates to student's level so that online test and learning can be complementary, helping examination to return to its original essence–appreciation of self and turning learning to be extended indefinitely.

Keywords

Context-aware, Customization Learning, Multi-Agent, On-Line Examination, Data Mining, Recommending Mechanism, e-learning, green test-paper, Personal Learning Profile

1. INTRODUCTION

With constant innovation of network technology and distributed system, it has largely lowered the time cost of information transmission and searching distributed in various locations, and it has helped created the prosperous scenario of E-learning. This paper will make use online teaching and learning, and the integration of online test and context-aware to generate such an "Intelligent Context Aware On-Line Examination and E-Learning Integrated System." It helps learners to be free from constraints of time and space during the process of learning or testing, and they can, at all time, conduct online test and learning through computer or browser of mobile equipment at anytime. Meanwhile, students can, after test, immediately learn about the deficiency of their learning from online correction and answering function. In such a way, it helps them from a smattering of knowledge with program content after test and frees them from the dilemma of not knowing where they can start to learn.

Furthermore, we have exploited the system functions of "Knowledge Reference Engine" and "Context Aware Engine"[1] so that teacher can quickly have searched and mastered relevant professional knowledge from massive ocean of Internet knowledge as they proceed to write about the database of examination, avoiding to limit themselves from the scope of measures writing for examination database and improve the scenario that students make to use of mere memorization of previous test-question for high score. Besides, one of the greatest defects of traditional online examination system is that it cannot render into suitable customized test and teaching materials based on the learning progress among students of different levels, so that students of diverse academic level can receive suitable online test or digital teaching materials coping to their levels, achieving the purpose of teaching accordingly. For this regard, this study has also proposed recording the learning processes of students, working in conjunction with Reference & Inference Base to automatically suggest patterns that suit students of diverse levels; besides, the system will base on the patterns of different regulations for writing test so as to generate online test-paper of diverse difficulty.

It is also from the score statistics and question-answer analysis function after test so that teacher can further focus on diverse learning levels of students to conduct more suitable teaching method and progress. On the other hand, "in-depth interactive answer" function can help students to obtain various digital teaching materials from each online test in relevancy to the multimedia teaching materials Metadata so that students can

conduct the pattern to strengthen and compensate their learning of weakness right after test. In other words, the system will, right after test of students, will immediately suggest the instruction movie file and teaching material in relevancy to the part where they should strengthen themselves. [2]

At the end, we will make use of extensive collection of recorded processes of student learning with Multi-Agents of diverse functions to organize and arrange statistics and recommend it to AP Server or pattern generator as the novel basis for students to carry out online learning or test next times. Meanwhile, the results of the analysis will then feedback to Reference & Inference Base to enhance to the accuracy of reference law database. In such a way, the test can, through constant records, help teacher to more comprehensively enhance the learning level and standard of students so that the teaching quality of teacher and learning efficiency of student can be boosted efficiently.

2. RELATED WORKS

Traditional online learning or online test system is mostly of two categories that are independent and cannot be integrated, or it needed to focus on one single professional program, which is of interactive digital program that is both time and cost consuming. As such, it has constrained an applicable digital learning and test system that can be widely used onto other professional areas. Besides, SCORM standard is then being formulated in view of the issues of interoperability between platform and teaching material so as to enliven the reusability of teaching material. Nonetheless, the sharing mechanism and customization of teaching materials of digital teaching material are reckoned to be of more important issues after standardization of teaching materials.

On the other hand, there might still be follow defects for traditional online test or manners of e-learning: (1) most of them are limited to "green test-paper"; (2) traditional online teaching is most only "self-made" and independent, and it is why the cost is relatively higher, and the content information of reference is relatively closed and subjective; (3) traditional online test cannot grasp the learning progress of students and so it can't achieve customized self-evaluation; (4) test system and teaching system are in most cased made in system that cannot be mutually interconnected; (5) traditional online teaching is mostly logged in with account number, and it will, based on time logged in and frequency of clicking, conduct extent of participation; however, it is unable to detect if the user is actually working on the net.[8]

Thus, this paper will focus on the above-mentioned defects and put forth a digital test and learning platform of mutually sharing mechanism so that diverse writers can share among themselves different focus of the teaching materials and test database. Then, it can avoid learners can only focus on the knowledge of program content from one single source for learning. Meanwhile, the sharing mechanism can largely enhance the referential convenience of teachers as they render test database or digital teaching materials.

At the end, the context-aware mechanism is put forth in this paper to assist the system as it bases on current level of the learners to suggest suitable test questions and learning materials so that learners can, free from constrains of time and space, conduct diversified learning. It will also provide the campus with a ubiquitous learning environment. Furthermore, the system will fuse online test into learning module so that learning efficiency can be greatly enhanced. It can then allow the theory of learning to return to (TEST = Touch Enter Study Teach) contact – enter – learning – feedback and test restores to it original essence – appreciation of self.

3. REQUIREMENTS AND SCENARIOS
3.1 SCENARIOS

Conventional on-line test is only a system tool for examinations. After tests, test takers are provided with test results and answers but no further exploration or research is possible, not to mention the understanding of students' absorption of knowledge and the provision of complete information on test questions. Similar to common class quizzes, nothing will be achieved after the tests. In terms of item bank, test questions are mostly composed by teachers in advance, from which a certain number of test questions will be randomly selected for future examinations. The test papers compiled in this way fail to present test questions corresponding to students' abilities, leading to a situation that some students consider the test too difficult while others think otherwise. In light of this situation, suggestions are made as below:

(A) On-line tests different from the conventional ones should be designed to allow students to do more than just taking on-line tests.

(B) Learning structure is incorporated in the on-line test system put forth in this study. The system focuses on teachers' construction of item bank. System's Knowledge Warehouse can be expanded through Knowledge Search Agent's regular data search. Through Knowledge Reference Engine, teachers can enrich their reference resources, diversify their test questions, making the preparation of test questions easier, more objective and comprehensive.

(C) The explanation of answers to test questions after examination isn't limited to the provison of standard answers. Through the correct answers provided by the system and the recommended supplemental teaching materials [6], it enables students' immediate understanding of the reasons behind the answers and the related content of multimedia information to improve their study effect.

(D) After the establishment of item bank, system can automatically build templates based on test takers' average scores or allow teachers to manually built templates and test their examination papers before on-line test papers are built according to the regualtions.

(E) Every test result will be recorded for later analysis of test takers' academic levels, which can serve as teachers' reference. According to students' different levels, teachers can choose suitable templates to build an e-learning environment enabling students to engage in step-by-step study. [11]

3.2 SYSTEM REQUIREMENTS

3.2.1 Composition of Test Questions

Before on-line examinations, teachers need to compose test questions. In the past, most on-line examination system required teachers to enter test questions, which would limits the test questions to the subjective cognition of the teachers who compose test questions and results in uneven distribution of examination questions.

The improved system bought forth in this study allows teachers to enter related key words, according to which the specially designed Knowledge Reference Engines and Knowledge Warehouse will conduct a blanket search of item banks and the related information periodically collected on the Internet. The search results will be provided to teachers as reference for their composition of test questions.

Teachers not only make use of their ideas but also can incorporate the whole Internet in their own tests, which can both enrich and diversify their test questions. Based on the records of students' learning process, Context Inference Engine can provide useful suggestions on test questions' level of difficulty and categories. Additionally, the concept of the group sharing of item bank is put forth for teachers of the same group to share their test questions with teachers from other groups, which can enrich the item pool richer and make it more convenient.

3.2.2 Template Construction and Test

Method of random selection is adopted for the compilation of test paper to prevent cheating on test. Apart from general examinations, Context Aware Agent can be used to analyze test takers' learning process; while Reference and Inference Base can be used to determine reasonable examination time. Thus, a suitable examination paper can be designed according to each student's academic level. Through tests, teachers can identify the difficulties in students' learning and provide them with further academic guidance to improve their study effect.

3.2.3 Post-examination Learning

Most on-line examination systems conduct tests only after students have finished their preparation work for the examinations. Immediately after the examination, test takers' answer sheet will be reviewed and the test results posted. This kind of examinations failed to make students understand what mistakes they have made and which parts of knowledge they should strengthen. After the examination, nothing can be achieved as students still have no idea what mistakes they have made on the test and how to improve their study.

The improved method presented in this study integrate the stages of both test and learning, which enables the production of teaching presentation, teaching documents and audio-visual files of classes to allow students to swiftly study on the parts they don't understand. Additionally, their learning process will be recorded by the system for the provision of customized learning information and improve their study effect.

4. System Environment and Architecture

The system is composed of three modules: item bank construction module, examination and feedback learning module

and in-depth teaching module. Below is the explanation on the workflow and details:

4.1 SYSTEM Workflow

The entire workflow of our system is described as below (see figure 1) :

(1) A1. Teachers log in the system using existing verification mechanism.

(2) A2. When the teacher want to query some information, only enter key words to sort out the related information in Knowledge Warehouse according to correlative degree through Knowledge Reference Engine which will collect regularly all relevant information in data warehouse in order to support the later q   u   e   r   i   e   s   .

(3) A3. Teachers refer to the related information collected using Knowledge Reference Engine and sort them out to compose test questions and store them in item bank DB which can offers abundant references about each professional course..

(4) B. After the construction of item bank, teachers can make use of learning process recording files and Reference & Inference Base for Context Aware Agent to analyze and set the most fitting standard for test paper compilation and provide suggestions on the selection of test questions from item pool. Thus, tailor-made test templates can be produced.

(5) C. Teachers conduct test on multiple item banks, number of test questions and the distribution of test questions to produce test templates.

(6) D. Besides the templates compiled by teachers on their own, Context Inference Engines & Search Engine can also be used to analyze students' learning process records and Reference and Inference Base can be used find out students' academic levels to produce customized test templates.

(7) E. According to test question samples and the number of test takers, teachers can randomly compile test sheets.

(8) F. Teachers can use Context Aware Agent to analyze and decide suitable examination time and select test questions suitable to students according to students' learning process records and the analysis of Reference & Inference Base.

(9) G. The abstract information of various multimedia teaching data base will be stored onto the Metadata, a data base for multimedia teaching materials.

(10) H. Through in-dept explanations on answers to test questions, students can locate related teaching materials in Metadata for real-time or later learning and study.

(11) I. During the examination session, the information about the content of students' answers, time and others will be recorded and stored onto learning process records.

(12) J. Context Inference & Search Engine will analyze students' learning process and Reference & Inference Base to adjust the standards of reference standards to achieve context aware goal.
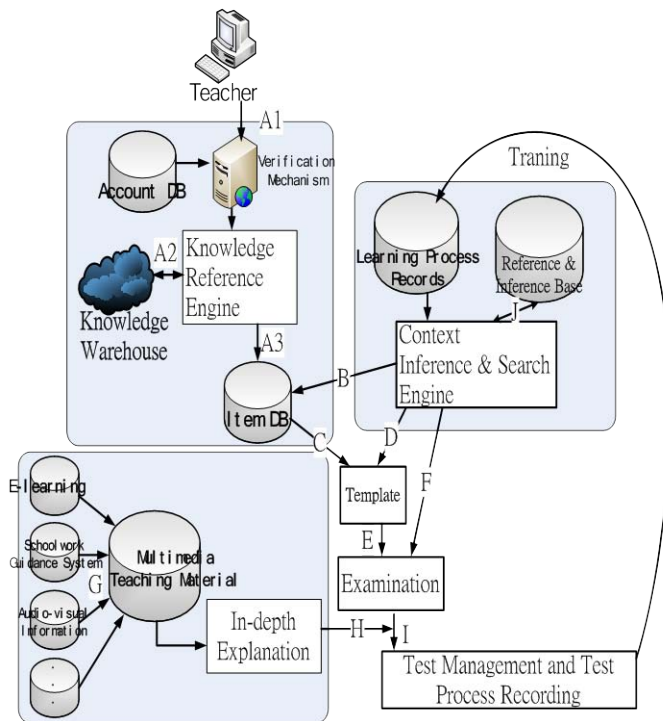
Figure 1. The Architechure of Context-Aware E-Learning and On-Line Examination with Feedback Mechanism

4.2 ARCHITECTURE OF SYSTEM MODULE

4.2.1 Module1 – Constructing Item Bank

Teachers log in the system through verification mechanism and use the data in Knowledge Reference Warehouse on the Internet or the existing data bases to collect related information and compile them into item bank as figure 2.

(1) Verification mechanism: verify the identifications of people who are our member and log in the system to further reference information.

(2) Knowledge Reference Engine: It can search out the relevant information of user's query from the knowledge warehouse according to some knowledge categories and inference rules. So, it can help teachers to quickly mining their search of the related information in Knowledge Warehouse.

(3) Knowledge Warehouse: an open information and knowledge warehouse to search and collect extensive information on the Internet by collecting regular or in the existing teaching material database.

(4) Item Bank DB: Store the test questions sorted out by teachers for future test paper compilation and sharing.
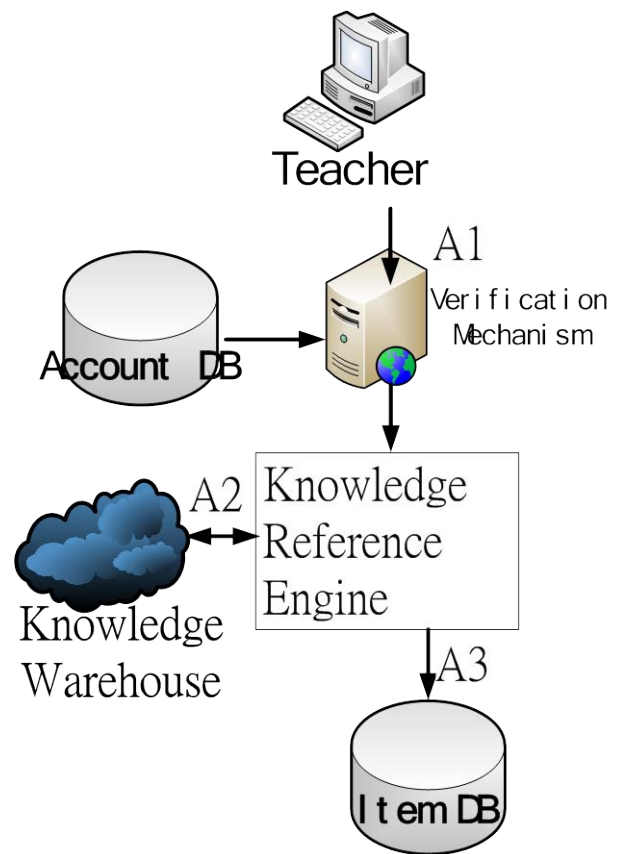

Figure 2. Module 1-Item bank Compilation Architecture

4.2.2 Module2- Examination and Feedback Learning Mechanism.

Before the composition of test papers, teachers can select suitable item banks, decide the number of test questions and test questions' distribution to build a template. After that, a test paper can be built according to the number of test sheets, test time and the information on the number of test questions on each page. At the same time, Context Aware Agent can come up with appropriate suggestions on customization test sheet templates according to students' learning process records and Reference & Inference Base. After students complete the test within the designated time period, the test results will be stored onto learning process records for analysis to further increase the accuracy of Reference & Inference Base (see figure 3).

(1) Template: Build standard for multiple-choice test questions' random selection and the distribution of test questions. Test sheets will be built based on this standard. And template can be automatically generated by system or be created by teachers.

(2) Examination: New test sheets can be composed through the selection of test sheet templates. That is by template which can decide the selection rules of examination questions. It also provides the function of test taker selection.

(3) Management of Test Results: Provide the functions of test score calculation and the decision for certain test takers to take a second test.

(4) Learning Process Records: Record test takers' examination process and results onto Learning Process Records for further analysis.

(5) Reference & Inference Base: Store original data standard such as students' mean test scores and the follow-up standards produced by system analysis.

(6) Context Aware Agent: Conduct analysis on students learning process and Reference & Inference Base and provide teachers with timely suggestions on test questions.
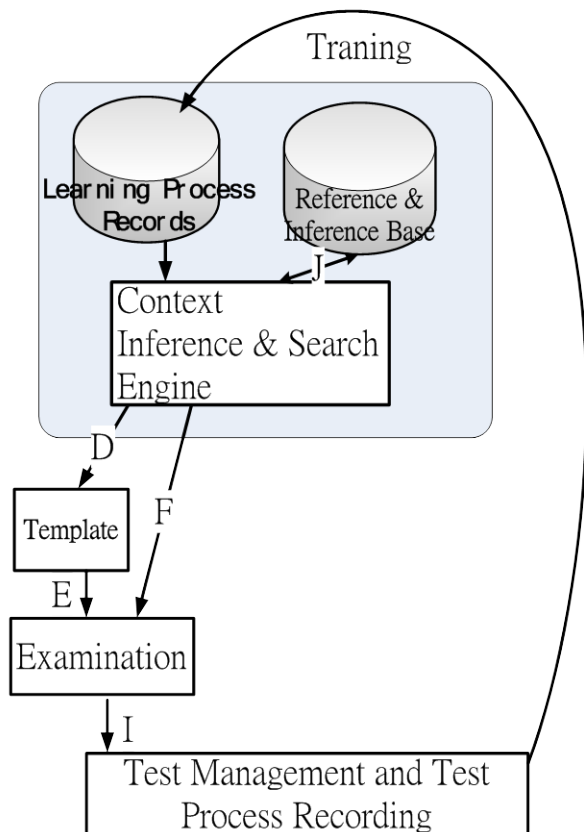

Figure 3. Module 2— Examination and Feedback Learning Architecture

4.2.3 Module3- In-depth Teaching.

In the process of taking test, students can access to test question-related information, even the detailed explanation on answers and the multimedia teaching materials stored in various data bases such as the presentation   files, teaching films, interactive teaching course and so forth to allow students to gain a more in-depth understanding of the test questions when they are sitting for test (see figure 4).

(1) Multimedia Teaching Material – Metadata: The description information of various multimedia teaching materials such as films and texts scattered on different teaching systems are stored here for speedy access when needed.

(2) In-depth Explanation: Provide real-time or later interactive explanation on test questions, real-time search of answers, and

reference materials for students to immediately gain a better understanding after examination to the test content they fail to grasp during test session.
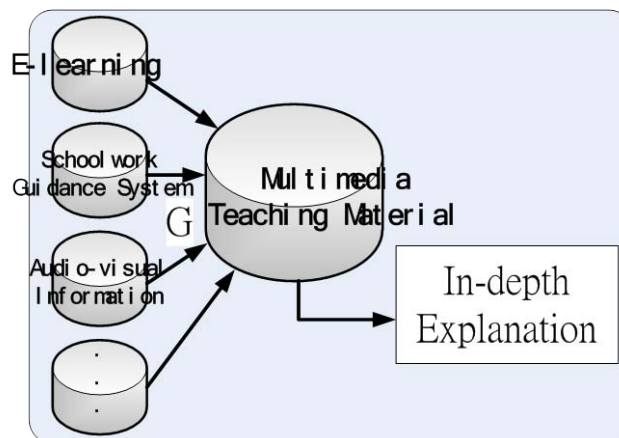

Figure 4. Module3-In-depth Teaching

5. CONCLUSIONS

The "context-aware customization learning system with adaptive intelligent on-line examination mechanism" suggested in this paper can provide following advantages to teachers who writer for test questions and learners: (1) Automatic expand Data Warehouse Base： from our knowledge agent, it will regularly collect related information, and then after classification of knowledge reference engine store to our data warehouse. When teachers who are to writer for test questions can inquire professional test-question material, there will, immediately, be massive, abundant, and the latest database for reference and search so that teachers who are write for test-questions are provided with the best electronic library; (2) Knowledge management & sharing mechanism: through the mechanism of network searching and platform sharing, it will gradually categorize knowledge sharing platform with "rich database of test-question" and interactive multimedia database of teaching materials"; (3) Context-aware customization learning: when it is to compose test-question, the system can, through the historical records of learning process of learning working in conjunction with reference & inference base, find out the customized test-paper and learning materials that best suit the current learning level for learners to provide itself as basis for teacher to compose test-questions. As a result, pattern established can be more flexible and accurate, helping learners to pick up professional knowledge with sequential progress; (4) automatic modification and feedback mechanism: the system will, working with patterns after test is established, base on the average level of students to suggest to teacher when will be the suitable timing for test. Afterwards, it will collect the score of students and the record of answer and learning, and again provide the latest results feedback to the reference law database after analysis so that it can act as the basis of figure correction and modification against the previous system benchmark; (5) integrated online test and learning system: it will automatically implement and manage test, and have the results stored in "personal learning profile;" it will also based on

the answer and score record of learners, integrate Multimedia Digital AP Server to provide immediate self-help and strengthening materials to students so that students can focus on the part they needed to be strengthened among extensive pool of books, thus helping learners to enhance the fun and efficiency of learning.

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