Research and Development of Online Simulation Learning and Assessment Management System

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Abstract: - With the rapid development of information technology, e-learning is an irresistible global trend. In order to instantly understand and supervise learning effects, this study develops learning portfolio provided by digital learning platforms to make evaluations. Then we can manage learning conditions and effects, and further provide individual assistance, reduce achievement difference and increase learners’ learning abilities.

Key-Words: - Shared platform, E-learning, Learning portfolio, Instant evaluation

1 Introduction
For the application of the networks in computer assisted teaching, the development of intelligence is an important issue [1]. The use of the Internet to provide highly interactive communication and a plethora of information, such as Computer Assist Instruction, Computer Aided Learning (CAL), and Distance Learning, allows students to improve learning outcomes by leveraging resources on the Internet. This will achieve autonomy in the learning environment [2], [3]. Educational reformers have been examining the learning outcome of students. The general approach is based on scores and grades. Experienced teachers observe the learning portfolios and result of their students to improve their own teaching techniques and enhance teaching effects [4]. On this basis, it should be possible to assist teachers to develop a systematic approach to record the scores of students in order to assess their learning situation on a real-time basis. A systemic method to record the learning portfolios and facilitate self-assessment will be able to enhance learning organizations in innovation and design in order to establish a solid foundation of basis knowledge via such innovation and design of student bodies. This helps to enhance creative thinking and design capability. The utilization of the SCORM platform as a learning process can facilitate the result assessment and contribute to an understanding of the learning performance at any given time. It can establish an understanding of the situation of each learner in order to assist individuals. This system can also inform the parents of the learners in a real-time manner so as to keep them informed of the capability indicators and attendance records of the learners. It can assist learners constantly so as to enhance their industrial and technical competences.

2 Research purposes
With the rapid development of information technology, E-Learning is a growing trend in the world. Therefore, this paper sets out its purposes of developing a real-time learning assessment and management system for E-Learning. The details are as follows:
(1) To leverage the benefits of the Internet and information technology in the application of teaching recordings and files by combing the characteristics and functions of computer and network technologies for the design and deployment of a digital management system;
(2) To allow learners to understand their own learning outcomes in a real-time manner with a self-assessment and feedback system, to effectively assist their learning in a scientific approach, as well as to reduce the workload of teachers in inspection and evaluation;
(3) To identify the learners whose progress is slow and outcome is poor via the assessment and feedback system in order to provide remedial opportunities. Remedial teaching hours to be offered in a timely manner in order to enhance the overall learning effectiveness;
(4) To provide colleagues in the same departments/faculties and teachers in other classes to understand the learning results of students throughout the semester so as to provide a complete history of their learning activities since their enrollment.
2.1 SCORM

The SCORM (Sharable Content Object Reference Model) was developed by ADL (Advanced Distribution Learning Initiative) under the US Department of Defense by integrating different learning protocols. It serves as a common standard for the developers of digital learning materials and production of digital teaching materials. The exchange and utilizations of teaching materials on the SCORM platform has become an important standard in the promotion of E-Learning in the international community [5], [6]. The purpose of ADL is to facilitate the collaboration of the departments under the US Federal Government, corporates, military organizations, and educational and training institutions, so as to create the modularized online teaching contents and business opportunities in tool development. In the formulation of the SCORM, the US government deliberately emphasized that it does not want to reinvent the wheel. It means that it will not propose new specifications. Rather, the focus will be on the integration of the structural models currently compliant with E-Learning protocols. The SCORM has evolved from SCORM 1.0, SCORM 1.1, SCORM 1.2, SCORM 2004 to SCORM 2006. It serves the four main purposes as follows [7]:

1) Reusability: The same standardized teaching material can be used on different occasions with no or little modification. It can also be easily combined with other systems or other teaching contents.

2) Accessibility: With this standard platform, learners can easily access teaching materials via the Internet or LAN, without the restrictions of time and locations. They can learn by easily and remotely accessing the information or content of the curricula.

3) Interoperability: All the teaching materials on the SCORM are designed under the same standard. Therefore, they can be presented across platforms and edited with various tools.

4) Durability: The teaching material does not become obsolete due to technological progression or standard changes. In other word, it has high compatibility.

2.2 Agent

Agents are the target-oriented software programs with autonomy, social ability, reactivity, proactiveness and mobility [8], [9], [10]. These agents are called intelligent agents [11], [12], [13], [14]. The technologies are currently being developed in the distributed environment and targeted to promote collaborative products. There are a number of reasons why agents are chosen as solutions, as summarized by some scholars in the applications and classifications of agent applications [15]. They are as follows [8], [12]:

1) The application domains include issues in data processing and responsibility distributions.
2) The integration of the existing structures and organizations require the maintenance of the autonomy of components.
3) The interaction process is highly complex, including coordination, information sharing and cooperation.
4) Solutions cannot start and finish without a prior clear description.

2.3 Learning Portfolios

Learning portfolios refer to the contents gradually accumulated via a systematic collation throughout the learning process. These contents can be used to assist and improve the learning process. The data gathered can also serve as indicators to learning outcomes. However, the filing of learning portfolios requires administrative resources and efforts from teachers and students. As far as the evaluation work is concerned, teachers bear the heaviest burden. In addition to normal teaching activities, they also need to spend considerable time on assessment and presentation of the learning portfolios to students in a fastest and most effective way. Tzeng develops digital teaching materials in a structure of network concepts and provides the tools for the assessment of digital learning portfolios via teaching experiments [16]. A qualitative questionnaire survey is also structured to serve as a tool to evaluate learning outcomes, attitudes and conceptual changes in association with knowledge transfers to students in technical colleges and universities. This system serves as a reference in the applications of conceptual teaching frameworks for the teachers in the fields of emerging technologies [16]. It is a real-time and personalized tracking system on the Internet for learning portfolios on the basis of learning portfolio theory, allowing teachers to easily manage all the issues in relation to curricula, such as announcements, grades processing, learning statuses of students and contacts with students. Meanwhile, this system also provides students a real-time feedback mechanism so that they are constantly aware of their own learning situations in order to make amends in their learning attitudes and directions. After the end of the curricula, students and teachers can download their own learning portfolios on the system. These files include the trend of the grades, teaching contents, classroom discussions and reference data collected by students.
It records the complete learning process and consolidates the recordings into packaged files, as the best method for students to review their own learning processes. The verification mechanism ensures that the packaged files faithfully record the actual performances of learners. It can effectively enhance the reliability of the learning portfolios [17]. Wu examines different types of digital teaching materials compliant with the SCORM and explores the influence of different teaching materials on learning satisfaction and performances of learners [18]. The key issue is the combination of digital learning and the SCORM standard, under the context of relevant learning theories. An empirical test is performed to assess the learning satisfaction and performances. It is believed that the different presentation methods of digital teaching materials have significant influence on the perception burdens, which in turn have significant influence on the learning satisfaction and performances. Pass et al. and Sweller et al. find that there is a negative correlation between learning outcomes and perception burdens. A reduction on the perception burdens of learners can greatly enhance learning effects [20], [21]. Bostrom, Offman, and Sein examine the factors that influence learning outcomes and indicate that learning behavior and attitude are closely related to learning effects [21]. The learners with poor attitudes report below-par learning effects. The learners with decent learning outcomes usually have good learning attitudes too. Wu performs a regression analysis and finds that the presentation of digital materials exhibits significant influence on learning performances [18]. The learners who follow the stimulated steps report the best performances. Wang adopts the self-assessment measures as the indicators to learning performances and finds that learning satisfaction and learning performances are highly correlated [22]. Dynamic multimedia digital teaching materials are incorporated in the mechanical diagrams in order to introduce the concept of games into learning of the curricula. The learning via simulated steps transfer static knowledge into animated one in order to reduce the perception burden. As a result, the learning attitude and behavior will change and the learning satisfaction will improve.

3 Research Method

3.1 Web Services

Two-way message protocols are one of the key elements of the Web 2.0 architecture. The two major types are REST (Representational State Transfer) and SOAP (Simple Object Access Protocol). REST is a Web service that presents the status of all things delivered to the client end. SOAP and other similar lightweight methods all reply on servers to store status information. In both situations, services are delivered via APIs, which are usually defined according to the specific needs of websites. However, standardized Web-serviced APIs (such as posting of articles on Blogs) are still widely in use. Generally speaking, the common language of Web services is XML, but there are many other languages in existence, such as JSON and YAML. Ajax is a hybrid form to enhance users’ experience when they browse Web applications. It can be applied to special formats, such as Google Maps and UrMap, or certain open formats by directly using Web-serviced APIs, data integration or even graphs.

3.2 Server Software

The functions of Web 2.0 are established on the existing Web server architecture. However, there is an emphasis on the backend software. Data integration involves more than just different names and different distribution methods in content management. Meanwhile, Web services require the support of more robust databases and work streams. As a result, they become more similar with the application server functions in the convention domain of corporate intranets. Regardless which general server methods adopted by vendors, all the required functions can be channeled onto the same server platform (as shown in Figure 3 SCO: Sharable Content Object. Alternative, plug-ins of Web servers can enhance the standard distribution tools and other tools on the APIs. No matter which route is chosen, the evolution of Web 2.0 will not make significant changes in either case [7].

Figure 2 illustrates Sharable Content Object (SCO) adopted by this paper :
3.3 Automatic Detection, Monitoring & Agency

It is a waste of time and an act of inefficiency for teachers and parents to monitor learning portfolios on a daily basis. Therefore, an appropriate mechanism is required to assist in the monitoring of online information and real-time notifications. It is expected to enhance the modularized linked databases on the Moodle platform. It can automatically detect and monitor the E-Learning activities of learners. When any monitored event is triggered and the information pops up, the information is presented to the teachers, supervisors, managers and parents of the user via the notification route. The automatic agency mechanism provides automatic warnings and detection functions by inspecting the databases. A monitoring and notification system that can comply with webpages and BBS systems is put in place. The system prototype and supervisory experiment are also structured in order to validate the feasibility of this architecture. Figure 5 illustrates the architecture of the agent.

3.4 Subsection Establishment of Learning Portfolios

The data of the learning portfolios of students are first accessed via php programs in the SQL syntax. The values are then transmitted to JpGraph for graphic presentations. The JpGraph provides the charts composed of the lines indicating passes, scores of male and female learners, average grades of individuals for different subjects and the distribution of personal lines. This allows teachers to visually and clearly understand the statuses of learners. If any learner fails any subject, the system will automatically send out notices to the teachers, supervisors and parents of the learner so that they are informed of the learner’s situation. This does not only inform the teachers of the learning progress of students but also facilitates further support. Figure 6 illustrates a learning portfolio.
With the online learning and assessment system, teachers can input homework questions on the digital teaching platform. They can evaluate students with homework, classroom quizzes, and periodical tests. After students log on to the learning system, their answers to the questions can be displayed directly and statistics are generated for performance assessments. The php program is used to write the statistical analysis for the evaluation of learning outcomes.

1 Start of the php graphic library.

```php
ini with set-ups of the GD2 (a graphic library)
extension=php_gd2.dll
<?php phpinfo(); ?>
```

As shown in the following figure, gd indicates the start of the php graphic library.

2 Line generations

Take an example of 15 students. The statistics are sourced from the records in the database. All the data is retrieved and saved to the $ydata array. These statistics are the basis for the JpGraph graphs, as shown above. The codes are as follows:

```php
$ydata[$i] = $sc[score];
The size of the window set up at 500*400.
$graph = new Graph(500,400,"auto");
The selection from 0~100 for the size of the scale.
The selection for the scale being optional.
$graph->SetScale("textlin");
```

3 Chinese displays of JpGraph

In order to enable JpGraph to support the Mandarin font, it is possible to modify the set-up in the Windows system underneath in the jpg-config.inc file. JpGraph will automatically access the font storage path. The original set-up is as follows:

```php
DEFINE('CHINESE_TTF_FONT','bkai00mp.ttf');
The codes are as follows:
DEFINE('CHINESE_TTF_FONT','mingliu.ttc');
This enables JpGraph to support the Mandarin font.
The heading of Chinese displays for the line charts is as follows:
```
$graph->title->Set("score charts");
$graph->xaxis->title->Set("student codes");
$graph->yaxis->title->Set("scores");
The set-up of Chinese fonts is as follows:
$graph->title->SetFont(FF_BIG5, FS_NORMAL);
$graph->yaxis->title->SetFont(FF_BIG5, FS_NORMAL);
$graph->xaxis->title->SetFont(FF_BIG5, FS_NORMAL);

4 Production of the Line Indicating the Number of Passes (at and above 60 points)

The above is an illustration.
A total of 15 students. The values of the line are generated by the codes:
for($k=0;$k<count($ydata);$k++)
    {
        $ydata2[$k]=60;
    }
JpGraph assigns the value of 60 to all the 15 students. Therefore, the $ydata2 array will have 15 values and generate 15 dots. If not, the line generated will not end at the bottom and will have blanks in between. Namely, the line will not be complete.

5 Colouring of the lines

The following codes can define the colour and width of the line.
$lineplot2->SetColor("red");
$lineplot2->SetWeight(2);
To change the colour, just assign the value for another colour in SetColor().
To change the width, just assign a different value in SetWeight().

6 Average lines

The method to generate an average line is the same as the method to generate the line indicating the number of passes. The only difference is that the averages of the whole class, of males and of females should be calculated and differentiated with different colours.
The codes for the calculation of average scores are as follows:
Total score of the class
for($i=0;$i<$num;$i++)
    {
        $sc=mysql_fetch_array($sql);
        $ydata[$i]=$sc[score]; //---------------Data for the class line ydata
        $total+=$ydata[$i];
    }
Average score of the class
$avg=round($total/$num);

Total score of the males
for ($i=0;$i<$num_man;$i++){
    $sc_man=mysql_fetch_array($man);
    $ydata4[$i]=$sc_man[4][score];
    $total_man=$total_man+$ydata4[$i];
}

Average score of the males
$avg_man=round($total_man/$num_man);

Total score of the females
for ($j=0;$j<$num_woman;$j++){
    $sc_woman=mysql_fetch_array($woman);
    $ydata5[$j]=$sc_woman[5][score];
    $total_woman=$total_woman+$ydata5[$j];
}

Average score of the females
$avg_woman=round($total_woman/$num_woman);

for($k=0;$k<count($ydata);$k++){
    $ydata2[$k]=60;              //-----------------The line indicating the number of passes ydata2
    $ydata3[$k]=$avg;            //-----------------The class average line ydata3
    $ydata4[$k]=$avg_man;        //-----------------The male average line ydata4
    $ydata5[$k]=$avg_woman;      //-----------------The female average line ydata5
}

After the above operations, the values are assigned to JpGraph for implementation and plotting of the required graphs.

The above two figures show the result of inquires for the learning outcomes of two students from the
database. JpGraph is then to generate the graphs. The steps are as follows:

```php
$datay[$i]=$name['score'];
//Inquiry of the score of a student
$datax[$i]=$name['classname'];
//Inquiry of the classes taken
```

The result values are saved in the arrays $datax and $datay, and submitted to JpGraph to generate the above figures.

Different from the line chart, these two figures require the set-up of SetTickLabels($datax) in order to generate the name of X-axis and display the Mandarin. If the data is entered in English, the display will be in English. If this value is not set up, the X-axis cannot display any texts and will be in blank.

```php
$graph->xaxis->SetTickLabels($datax);
$graph->xaxis->SetFont(FF_BIG5);
```

The scores of students are presented above or below the line indicating passing grades on the basis of the failures provided by the database. It is easy to tell their individual situations apart. Those who fail shall take supporting classes, to be taught by the teachers, supervisors, assistant professors and classmates. Assistance and support should be provided to the students who fail. Meanwhile, the system would automatically inform the parents of the failed students so that these parents can participate in the support classes to improve the students’ standards and eliminate learning gaps.

The learners may encounter problems associated with perception burdens, such as the difficulties in writing programs. It is possible to refer to the line charts to examine the differences in the male and female students of different departments and the male and female students in the information management departments.

Fig.11 Learning Variances of the Individuals and Averages of the Class, Male and Female Students.

4 Conclusions and Contributions

This paper provides a real-time statistical analysis tool for the evaluation of learning outcomes during the curriculum period so as to facilitate an online or office-hour supporting classes. It is hoped that computer assisted learning can be applied in teaching and experimental classes by providing a new research direction and finding. This paper hopes to make contributions to the research of computer assisted learning.

The following is a summary of the importance to academic researches, national development and other applications:

1. To guide and assist learners to understand their own learning statuses.
2. To reduce the burden of teachers with the supporting function of a teaching agent by enhancing learning interest, shortening learning processes and improving overall learning benefits.
3. To inform the parents, supervisors and teachers of the learners on a real-time basis so that they are informed of the indicators to their learning outcomes and able to review their learning effectiveness.
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