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Design and implementation of learning management platform for aviation flight training based on SCORM/AICC standard

——A case study of K Airline Company flight training learning platform

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Current common learning management systems alone are not sufficient for meeting the requirement of aviation flight training. In this paper, we implemented a learning management system (LMS) for aviation flight training supporting SCORM/AICC standard. The system was applied to the flight training department and got satisfactory assessments, and we made a qualitative analysis to explore major influential factors to improve the effectiveness of LMS training. According to the result, most users were relatively satisfied with the performance of the system. Meanwhile, it was suggested that the system needs further improvement in interactive features and the student management.

Keywords: Scorm, learning management system, airline industry, ubiquitous learning.

1. INTRODUCTION

Enterprise training plays an important role in one's lifelong learning, and e-learning is a key part in enterprise training. When traditional class-teaching falls behind in satisfying the demand of enterprise training, e-Learning methods are adopted widely. Currently, large enterprises make more investment in e-Learning, the e-Learning-Based training become a part of culture and welfare of a corporate. How to attract professionals and how to train them have aroused the attention of enterprises' managers. However, the existing training system has many problems in management, which leads to massive work pressure for related staff. Students are also not satisfied with the training system. Our work is to design and develop a modern e-Learning system for K airline company and to assess the effects

2. RELATED WORKS

2.1 The standard in E-Learning

It is very necessary to promote the standardization of e-Learning. And how to organize learning contents and resources in e-Learning systems is a big issue¹.

Sharable Content Object Reference Model (SCORM for short), describes how a Learning Management System (LMS for short) serves up Web-based learning content to learners in a standard way. It gives a specific way to deliver standardized e-learning content in different platforms². The SCORM standard is based on World-Wide-Web, its major

advantages include Interoperability, Easy to Use, Reusability and Ubiquity³.

Courseware content can be well organized and navigated by SCORM standard. Using the SCORM standard to develop software can be supported in many popular LMS; besides, the whole process of learning data can also be recorded and the knowledge can match SCO in the SCORM standard, these are the reasons that we use SCORM standard to design the LMS.

With the rapid development of mobile Internet, there are tremendous demands in mobile client of SCORM-based LMS are needed for learners. Learners are willing to check and view content in anytime and anywhere through their mobile devices. Hence, it is more important to design and develop a mobile client of LMS in enterprises' e-Learning.

AICC standard was adopted widely and supported by many e-Learning systems in aviation industry. AICC (Aviation Industry CBT [Computer-based-training] Commission) is a famous standardization organization working on computer-based-training standard. AICC was found for US Air Force's pilot training. Later on, the standard initiated by AICC was applied to business, which is called AICC standard, and its formal name is AICC Guidelines & Recommendations (AGR's for short).

2.2 e-Learning Platforms in Aviation Industry

The AICC was formed by Aircraft manufacturers (Boeing, Airbus, and McDonnell Douglas) at first. SCORM and AICC are widely adopted and supported in aviation

industry's training. They have been the general standards in international aviation e-Learning⁴.

As the most popular LMS in aviation industries, Pelesys LMS is used in more than 60 companies include Boeing, Airbus and Air Canada. It is fully compatible for learning contents based on SCORM and AICC standards, and it also has complete management functions of learners and more LMS's basic functions⁵. K airline company also had used Pelesys LMS. However, Pelesys LMS is not friendly to mobile learning, and it fails to support 3D learning content well which is necessary in K company's pilot training.

2.3 The status of LMS in the airlines industry

However, in some particular fields, especially in the field of airline flight training, effective platforms are rare. Given the particularity of pilot vocational training in the field of airline, as well as that ordinary e-Learning platform system and the common design method of the course content are not entirely suitable for airline flight training. Pilots can't take advantage of traditional course form, even though they have lots of fragments of time. In order to greatly enhance the effectiveness of learning time and the learning experience of using the flight training system, adding the LMS (learning manager system) mobile end architecture in the process of building the system framework becomes necessary.

Common learning platform system lacks of teaching resources reusability, sharing, and learning process recording. A successful online teaching platform solutions, which would use AICC/SCORM courseware standards supplemented by curriculum release, student learning and other functional requirements. All those would make the air accumulated in the field of online courseware resources could be reused and shared in the training.

Therefore, we need to rebuild a new suitable e-Learning system based on the flight training demand for new features.

3. DESIGN AND IMPLEMENTATION OF E-LEARNING PLATFORM SYSTEM

According to the characteristics of K Company Airlines flight training course, this system focuses on the mobile end, a variety of new media courseware resources support, system security and so on. We will introduce the platform requirement analysis, function module design and system function realization of the platform.

3.1 The function module design of e-Learning platform

According to the different function requirements, users are divided into administrators, instructors and students. The platform system mainly consisted of two workflows of curriculum releasing model and the learning model. Learning model includes support for ubiquitous mobile learning by Android client.

Four function modules (course unit, course, user, data recovery) composed of the logical flow of administrators, students and teachers. Teachers can upload courseware to create learning content through the course unit module and

then assign to course through course module. Finally, they can assign courses to specified students accordingly. Meanwhile, students can learn by course modules and knowledge test.

3.2 The technical route of e-Learning platform

The learning platform is based on the integration of Web development "LAMP model" (Linux operating system, Apache network server, MySQL database, PHP language) development solution. As the most mature, stable, and secure enterprise WEB development technology, PHP+MySQL is widely used in ultra large site. Its mature architecture, stable performance, embedded development mode, and simple grammar promise the efficiency of the development of a learning platform system.

In the Android mobile terminal which mainly provides students with learning model, parsing SCORM courseware is the core function module of the mobile terminal system architecture. The system uses the third square frame jQuery mobile as a bridging layer to provide the JS object and native code interaction. The mobile terminal applies SQLite as a local database. When the user is online, the mobile terminal can download courseware learning record to a local database from the server simultaneously.

3.3 E-Learning platform system function realization

Many e-Learning learning platform, which is based on LMS architecture B/S learning platform and developers in an endless stream, and the advantages of B/S architecture based on the PC Internet era is obvious. At the same time in the PC side, ADL official according to the SCORM standard implementation of the API model using the traditional Java B/S. This system uses the structure of PHP+MYSQL, through the ADL simple reconstruction can be completed in the traditional B/S architecture of the system to achieve, LMS interface, as shown in Figure 1.

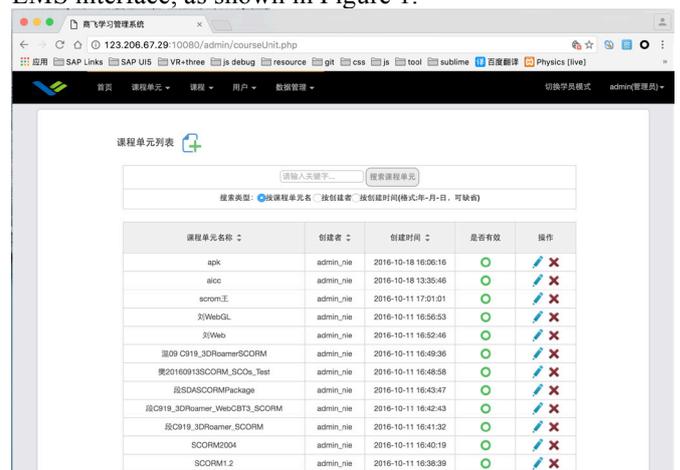


Figure 1 PC end LMS interface display

In the combination of traditional LMS systems and mobile devices, the following issues need to be resolved:

(1) While the traditional B/S structure of the LMS, SCORM support architecture design uses B/S mode, mobile devices are often offline. The system needs to solve offline learning and with the existing LMS platform keep

synchronous problem of record.

(2) How to choose suitable mobile terminal equipment to meet the needs of the larger groups of users and to reduce development costs also need to consider clearly. Though, the SCORM ADL official API is realized by the traditional B/S architecture of J2EE, the mobile terminal, due to the different operating system, was developed in different language. At the same time, due to the special nature of the aviation industry, K Company is extremely sensitive to the security of data information, so courseware data transmission is encrypted in the system development process.

(3) It is necessary build a courseware development standard in the future development of courseware. Traditional SCORM courseware is based on PC browser design, if learning in mobile phones and pad directly, page compatibility and interface experience is poor; in the field of aviation training, due to the demand for aircraft flight and instrument simulation, courseware multimedia format have restriction based on B/S structure. Therefore,

Considering the difference between the mobile terminal and the PC side of the learning environment and learning equipment in the actual development process, the mobile terminal needs to realize the students' learning function framework, as shown in Figure 2.

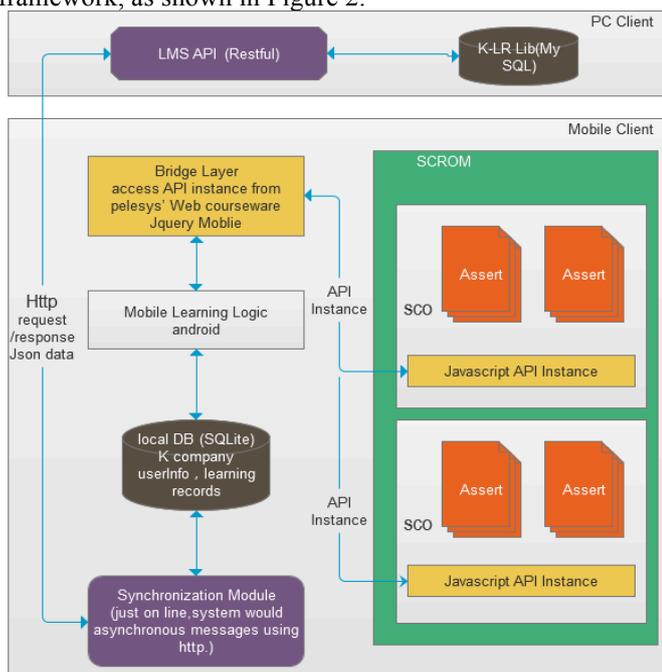


Figure 2 The mobile terminal framework

Download the PC SCORM courseware. This refers to the standard SCORM courseware, uploading to the PC terminal by using any tool to make SCORM courseware, then download on the mobile end and learning, support SORM1.2, SORM2004, as shown in Figure 3, is the list of students downloading the mobile terminal registered course.

Adapter API module. This is the need to implement the software developer JS adaptation method, the purpose is to produce an API JS instance, for the SORM standard courseware JS method calls.

Bridge Layer. This is to use PhoneGap to provide JS and native code to interact with the third party framework to achieve, of course, also achieved the benefits of cross

mobile platform.

User information and learning record access module. The mobile terminal uses SQLite as a local database, iOS/Android/WP are supported, the system client using Android system.

Data synchronization module. In addition to learning records as well as user information, course unit information, course information, message notification and other data needs to be synchronized.

Support Unity3D virtual assembly courseware play The U3D environment will model from the format of 3ds conversion for unity3d format, and then develop corresponding interactive multimedia courseware resources used in flight training, through the records of SCORM standard learning process, as shown in Figure 4.



Figure 3 Mobile client interface

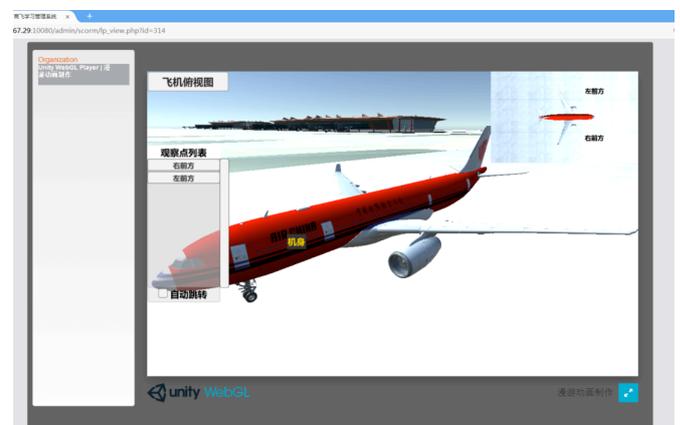


Figure 4 Interactive multimedia courseware

4. EMPIRICAL RESEARCH

To explore the effectiveness of LMS training and its

influencing factors, this study carried on empirical research through the training effect evaluation questionnaire and the influence factors list. According to the results, we can raise schemes for further improvement.

4.1 Experimental Tools

The experimental tools include influencing factors of LMS questionnaire and LMS effect evaluation questionnaire.

The purpose of influencing factors of LMS questionnaire is to determine the most common influential factors, and through the control of the main factors to improve the effectiveness of LMS training. To make the questionnaire, 15 experts in related fields participated in an interview. Firstly, they filled out a form to identify the factors that affected the effectiveness of LMS training. And then we concluded three aspects as classification of these factors, including personal characteristics, system design and organizational characteristics through interviews. The final list of factors is shown in Table 1.

Table 1: The list of influencing factors of training effectiveness

Personal Characteristics	T1	Expected utility
	T2	Degree of preparation
	T3	Career planning
	T4	Personal energy
	T5	Organizational identification
	T6	User attributes
	T7	Education level
	T8	Computer literacy
System Design	T9	Training content
	T10	Interactive strategy
	T11	Student management
	T12	Technical support
Organizational Characteristics	T13	Leadership concerns
	T14	Learning atmosphere
	T15	Incentive measures
	T16	Task constraints
	T17	Target cues
	T18	Feedback
	T19	Colleague support
	T20	Results clues
	T21	Performance oriented intervention

The LMS effect evaluation questionnaire focuses on the reaction level and learning level in the four level training evaluation model of Kirkpatrick, which includes personal satisfaction and learning effects⁶. Individual satisfaction is the indicator of the reaction level and learning effect is the index of learning level. The effect evaluation questionnaire refers to E-learning evaluation model of Horton William⁷, extracting personal satisfaction and learning effects of two indicators for 11 sub items, as shown in Table 2. Each item scores 1-5 points.

Table 2: Training effect evaluation index

Index	Item
Personal satisfaction	1. Rich in content design and form diversification
	2. Curriculum content is

	<p>difficult to moderate, logical</p> <p>3. Query convenience</p> <p>4. System operation is simple and function is complete.</p> <p>5. Network speed can meet the needs of LMS training</p>
Learning effect	<p>6. The LMS training can help integrate knowledge and skills</p> <p>7. The LMS training can help master the structure and content of the course</p> <p>8. The LMS training can help work better.</p> <p>9. The LMS training is conducive to the improvement of personal ability</p> <p>10. The LMS tests can check study results</p> <p>11. Courses in LMS can offer the case for own inspiration</p>

4.2 Experimental Process

We selected 260 training students from K airline company flight training department as experimental objects. Under the guidance of the teacher, they need to complete a chapter of learning content named Overview of Flight within a week. All the learning process was completed on LMS. After the completion of a week of learning tasks, the participants will fill out the scores of two questionnaires described above.

260 questionnaires (each in two forms) were issued to the objects after the LMS training and 241 copies were returned. After the deduction of non-applicable and invalid 12 questionnaires, the actual recovery copies were 229. The average recovery rate was 92.7%, and the effective recovery rate was 88%.

4.3 Results

Through the pre-survey, two questionnaires were confirmed to have good reliability and validity. By exploratory factor analysis, two common factors on the overall interpretation of the total variation of the amount reached 66.42% in the LMS effect evaluation questionnaire, and the Cronbach alpha coefficient of the scale was greater than 0.80. By exploratory factor analysis, three factors to the overall interpretation of the variation of the amount reached 59.81% in the influencing factors questionnaire, and the reliability of the three dimensional structure and the Cronbach alpha coefficient of the total scale was more than 0.80.

The general training effect, personal satisfaction, and learning effect of the objects in the descriptive statistical

analysis are shown in Table 3. According to the result, the score of the three indexes are all more than 3 points, which implies a relatively satisfactory state. The score of individual satisfaction is slightly lower than that of the learning effect. However, these three points are not to reach the degree of satisfaction or even fully satisfied state, which means the LMS training system still has room for improvement.

Table 3: Training effect statistics

Index	Average score	Standard deviation
General training effect	3.38	0.69
Personal satisfaction	3.34	0.69
Learning effect	3.42	0.77

In the personal satisfaction evaluation, Item 1 gets 3.25 points, Item 2 gets 3.45 points, Item 3 gets 3.50 points, Item 4 gets 3.19 points, and Item 5 gets 3.35 points. Scores of Item 1 and Item 4 were lower than the overall training effect and the average score of personal satisfaction, indicating that the two aspects of LMS is not good enough. In particular, Item 4 has the lowest score, indicating that the operation and function of LMS need to be improved. At the same time, although the score of the network conditions is higher, it is still lower than the average level of the overall training effect, which means the study environment of software and hardware facilities need be strengthened.

In the learning effect evaluation, scores for Item 6 to 11 are 3.32, 3.59, 3.35, 3.48, 3.30 and 3.48 respectively. The scores of Item 1, Item 3 and Item 5 are lower than the average of the learning effect and the overall training effect, which means LMS needs to be improved in these aspects.

In the aspect of influencing factors in of training, the scores of the 19 items are between 3.05-4.13. All of the factors have influences on the training effect, but the influence degree is different. Statistical analysis reveals that the training effect is mainly influenced by leadership concerns (T13, 4.13 points), incentive measures (T15, 3.97 points), training content (T9, 3.88 points), technical support (T12, 3.82 points) and computer literacy (T8, 3.75 points).

5. CONCLUSION AND REFLECTION

This study takes the K airline company flight training department as a sample to explore the effect of LMS training and its influencing factors through the empirical study, and puts forward the following suggestions for improvement.

First of all, the LMS system function needs further improvement and should increase the LMS interactive features and the student management function. The LMS interface design and style should be simple and easy to use, which can increase the attractiveness of students. Secondly, the content of LMS requirements should be more professional and the system, in accordance with the requirements for each position, establishing suitable training standards, classification, design and training content. while

strengthening the training content timely maintenance and update. Timely to add new content, making the content more targeted. Finally, we should establish a matched rule with LMS training management system, which mainly includes two aspects: one is from the organizational level, establishing relevant organization and management system, clearing the status and role of LMS. Regulate the management for students in network learning in training time, content and examination etc. Make regular online self and organizational assessment, and take constraint measures to increase the LMS, connected with the LMS staff incentives system. Develop training and examination standards, to reward students with excellent training and examination scores. The other one is from the application level, establishing the development of the use of LMS training system management system, including a complete set of the ultimate, system, process, unified operation method, to improve work efficiency.

However, there are some deficiencies in this research. For example, it has some limitations in the sample selection, and there is no comparative research outside the K company. At the same time, the research uses the first two levels of the Kirkpatrick four-layer model as the evaluation index (Kirkpatrick,1976). In the future, additional training evaluation index in Kirkpatrick and other index corresponding to specific circumstances should be included.

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