Constructing the 2D Adventure Game-Based Assessment System

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Abstract. Due to the advanced computer and network technologies, it could be helpful to conduct an advanced distance learning system for learners to process their learning activities in anytime and anywhere. However, according to many research issues which found that the learning motivation is the most important element to encourage people into their learning and assessment activities. In this paper, we proposed the 2D Adventure Game-Based Assessment System which not only could draw people into their learning activities, but could help instructors easily to design and manage the related learning and assessment content.

Key words: GBL, Assessment system, Game design, Learning Motivation

1. Introduction

In recently year, there are more and more advanced computer hardware and communication technologies could help us to process a lot of difficult problems in many domains, even though in education domain. Due to the advanced e-learning methodologies and related auxiliary computer technologies, there are more and more researchers have interested in observing some key elements of "Learning Motivation Encouraging". How to promote such advanced e-learning system and to attract people to use them will become more and more important. Marc Prensky mentioned that general knowledge concepts and learning abilities could be improved by game play behavior [1]. It is practical to integrate interactive game elements into learning activities to improve the learners' efficiency, performance and motivation of learning [2]. Instructors could utilize the game-based learning tool easily to develop the interactive game-based learning environment in order to let learners' to enjoy their immersion experience learning behavior [3]. Kuang-Cheng Feng point out that we could develop one on one game-based learning environment by monitoring the

learner's learning portfolio [4]. Ang Chee Siang indicated that we could integrated the behavior, cognitive and motivation factors into the course mission in order to improve the learners' learning motivation and learning performance [5]. Magy Seif El-Nasrpointed out that learner could utilize the simulation game to develop their abilities on problem solving, information searching and analysis [6]. They also could make practice on their learned skills in this game environment. Some issues had point out the relations between game playing behavior and game playing motivation [7][8] which provide the Model in order to analysis the game playing preferences. It could helpful for providing the hint to analysis and to design the learner's learning motivation analysis methodology. According to above discussions, we found that game playing behavior and related game elements could effectively improve the learners' learning efficiency and motivation. In this paper, we would like to propose the 2D Adventure Game-Based Assessment System and related course content authoring tool. By using assessment system, learners could do the assessment activities as game mission solving. When they finished all particular game missions, they could get some rewards to attract them and to help them to do the next assessment stage. Instructors could easily to edit the assessment content and easily to realize learners' assessment status. The remaining of this paper is organized as follow: In Section 2, we will illustrate the architecture of our proposed 2D Adventure Game-Based Assessment System, related system modules and workflow. In Section 3, we will introduce the sample demo of the Game-Based Assessment System. Finally, the conclusion and the future work are shown in Section 4.

2. 2D Adventure Game-Based Assessment System Architecture

In this section, we would like to introduce the architecture of this 2D Adventure Game-Based Assessment System and its workflow.

2.1 2D Adventure Game-Based Assessment System Workflow

Fig 1 shows the 2D Adventure Game-Based Assessment System architecture. The system includes three sub systems. There are 2D Game-Based Assessment Content Authoring System, 2D Game-Based Assessment Environment Management System and Game Playing System. Instructor could utilize the 2D Game-Based Assessment Content Authoring System to manage their assessment activity and related content editing. The 2D Game-Based Assessment Environment Management System has focused on managing the related data processing when Instructors/learners work on their content editing/assessment activities. Game Playing System will take charge of presenting the game assessment content learners.
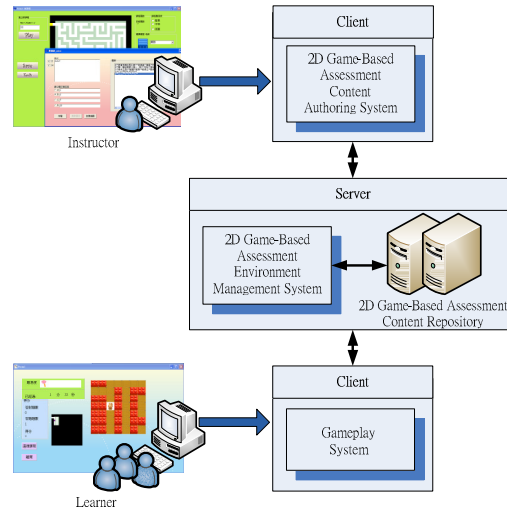
Fig 1. 2D Adventure Game-Based Assessment System Architecture

Fig.2 shows the game playing workflow of the 2D Adventure Game-Based Assessment System and Content Authoring Workflow. In 2D Adventure Game-Based Assessment System part, the learner needs to check the authorization first. When the learner login successfully, the system will load user assessment portfolio and try to initialize the related game playing status. Then the learner could select the related assessment mission they want to start. When the learner get start and try to solve the assessment mission, he/she could go to the related mission area according to the hint information which provide by NPC (Non-Player Character). The NPC will provide the related hint information to players. Therefore, the learner could finish the game mission as quickly as possible. When the learner finish all missions, the game system will save the learner's process of play and assessment status in his/her assessment portfolio and send the portfolio back to the backend server. In Assessment Content Authoring Workflow part, the first step for the instructor is to login and check the authorization. Then the instructor could start to work on the game-based assessment content editing. In this editing phase, the instructor need to design two types of content. The first is the interactive assessment content by option selecting. The instructor could easily to utilize our proposed assessment content authoring interface and related guilder to design the assessment content in option select mode. The instructor could utilize the existing media content (Like the Flash, various kinds of video media… etc) which made by other people over the internet in order to edit the assessment content. The second is to fit these related assessment content in 2D adventure game map. The instructor could select the random map which provide by authoring tool in order to design the game mission. Then the instructor could select the map, to decide the mission point, to design the related materials (Like NPC, Game events) and to setup related rewards when designing the game mission scenario. At last, the instructor could save all contents in one integrated package and upload it to the backend content repository in order to share it to other instructors.
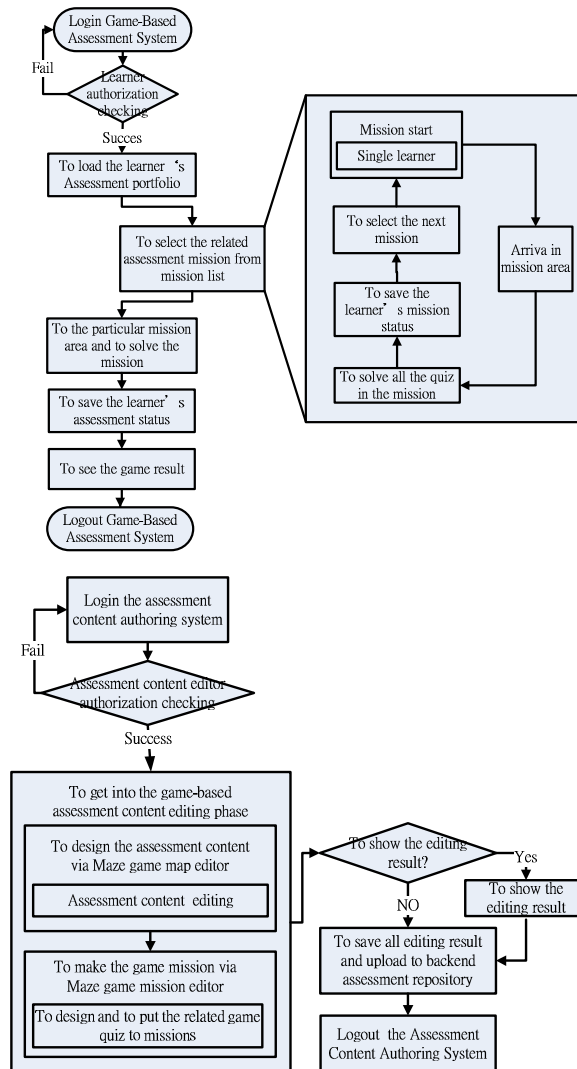
Fig 2. 2D Adventure Game-Based Assessment System and Content Authoring Workflow

2.2. 2D Adventure Game-Based Assessment System Modules

In this section, we will introduce the related system modules which show in Fig 3. The descriptions about the 2D game-Based Assessment Content Authoring System modules which as follows:

● Game assessment content package repository connection processing module: It will take charge of the data connection from backend server to user client.

- Maze game assessment content editing module: It's responsible for provide the adaptive content editing interface and related guilder to instructors in order to reduce the loading when doing content editing.
- Maze game assessment content package combined module: It will take charge of the format checking and data compressing. All data will be integrated in one zip package.
- Video/Quiz assessment content editing module: It' responsible for managing and providing the interactive game puzzle in option selecting and game hint information in video present style.
- Maze map editing module: It will take charge of the related materials and initial parameters in 2D adventure game map.
- Game assessment rule editing module: It will take charge of the whole game assessment rules definition. The instructor could utilize the module easily to design the related assessment rules and put these rules to the game map.
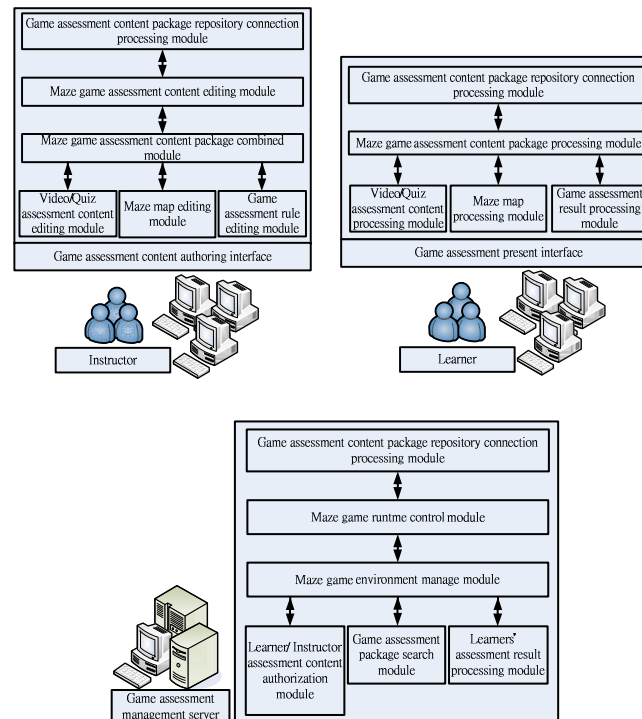

Fig 3. 2D Adventure Game-Based Assessment System Modules

The Game Playing System which includes the Game assessment content package repository connection processing module, Maze game assessment content package processing module, Video/Quiz assessment content processing module, Maze map processing module and Game assessment result processing module. The functionalities will similar to the previous modules we mentioned, but they only take charge of related data processing and send the assessment result to the game assessment management server.

The descriptions about the 2D Game-Based Assessment Environment Management System modules which as follows:

- Game assessment content package repository connection processing module: It will take charge of the data connection from backend server to user client.
- Maze game assessment content present module: It responsible for managing the game runtime and data processing in order to make the server loading in stable status.
- Maze game environment manage module: It will take charge of managing require which provide by learner/instructor client. Like the user authorization, assessment content searching and assessment result managing.
- Learners/Instructor assessment content authorization module: It responsible for managing the user authorization and registration.
- Game assessment package search module: It will take charge of managing the materials searching require from instructor.
- Learners' assessment result processing module: It' responsible for managing and processing the learners' assessment result.

2.3. 2D Adventure Game-Based Assessment system – Learning Assessment and Motivation Analysis

In learning assessment part, we could utilize the two-way specification table to record the assessment content not only in real assessment score but in knowledge inclination. The two-way specification table is proposed by Anderson and Krathwohl [9].

Table 1. The Two-way specification table**.**

Cognitive process dimension / Knowledge dimension		Remembering	Understanding	Applying	Analyzing	Evaluating	Creating	The suggestion amount of questions	The practical amount of questions
Game Mission	Factual knowledge								
	Conceptual knowledge								
	Procedural knowledge								
	Meta-cognitive knowledge								
The suggestion amount of questions									
The practical amount of questions									

This table has two dimensions. One is for knowledge dimension, and the other is for cognitive process dimension. The knowledge dimension indicates the knowledge classification which includes the factual knowledge, conceptual knowledge, procedural knowledge and meta-cognitive knowledge. The cognitive process dimension includes remembering, understanding, applying, analyzing, evaluating and creating. Knowledge dimension classifies the learning knowledge classifying from the "Learning" perspective. The cognitive process dimension classifies the learner's thinking model from the "Thinking" perspective. The two-way specification table is summarized in Table 1. In learning motivation checking part, we would like to utilize the Need-hierarchy theory which proposed by Maslow [10] to cooperate with Two-way specification table to analysis which Learning Motivation Layer does the learner stay. The Learning Motivation Layer will mapping with several particular elements of Cognitive Process Dimension from Two-way specification table. When designing the Two-way specification table, the instructor will select the related elements of Cognitive Process Dimension, it will automatically do the elements mapping to the particular Learning Motivation Layer and it will add one score on the layer. When score with the layer is achieving to the Total Score. The learner's learning motivation could automatically get into the next Learning Motivation Layer and the system could provide related rewards and help information to encourage him/her to do the next learning assessment stage. Learner's learning assessment result could clearly to show up as graphic chart to the instructor in order to let him/her easily to know the learner's assessment status in time. At last, the instructor could reference the result and to adjust the assessment content, activities or principles of teaching.

Table 2. The Learning Motivation Analysis Table**.**

Learning Motivation Layer	Score	Total Score	Knowledge Level	Cognitive Process Dimension	The Goal of Learning Motivation Layer
Physiology			Basic Knowledge	Remembering Understanding	To practice and to learn the Basic Knowledge
Safety			Basic Advanced Knowledge	Understanding Applying	To practice and to organize the Basic Knowledge into the Advanced Knowledge
Belonging			Normal Advanced Knowledge	Applying Analyzing	To practice and to learn the Advanced Knowledge by Team Collaborating
Esteem			Particularly Advanced Knowledge	Analyzing Evaluating	To practice and to focus on learning the particularly advanced knowledge
Self-Actualisation			Complete Knowledge	Evaluating Creating	Refine the knowledge and trying to challenge the knowledge

3. 2D Adventure Game-Based Assessment System Demo

In this section, we would like to show some result of our proposed system. Fig 4 shows the part of assessment content editor functionalities of game map and related parameters. When instructor starts to edit the game assessment content, he/she could select the map present style. Then the instructor could define the difficulty level in the game. We provide three difficulty levels, there are simple, normal and difficult. The difficulty level could effects the visible view which player could see. When finished the setting of map parameters, the instructor could keep continuing on editing the game map. During game map editing phase, the instructor could select the point (Scores) in game map in order to design the NPC/game event. Then, the instructor could fit the related assessment content by using option style which form game assessment repository or he/she could design new assessment content by using authoring tool which show in Fig.5. When the instructor finished whole game assessment content, he/she could save the content in one zip package and upload it to the backend repository.

Fig 4. 2D Adventure Game-Based Assessment System - Game Map Editor
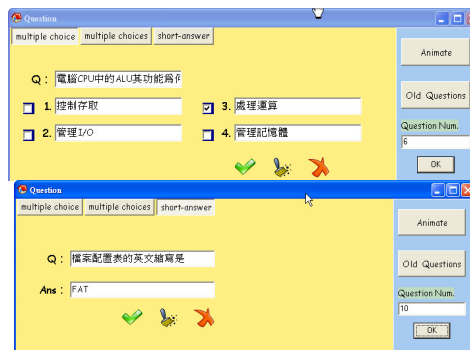

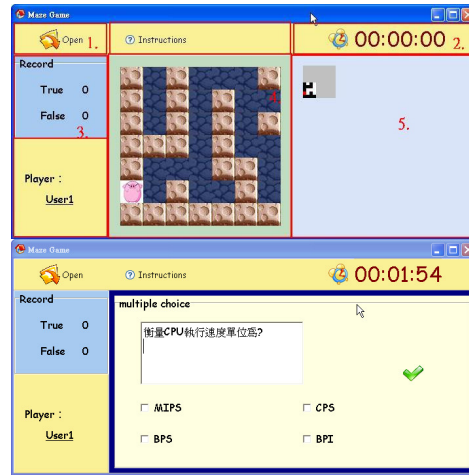Fig 5. 2D Adventure Game-Based Assessment System - Assessment Content Editor

Fig 6(1). 2D Adventure Game-Based Assessment System - Adventure Game Environment
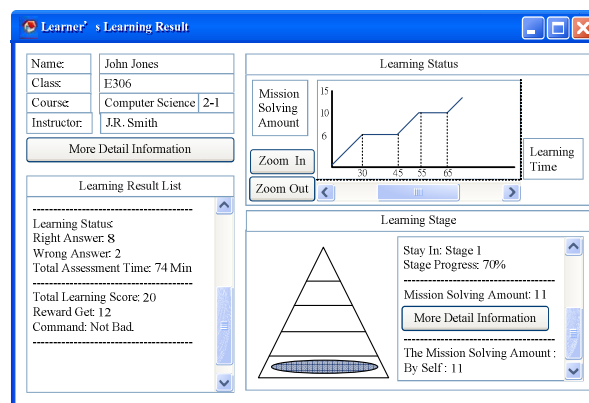

Fig 6(2). 2D Adventure Game-Based Assessment System - Assessment Result Form

When the instructor finished the game assessment content editing behavior, the learner could download the related assessment content and start to do his/her game playing assessment activities. Fig.6(1) shows some demo screen dump of game playing environment. The learner has to solve all missions in the maze. Player will keep continuing to find the useful hint and related information which form the NPC and try to solve the related events during the game. When he/she solves all missions, the assessment results will send back to the backend game assessment management system. The learner could see his/her assessment results in learners' assessment result list as Fig 6(2).

4. Conclusion

In this paper, we proposed the 2D Adventure Game-Based Assessment System and related content authoring tools. Instructors could easily to edit the related assessment content by user friendly interface. They also could easily to manage the learner's assessment status and motivation by graphic chart. Learners could enjoy the assessment activities in order to improve their learning efficiency and skill ability. In the next step, we will attempt to involve the IRT (Item Response Theory) and QTI standard in our system. It could not only provide the adaptive assessment environment, but could also make the assessment content more easily to share the assessment content to other instructor. Hopefully, it could help learners and to attract them to enjoy the game-based assessment environment when doing the knowledge training activities.

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