Using Intelligent Agent to Design a Pedagogical Process for Mobile Learning Environment

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Abstract

This research designs a pedagogical process for students learning in the mobile learning environment with intelligent agent. The intelligent agent can discover students' interests and generate a sequence of learning quests for the mobile learning activity. The intelligent can also diagnose students' misconceptions according to their assessment result. Furthermore, the intelligent can use the misconceptions to plan a remedial learning path for students reviewing the learning objects they might not understand. The whole pedagogical process is demonstrated with the lesson "Botany" and is shown in the end of this research.

摘要

本研究設計了一個行動學習之教學流程，該教學流程透過智慧型代理人輔助學生學習、測驗、與補救教學。在學習部份，智慧型代理人找出學生的學習興趣，並根據學生興趣產生具有故事情節的遊戲學習任務，以增加學生的學習興趣。在測驗部份，智慧型代理人可根據學生的答題結果找出學生的迷思概念，而這些迷思概念亦可提供智慧型代理人建立補救教學的學習路徑，以引導學生複習不懂的概念。此教學流程由數個系統所建立而成，而在本論文的最後，利用「植物」的課程展示整個學習流程。

Keywords: Mobile learning, Intelligent Agent, Game-based Learning, Remedial Learning

關鍵字：行動學習、智慧型代理人、悅趣式學習、補救學習

1. Introduction

Mobile Learning is a new pedagogical method with mobile device. In [15], the researchers defines the essential of mobile learning is using mobile device and wireless communication. Kynaslahti (2003) believes that the characteristics of Mobile Learning are convenience, expediency, and immediacy. [19] Furthermore, (Chan, Sheu, & Chan, 2003) define that the mobile learning device, the communication infrastructure, and a learning activity model are three necessary elements in mobile learning.

Some researches apply Mobile Learning in the class to let students observing the real learning objects. For example, [6] ask students to use mobile device to observe the birds outside the class. Chen has also applied this system to butterfly watch lesson. [7] Mobile device can also used to be the navigation tool in the learning activity. [3] use mobile phone to navigate students learning the history of the small town. [20] and [23] design learning path for students observing the plant in the campus.

This research not only use mobile device to navigate students in the class, but also discuss what kind of navigation path is suitable for students. The related literatures of this research are surveyed in section 2, including the mobile learning navigation, intelligent agent, game-based learning, and automatic item generation. Section 3 shows the system operation flow for students learning with digital agent in the mobile learning environment. The system demonstration is shown in section 4. Section 5 gives a brief conclusion and the future works of this research.

2. Backgrounds

This research designs a pedagogical process for mobile learning environment. The whole process applies some previous researches of our research team, including the mobile learning navigation, intelligent agent, game-based learning, and automatic item generation.

Mobile Learning Navigation

Mobile learning can help student learning the learning objects in the real world. How to navigate students in the mobile learning environment is an important issue for mobile learning development. [13] and [17] are two of the researches focusing on the navigation path planning.

Our research team has developed mobile learning navigation system for botany learning. [4] uses shortest path to plan the learning path in the mobile learning environment. [20] applies information theory to decide the learning sequence of the learning objects in the mobile learning environment. [25] designs the learning scene to cut the learning environment into several scenes according to the similarity of the learning objects for improving the learning path efficiency.

Intelligent Agent

An intelligent agent has properties as autonomy, social ability, reactivity, and pro-activeness. [27] The intelligent agent can be considered as cognitive tools.

It is usually applied in three educational areas, which are managing large amounts of information, serving as a pedagogical expert, and creating programming environments for the learning. [2] Conversational agent is one of the applications for intelligent agent. [18] and [22] are the examples applying conversational agents in education.

In our previous research, a conversational agent can analyze students' conversation in the chat-room. [16] Furthermore, the conversational agent can ask students to discuss the problems of the course more if they are not talking in the chat-room or straying from the main subject. [8] Figure 1 shows an example of conversation agent, Vance, guiding students in the chat-room.

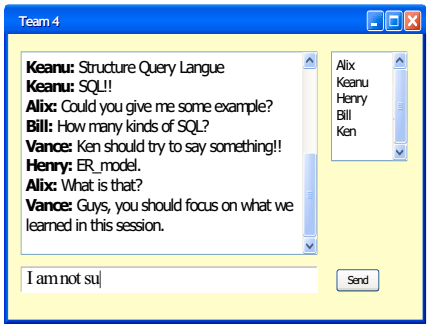


Figure 1. Conversational Agent in chat-room

Game-based Learning

To motivate students' learning, game-based learning is one of the pedagogical methods used for increasing learning motivation. River City [12] and Quest Atlantis [1] are two famous on-line game-based learning platforms. [28] even use game in the mobile learning environment.

Our previous research also implements a National Palace Museum Adventure (NPMA) game for students using mobile device with learning quests in the museum. [5] The NPMA system can store different quests for various roles which gives students chance to choose their favorite role to role-play in the game. The learning quests are also delivered according to their interests based on the information theory and rough set. Figure 2 shows a system snapshot of the NPMA game. The bottom-right displays the Non-Player Character (NPC) in the game guiding students in the learning process. The learning quests are listed in the bottom-left of the screen.



Figure 2. NPMA system

Automatic Item Generation

Test is one of the wildly used assessment tool for estimating the learning effect of students. When the computer is getting more popular, Computer Assisted Test (CAT) becomes an alternative for teachers examining students through computer. Many education organizations use CAT for the assessment. [10][26] There are also some other researchers focuses on automatic item generation. [11][14]

The previous research in our research team designs an item generation system which can generate item with different cognitive abilities. [9][21] Figure 3 shows that when students ready for the test, they can click the "Begin Test" button and start the test. The stem, distractors, and the correct answer are generated automatically from the knowledge structure. Students can click the "Confirm" button after they choose the answer. The system will deliver the next item with different difficulty according to the answer which the student replied in the previous item.

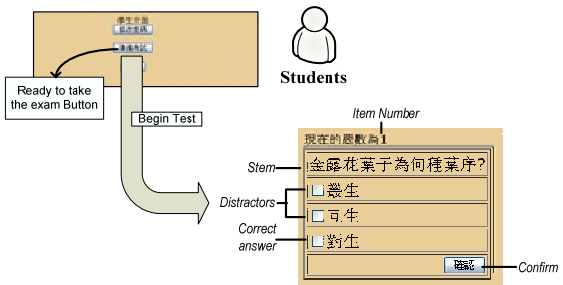


Figure 3. The multiple-choice item constructed by the Automatic Item Generator

3. System Operation Flow

According to the previous researches, this paper designs a mobile learning system with intelligent agent. The entire pedagogical process is separated into three major parts with eight steps as Figure 4 shows.

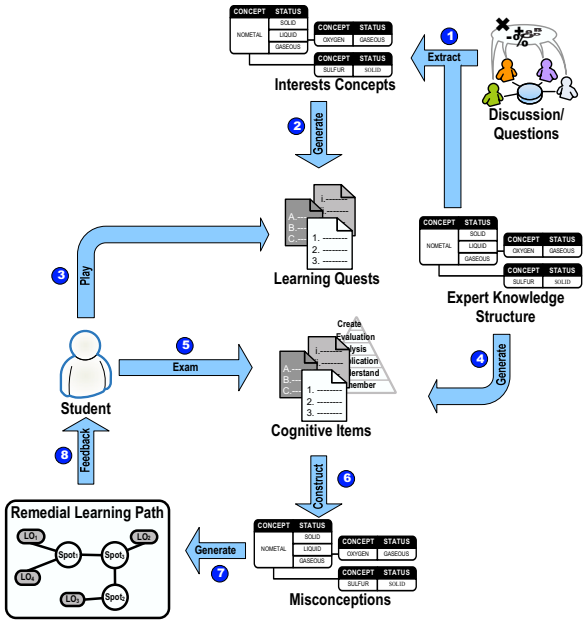


Figure 4. Pedagogical Process

Learning

The first part focuses on how to increase students' learning motivation. Three steps are processed in this part:

(1) Gather students' conversation and extract their interesting concepts.
[16] discusses how to use speech act theory to analyze students' conversation in the chat-room. The system constructed by [16] with expert knowledge structure can be used to find out what keywords are frequently discussed in the chat-room. These keywords are considered as students' interesting concepts.

(2) Generate story-based learning quests in the mobile learning environment from students' interesting concepts.
To motivate students' learning interests, this research constructs a story's background and asks students solve the quests to learning the knowledge. The story involves different characters, and the students can choose one of the characters to start a role-play activity. Furthermore, to make students have more interests to do the learning quest, the quest generation is related to the interests concepts discovered from the previous step.

(3) Navigate students solving the learning quests in the mobile learning environment.
The second step in the pedagogical process can generate various learning quests. This step use information theory and rough set to decide the learning quest sequence. The method is described in [5]

Assessment

The next part of the pedagogical process is assessment which tries to find out the students' misconceptions. This part of learning process also includes three steps:

(4) Generate cognitive items from the expert knowledge structure.
Teacher need to take time to design a test sheet. [9] designs a method to generate different cognitive items from the expert knowledge structure automatically.

(5) Students take the test of cognitive items in the on-line test system.
Chen's research also constructs an on-line test system. Students can take the test on the on-line test system during the exam time.

(6) Diagnose students' misconceptions according to their answers in the on-line test system.
After students answering the test sheet, the system can check the answers are correct or incorrect. All the items with incorrect answer are collected and generate a misconception list for the student.

Remedy

The last part of the pedagogical process is focuses on remedial learning. The system constructs a remedial learning path according to students' misconceptions. Two steps are involved in this part of learning process:

(7) Generate students' remedial learning path based on their misconceptions.
The misconceptions diagnosed from the previous step can be used to help designing remedial learning path. [24] uses information theory and concept lattice to generate remedial learning path from students' misconceptions.

(8) Feedback and navigate students review the concepts they might not understand according to the generated remedial learning path.
The remedial learning path generated from the previous step will feedback to students. This step not only tells students what learning objects they should review again according to their assessment but also navigate students how to reach the location of the learning object in the mobile learning environment. [20] use sentence template to generate navigation sentence and send the message to students when they are in the mobile learning environment.

4. Processes Example of the multimedia mobile learning system

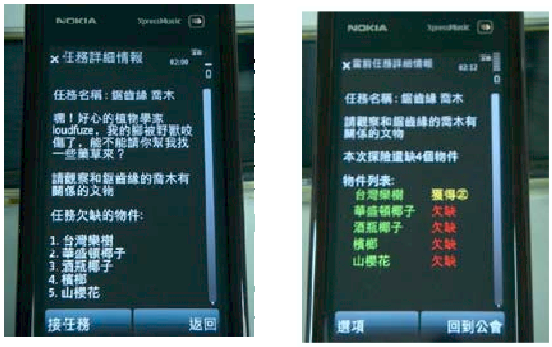
According to the pedagogical process designed in section 3, this section demonstrates the system used in the entire process. The lesson demonstrated in this research is "Botany". The expert knowledge structure

in build in the knowledge map as Figure 5 shows. Teachers can insert the knowledge structure by using the user interface supported bye the knowledge map system.



Figure 5. Knowledge Map

After the teacher constructs the expert knowledge structure, the teacher asks students to discuss the problem or issue in the chat-room. After finding the interests concepts from the chat-log, the students will use mobile phone to start the learning quests in the mobile learning environment. The snapshots of learning quest sent to mobile phone are demonstrated in Figure 6. Figure 6(a) shows the mission description of the learning quest, and Figure 6(b) presents the learning objects which the learning quest ask students to observe.



(a) (b)

Figure 6. Learning Quests. (a) The mission description in the learning quest. (b) The list of the learning objects that students needed to observe.

After the mobile learning activities, the teacher can ask students to take test on the on-line test system. The items are generated from the expert knowledge structure which the teacher built in the beginning. Figure 7 shows the snapshot of an multiple-choice question in the on-line test system.

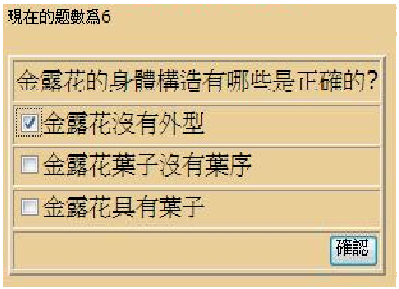


Figure 7. On-line test system.

After taking the test, the students can review the learning objects which they have misconceptions. The remedial learning system lists the learning objects in the screen as Figure 8(a) shows. Students can click the "map" button to see where the learning object is in the campus. If they find out the learning object, they can click the button "I find out the plant" as Figure 8(b) shows.



(a) (b)

Figure 8. Remedial Learning Path Navigation. (a) The list of learning objects with coordinate. (b) The campus map with learning objects.

5. Conclusion

This research applies the previous researches from the research team to construct a pedagogical process for students learning in the mobile learning environment. The pedagogical process has eight steps which can be separated into three major parts. The first part is focusing on motivating students learning interests. Digging students' interesting concepts from the chat-log and using story-based learning quests are the methods for this stage. The second part of the pedagogy is assessment, which constructs the items automatically and finding out students' misconceptions. The last part of the pedagogy is remedy, which generates a remedial learning path for students to review the learning objects they might have misconception.

The intelligent agents in the whole pedagogical process are invisible. How to use emotional intelligent agent to navigate students during the learning activity could be an interesting issue. Furthermore, the learning quests in the game-based learning activity are fixed. How to generate the learning quests automatically is also a challenge issue.

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