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A Context-aware Dynamical Learning Environment for Multiple Objectives

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Abstract: In a real ubiquitous learning environment, different learners may have different learning objectives; a learner also has different objectives in different periods. Ubiquitous learning environment should be able to support different learning objectives. However, most of ubiquitous learning environments are designed for specific learning objectives, in which all learners only get learning resources related to the specific learning objectives with fixed contents. This research proposes a ubiquitous learning environment to support different learners' learning with different learning objectives at same time. This environment is called CDLEMO (Context-aware Dynamic Learning Environment for Multiple Objectives). It can provide available and suitable learning resources, and the contents of a resource can be adjusted dynamically according to learning objective. The results of a pilot experiment conducted in the botanical garden in Beijing Normal University show that CDLEMO can make learning become more convenient and fun, enhance learning motivation, stimulate learning interest, and it wins the learners' acceptance and approval.

Keywords: Ubiquitous Learning Environment, Context-aware, Learning Objective, Learning Resource, Learning Content

1. Introduction

Ubiquitous Learning has become an important direction of the next generation of e-Learning (Ley, 2007; Chu, Hwang, Huang and Wu, 2008; Hwang, Yang, Tsai and Yang, 2009; Hwang, Wu, Tseng and Huang, 2011). A growing number of researchers do researches in this field, especially in ubiquitous learning environment (Hwang, Tsai, and Yang, 2008; Hwang, Yang, Chin and Stephen, 2009; Feeney, Ahgre, and Westerlund, 2001; Kindberg and Fox, 2002). How to realize learners timely access to the needed learning resources anytime and anywhere is one of the most important research issues in the era of ubiquitous learning (El-Bishouty, Ogata and Yano, 2007; Shih, Chu, Hwang and Kinshuk, 2011). In a real environment, different learners may have different learning objectives, and different learning objectives need different learning resources and contents. But now most ubiquitous learning environments are designed without considering learning objective, so the learning resources in those environments are static and contents of learning resources cannot be adjusted according to learning objective.

Aiming at the problem that current ubiquitous learning environments are difficult to support a variety of learning objectives at the same time, this study proposes a ubiquitous learning environment, named context-aware dynamic learning environment for multiple objectives (CDLEMO). CDLEMO consists of learning resource space, context-awareness system and learning resource aggregation system. CDLEMO can provide learner learning resources with suitable content according to his learning objective and location. In addition, this study does a pilot study, and then interviews the participants to understand their recognition and acceptance of CDLEMO.

2. Relevant works

At present, there are more and more researches on ubiquitous learning environment. From the two perspectives of learning resource and learning objective, we divide current ubiquitous learning environments into ubiquitous learning environment with static resources for single objective, ubiquitous learning environment with personalized static resources for single objective, and ubiquitous learning environment with personalized static resources for multiple objectives.

In the ubiquitous learning environment with static resources for single objective, all learners will obtain the same learning resources, the contents of which all are static. For example, a ubiquitous learning environment for supporting language learning named TANGO (Ogata and Yano, 2004; Ogata and Yano, 2005), in which learners can obtain the language express about the object near him with the help of RFID and mobile device; Another is a ubiquitous learning environment for language listening and speaking named HELLO (Liu, 2009), in which learners can access to the English learning resources anytime and anywhere via QR-code and PDA. Both TANGO and HELLO aim at specific language learning objectives, all the learners will get the same learning resources with static contents.

Ubiquitous learning environment with personalized static resources for single objective also aims at specific learning objective, but it can provide learners personalized learning resources with static contents. For example, a ubiquitous learning environment for conducting complex experimental procedures (Hwang, Yang, Tsai, and Yang, 2009), we called CUECE, which can provide suitable operation guidance information to learners via perceiving learners' situation, such as learner's location, and the surrounding situation, such as environmental temperature; another is a ubiquitous learning environment for helping and guiding learning named CAULS (Chen and Huang, 2012), which can use test to understand learner's current learning situation, then choose the appropriate learning strategies and provide corresponding learning resources for learner. In both CUECE and CAULS, in different situations (such as learners' situation, environmental situation, etc.) learners will obtain different learning resources in their learning processes, but learners' final learning objectives are the same. That is, the learning objective supported by learning environment is the same. And although different learners get different learning resources, the contents of all learning resources are also still fixed.

Ubiquitous learning environment with personalized static resources for multiple learning objectives can support different learning objectives and provide personalized learning resources with fixed contents. For example, a ubiquitous learning environment named PERKAM (El-Bishouty, Ogata and Yano,2006; El-Bishouty, Ogata and Yan, 2007) can recommend suitable and personalized learning resources and helpers around learner according to learner's location, surrounding and his learning objective. Although PERKAM can provide personalized learning resources for learners with different learning objectives, but the contents of the learning resources are still static. That means the contents of a learning resource are fixed, cannot be adjusted dynamically according to different learning objectives, so it is still unable to fully meet the needs of learners with different learning objectives.

3. Context-aware Dynamical Learning Environment for Multiple Learning Objectives

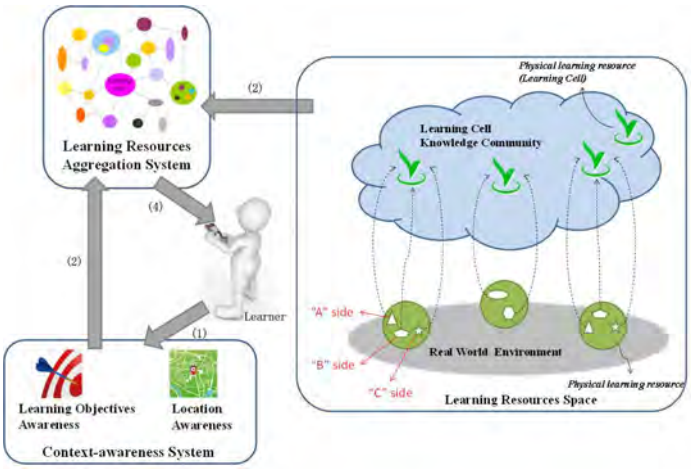

Figure 1. The Context-aware Dynamical Learning Environment for Multiple Objectives

CDLEMO proposed in this study is composed by learning resources space, context-aware system and learning resources aggregation system. CDLEMO is developed by JAVA, using GPS technology to get location information, achieving learning objectives based on location information, using AJAX technology to present learning objectives set and contents, using MySQL5.0 databases to store data.

In Figure 1, learner uses a mobile phone with GPS as his learning device. When the context-aware system obtains learner's location and learning objective, it will deliver the information to the learning resources aggregation system. Then the learning resources aggregation system will find the suitable physical learning resources around learner and the corresponding digital learning resources. A digital learning resource may contain several contents about different sides of a physical learning resource (such as "A" side, "B" side, "C" side in Figure 1), and the contents will be adjusted dynamically and presented to learner according to his learning objective.

3.1 Learning Resource Space

In Figure 1, the learning resource space contains real world environment and digital learning resource space. There are kinds of physical learning resources in the real world environment, such as a tree, a flower. And Learning Cell Knowledge Community (http://lcell.bnu.edu.cn) is used as the digital learning resource space in CDLEMO, which can supply various digital learning resources, called Learning Cell(Yu, Yang and Cheng, 2009), short for LC. LC is a novel learning resource model, which can be presented on different learning devices in different formats according to the parameters of learning device. And the contents of LC also can be organized dynamically according to learner's current situation. According to learner's learning objective, when a learner selects a LC for learning, the learning contents in the LC will be adjusted adaptively based on learner's learning objective.

3.2 Context-awareness System

The context-awareness system mainly obtains learner's location information and learning objective. It uses GPS technology to gain learner's location information. The importance of location information is to help the system gain available resources around learner, and get the learning objectives set finally. Once learner connect his phone to wireless networks and open GPS, the system will obtain his location information via GPS. Based on the location information, the system can get all surrounding available physical learning resources as well as the associated digital learning contents. Because of the digital learning contents have their own tags of different learning objectives, the system can aggregate all these learning objectives supported by the learning contents, then presents the learning objectives set to learner, and learner can choose his own learning objective.

3.3 Learning Resource Aggregation System

According to the location information and learner's learning objective, the system will aggregate the surrounding physical learning resources and corresponding LCs, and then present them to learner. For example, there are some dicotyledons and monocotyledons in a garden, and a learner's learning objective is to learn the structure features of monocotyledons, then the system will automatically aggregate and present the pictures of monocotyledons in the garden to learner in order to help him recognize the monocotyledons. And when the learner chooses and clicks a monocotyledon picture on the phone, the system will aggregate the contents about the structure of the monocotyledon of the corresponding LCs dynamically.

4. A Pilot Study

A pilot experiment was conducted in the botanical garden in Beijing Normal University for understanding learner's acceptance and recognition of CDLEMO. After the experiment, an interview was carried on to all participants.

4.1 Participants and experimental procedure

There are six Beijing normal university students participated in the experiment. The researcher randomly divided them into three groups, each group of two people. The experiment was conducted three rounds with three learning tasks in total. Each round, the researcher assigned three tasks to the three groups respectively, and the tasks of the three groups are different. The learning tasks are: observing monocotyledonous leaf and learn leaf characteristics, observing monocotyledonous flower and learn flower characteristics, observing dicotyledonous flower and learn flower characteristics. Every participant used their own mobile devices to do the tasks. The mobile devices include android phone, apple phone and android pad, all of which have GPS.

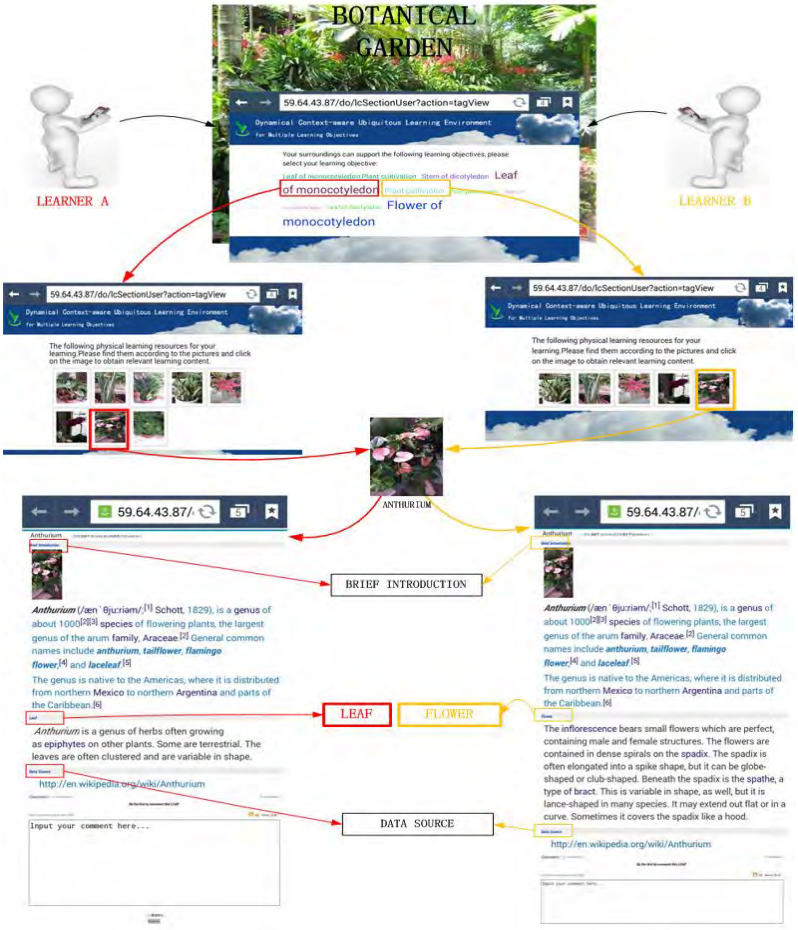

Figure 2. An example of learning in CDLEMO

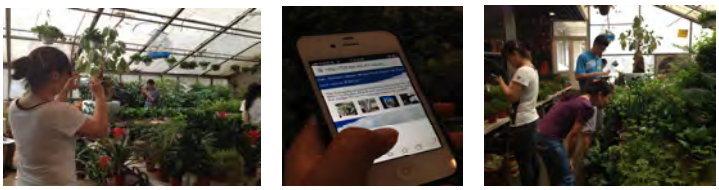

Figure 3. The learning scenarios in CDLEMO

As shown in Figure 2, take a round of experiment for example. After two learners (Learner A and Learner B) come from different groups enter the botanical garden with their mobile phones, the system will get their location via GPS. And then based on the location information, the system will know and present all learning objectives the garden can support to learners. Learner A chooses "monocotyledonous leaves" as his learning objective, learners B chooses “monocotyledonous flower" as his learning objective. Then the system will provide learner A the learning resources supporting learning “monocotyledonous leaves” in the garden, and provide learner B the learning resources supporting learning “monocotyledonous flower”. Then the related physical learning

resources' photos taken in the garden will be presented respectively on their mobile phones. When both learner A and learner B choose anthurium as learning object, they will find anthurium in the garden according to the photo on their phones. Then they can observe the anthurium, and click its photo on the phones to access the LC. But when they access the same LC about anthurium, the contents presented on their phones are something different. The contents on Learner A's phone are comprised with three parts: brief introduction, leaf and data source, while the contents on Learner B's phone are comprised with three parts: brief introduction, flower and data source. Figure 3 shows the learning scenarios in the CDLEMO.

4.2 Interview instrument

After the experiment, the researchers conducted an interview for all participants. The purpose of the interview is to understand the learners' acceptability and recognition of CDLEMO, and also collect suggestions for improvement of CDLEMO. S1, S2, S3, S4, S5, S6 were used to represent for the six participants in turn. The interview includes five questions: "Do you think it is convenient for studying in the CDLEMO and why?" "Do you think the learning resources and content provided by CDLEMO are closely related to your learning objective?" "Do you think CDLEMO is helpful to your study and why?" "Would you like to study in the CDLEMO?" "Do you have any suggestions on the improvement of CDLEMO?"

4.3 Findings

After the interview, the data were collected and analyzed. Through the result of interview, we found that:

CDLEMO gains high reorganization from participants. Participants believe CDLEMO has great help in learning. CDLEMO provides learners physical learning resources in the real situation and LCs related to their learning objectives, makes learning become more intuitive and profound, and photos of physical resources help learners quickly find their learning objects within certain scope.

"CDLEMO has great help in learning, let learners watch the objects in the real situation, makes the study more specific, and would not be so abstract." (S1, 2014.05.24)

"Learning is fun and active in real environment."(S2, 2014.05.24)

"The way of finding physical learning resources deepen learner's impression of the learning object." (S3, 2014.05.24)

Participants have high acceptance of CDLEMO. All participants think Learning is very convenient and interesting in CDLEMO, which can quickly provide learning resources according to their learning objectives, and the pictures make learners easily find the unknown physical learning resources.

"CDLEMO is convenient. It can quickly locate and provide related learning resources in this environment." (S1, 2014.05.24)

"CDLEMO is very convenient. It is particularly easy to find physical learning resources via pictures CDLEMO provided." (S2, 2014.05.24)

In addition, participants gave some suggestions for CDLEMO. For example, providing different angle pictures to help learner find resources more quickly, providing a collaborative learning mechanism so that learner can get help from others.

"Presenting several photos taken from different angles for each physical learning resource can make learner find physical resources more convenient and faster." (S1, 2014.05.24)

"Designing a collaboration mechanism that learner can get others' help when he cannot find the physical learning resource." (S4, 2014.05.24)

5. Conclusions and future work

In a real world, different learners have different learning objectives. However, most of ubiquitous learning environments were designed for some specific learning objectives, and supply fixed learning resources with static contents. So that learners with different learning objectives are hard to get the

needed resources. To address this problem, this research proposes CDLEMO. Learners having different learning objectives can study in CDLEMO at same time, and CDLEMO will give them different learning resources related to their learning objectives. CDLEMO gets location information via GPS, and then gains learning objectives based on location information. When it knows learner's learning objective, it will search available and suitable physical resources according to the learning objective, and adjusts learning contents of the digital learning resource for matching learner's learning objective. A pilot experiment was conducted and the result showed that learners' acceptance and recognition of CDLEMO is high. Learners can gain needed learning resources and content quickly in CDLEMO. And they thought CDLEMO made learning become more intuitive, impressive, convenient and fun. Also, some participants put forward some suggestions for improvement of CDLEMO, such as providing more pictures taken from different angles for each physical resource.

Certainly, because of the number of participants is too small, so we need to check the result carefully. And our important future work is to design and do broader sample experiment to verify the effect of CDLEMO in learning, as well as to improve CDLEMO based on learners' suggestions.

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