A Repertory Grid-Oriented Mindtool for Conducting Mobile Learning Activities

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1. Introduction

Jonassen (1999) indicated that the development of expert systems results in deep understanding because they provide an intellectual environment that demands the refinement of domain knowledge; moreover, the process of building expert systems (i.e., knowledge acquisition) requires learners to synthesize their knowledge by making explicit their own reasoning, and hence it improves retention, transfer, and problem-solving abilities. That is, with proper design, knowledge acquisition approaches could be innovative Mindtools for improving student learning efficacy.

Among various knowledge acquisition approaches, the repertory grid method that originates from the Personal construct theory proposed by Kelly (1955) has been recognized to be very effective. Various studies have reported the effectiveness of using the repertory grid method in assisting the domain experts to better organize their knowledge and experiences (Boose & Gaines, 1989; Hwang et al., 2006; Chu & Hwang, 2008). A single repertory grid is represented as a matrix whose columns have element labels and whose rows have construct labels. Elements could be decisions to be made, objects to be classified, or concepts to be learned. Constructs are the features for describing the similarities or differences among the elements. Each construct consists of a trait and the opposite of the trait. A 5-scale rating mechanism is usually used to represent the relationships between the elements and the constructs; i.e., each rating is an integer ranging from 1 to 5, where “1’’ represents that the element is very likely to have the trait; ‘‘2’’ represents that the element may have the trait; ‘‘3’’ represents ‘‘unknown’’ or ‘‘no relevance’’; ‘‘4’’ represents that the element may have the opposite characteristic of the trait; and ‘‘5’’ represents that the element is very likely to have the opposite characteristic of the trait (Chu & Hwang, 2008).

In this study, an innovative Mindtool based on an enhanced repertory grid method for conducting learning activities in authentic learning environments is presented.

2. Repertory Grid as Mindtools for Mobile Learning

In this study, the authentic learning environment is an elementary school garden consisting of 12 areas of plants as target learning objects. Each area has an instructional sign to introduce the plants in that area. The target plants are labeled with an RFID (Radio Frequency Identification) tag, and each student has a mobile device equipped with an RFID reader. In addition, wireless communication is provided, so that the mobile device can communicate with a computer server.

The students who participate in the learning activity are asked to observe and classify the target plants. While they move around in the authentic learning environment, the learning system can detect the location of individual students by reading and analyzing the data from the nearest RFID tag; therefore, the learning system is able to actively provide learning guidance or hints to individual students by interacting with them via the mobile device.

The innovative approach consists of two stages; that is, the objective knowledge construction stage and the student knowledge construction stage. In the first stage, the domain experts (teachers) are asked to determine the target learning objects and construct the objective repertory grid by following the standard repertory grid method An illustrative example is given in Table 1.

In the second stage, an interactive learning procedure is used to guide the students to observe and compare the features of the target objects in the authentic learning environment based on the enhanced repertory grid given by the teacher (which is referred to as the *objective repertory grid* in the following).

Step 1: Display the structure of the objective repertory grid to individual students.

Step 2: Guide the students to observe and describe the main features of each learning object based on the objective repertory grid structure.

For each construct (trait/opposite pair), guide the students to observe the target learning objects, and fill in the <construct, element> value for the elements in each row of the grid. In addition to guiding individual students to the location of each target object, a question-based model is used to guide individual students to observe and compare the features of the target objects. That is, each step of the guidance is presented as a multiple-choice question, in which the candidate answers are the main features of the construct to be observed.

Step 3: For a construct, compare the main-feature description (rating value) for each learning object (element) given by the student with the corresponding rating given by the expert.

Step 3.1: If the main-feature description is incorrect, guide the student to observe another learning object with the "incorrect main-feature" and compare it with the target object. This step aims to assist the students to reflect on their previous decisions by comparing the features of the learning objects in the real world such that their knowledge and critical thinking ability can be improved.

Step 3.2: If the main-feature description is correct, guide the student to describe the learning object with one of the candidate sub-features. Supplemental materials will be given if the student fails to correctly identify the sub-features of the learning object.

Step 4: Repeat Step 3 until all of the main features and their sub-features are correctly identified by the student.

Table 1. Illustrative example of an enhanced repertory grid completed by the teacher

Trait Construct	**Golden Chinese banyan**	**Arigated-leaf croton**	**Cuphea**	**Indian almond**	**Money Tree**	**Crown of thorns**	**Pink ixora**	**Opposite Construct**
Leaf-shape long and thin	2	2	2	4	2	2	2	**Leaf-shape flat and round**
The leaf has a tapering point	3	1	1	4	2	1	3	**The leaf has a hollow point**
Perfectly smooth leaf edge	1	1	4	1	1	5	1	**The leaf edge has deep indents**
The leaf vein has few branches	2	3	2	2	3	3	3	**The leaf vein has many branches**

3. Development of a Mobile Learning Environment with Sensing Technology

Based on this innovative approach, Mobile Knowledge Constructor (MKC), a Mindtool for context-aware ubiquitous learning, has been developed to assist the students in observing and classifying learning objects in the real world. MKC is able to detect the location of individual students and provide them with adaptive supports via the use of PDA's (Personal Digital Assistants) equipped with RFID and wireless communication equipment.

Assume that MKC is guiding the students to find the target object "Liquidambar" on the campus. The student is then asked to observe the "leaf point" of "Liquidambar" and answer the question generated from the enhanced repertory grid model. If the student failed to correctly identify the plant feature, the MKC system will try to guide him/her to observe another target object which exhibits the incorrect answer, and compare the difference between the features of the two target objects. For example, if an incorrect answer "Round with a blunt tip" is given by the student for the "leaf shape" of "Liquidambar", the learning system will guide the student to find the plant "Golden chinese banyan" that really has a leaf point that is "Round with a blunt tip" and compare it with the leaf point of the original target "Liquidambar". To assist the student in easily finding the plant "Golden chinese banyan", the MKC system shows a campus map which marks the plant "Golden chinese banyan" and the student's location.

When the student is close to the plant "Golden chinese banyan", the MKC system will guide him/her to observe and compare the leaf shapes of "Golden chinese banyan" and "Liquidambar", as shown in Figure 1. The student is then asked to walk back to the target plant "Liquidambar", and answer the question concerning "the leaf shape of Liquidambar" again, as shown in Figure 2.

Figure 1. Interface for guiding the student to compare the leaf shapes of “Golden chinese banyan” and “Liquidambar”

Figure 2. Interface for guiding the student to return to the target plant

4. Experiment and Analysis

To evaluate the effectiveness of the innovative approach, an experiment was conducted on a natural science course of an elementary school which is located in a small town in southern Taiwan. The participants of this study were 61 fifth-grade students taught by the same teacher in another elementary school. After receiving the fundamental plant knowledge in a natural science course, the participants were divided into a control group (n = 29) and an experimental group (n = 32).

Figure 3 shows the procedure of the experiment. In the first stage (four weeks), the teacher was guided to provide the classification knowledge of the target plants based on the enhanced repertory grid model. In the second stage, after receiving the fundamental knowledge of the plants in the natural science course (about 50 minutes), all of the students were asked to answer a pre-questionnaire and take a pre-test. The students spent 40 minutes to answer these test and questionnaire items. The question items in the pre-questionnaire were concerned with the students’ attitudes to the plants and the natural science course. The pre-test aimed to evaluate the students’ basic knowledge about the plants on the campus.

After taking the pre-test, the students in the experimental group were arranged to observe and compare the features of 13 plants on the campus using MKC, while those in the control group were guided to observe the plants via PDAs. This stage spent almost 160 minutes. After conducting the learning activity, the students were asked to take a post-test and answer a post-questionnaire (45 minutes).

Table 2 shows the *t*-test results of the pre-test. Notably, the mean and standard deviation of the pre-test were 71.14 and 14.56 for V1 (experimental group), and 73.09 and 11.21 for V2 (control group). As the p-value (Significant level) =.557 >.05 and t =-0.591, it can be inferred that V1 and V2 did not significantly differ at a confidence interval of 95% in the pre-test. According to the *t*-test result (t=-0.591), it was evident that the two groups of students had equivalent abilities before learning the subject unit.

Table 2 *t-test* of the pre-test results

		N	Mean	S.D.	*t*
V1	experimental group	32	71.14	14.56	-.591
V2	control group	29	73.09	11.21	

Table 3 shows the ANCOVA results of the post-test; in addition, the original means and standard deviations are also presented. The mean and standard deviation of the post-test were 44.31 and 13.68 for the control group, and 52.69 and 13.45 for the experimental group. From the post-test scores, it was found that the students in the experimental group had significantly better achievements than those in the control group (F = 7.533, p<.05). This result implies that learning with Mindtools in an authentic learning environment significantly benefits the students more than learning in a "pure" u-learning environment. That is, the knowledge engineering approach is helpful to the students in improving their learning performance.

Table 3 Descriptive data, and ANCOVA of the post-test results

Variable		N	Mean	S.D.	Adjusted Mean	Std.Error.	*F value*	*p*
post-test	Experimental group	32	52.69	13.45	52.185	2.236	7.533*	.024
	Control group	29	44.31	13.68	44.652	2.346		

*p<.05

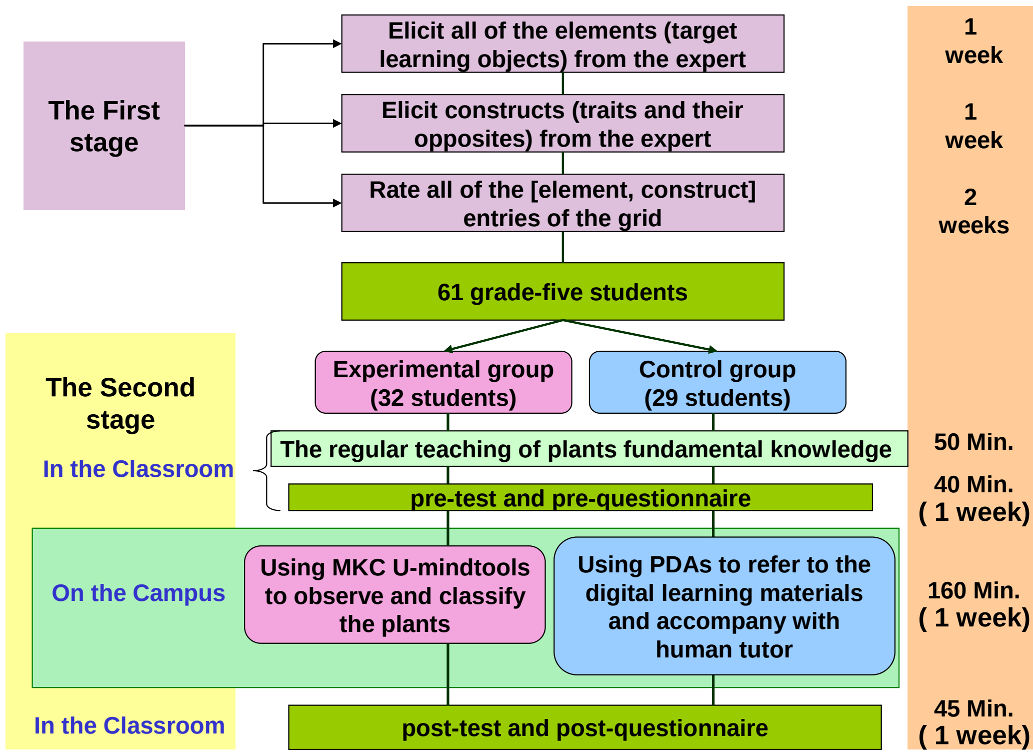

Figure 3. Procedure of the context-aware u-learning activity for comparing the u-Mindtool and u-learning approaches

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Development of a Mobile Learning Environment for Local Culture Courses

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1. Introduction

Mobile learning entails the kind of learning in which learners use mobile devices with digital content inside, to learn in anytime anywhere situations. Such devices include PDA, laptop computers, cellular phones with WIFI or other Internet connection capability, customized hardware. To avoid students aimlessly wandering around, instructors need to carefully arrange the learning environment and design an interactive learning model, along with prepare meaningful learning content.

This research is a mobile exploration activity to guide elementary students in Taiwan for local culture courses. This research first situates students in both the real world and the virtual world to extend students' learning experiences; second, it designs educational activities between the field and the digital system to demonstrate the practices of mobile learning which emphasizes learning to happen close to real life; third, it develops digital system with learning content to facilitate students' field studies; and forth, use a comprehensive evaluation methods to analyze the learning effectiveness.

As students are placed in the authentic learning context, students are dispersed around the environment. In situation as such, teachers have difficulties to attend to individual students. Using digital tools such as PDAs, students can explore the environment with individual attentions. In other words, PDA substitutes teacher's role and the pre-designed digital resources in the system works as learning scaffolds to guide students.

2. Literature Review

Mobile technologies fulfill educational dreams by providing the possibility of creating innovative learning experiences that can take place in a variety of outdoor settings (for example, parks, city centers, woodlands) and indoor settings (for example, museums, learning centers, labs, home) [11]. Examples such as bird-watching [2] or museum learning [1] are informal learning situations which are sustained by the combination of powerful functions and high portability. Formal learning situations, on the other hand, are widely used in different fields around the world including natural science [8], social science [7], math [12] and languages [6], just to list a few, and have gained positive results. Among these, the Ambient Wood project led by Yvonne Rogers in England [10] and Butterfly learning with expert system on PDA led by Gwo-Jen Hwang in Taiwan [3] are eminent natural science mobile learning projects.

Colburn defined inquiry-based instruction as the creation of a classroom where students are engaged in essentially open-ended, student-centered, hands-on activities [4]. According to Collingwood, history is a kind of science which involves inquiry into the past [5]. Inquiry-based learning opens a new way for social science learning. However, unguided online historical inquiry does not guarantee meaningful learning [9].Therefore, a similar research model is adopted in our research in consideration of appropriate tasks, sequence of hints and clues, as well as interactive dynamics during the inquiry activities. It is to ensure learning to happen accordingly.

3. Instructional Design

There were 32 fifth grade elementary school students participated in this research. In the beginning of the learning process, the teacher gave the orientation to the use of PDA. Then, after students filled out the pre-class questionnaire, which is for researchers to understand their initial understanding to the course materials, they started to conduct field inquiry in Peace Temple (Figure 1).

In the research, two learning tasks are designed to see if inquiry-based mobile learning can expand the width and depth of knowledge. One task is to ask students to tell an imagined story, the other is a hands-on artwork, in which we ask students to draw, cut, and paste to design a temple. We incorporate activities in historic monument investigations using handheld device, PDA. The objective of teaching is to support students' cognitive and affective learning, and increase independent learning motivation. Four steps of learning activities are designed (Figure 2).

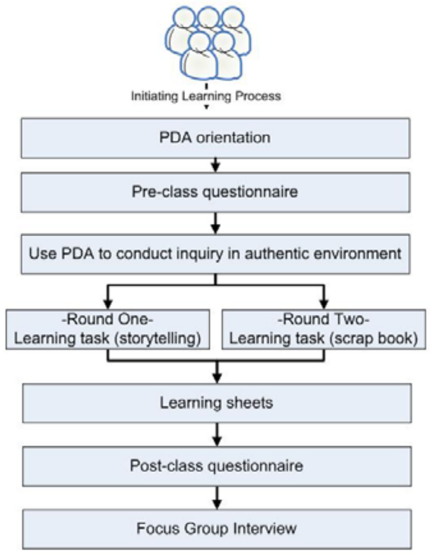

Figure 1 Research Process Diagram

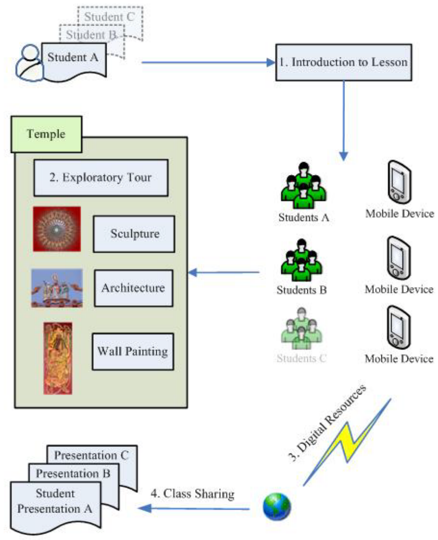

Figure 2 Concept map of instructional design

Before the course, the teacher has to design the themes and hints for the learning activity, and the technical designers help to implement them into the system. After creating situations to stimulate students' learning motivations, the teacher introduces the historic background of the temple, local cultures and religions, and other related information so the students can have basic concepts about the trip.

For the fieldtrip, students are divided into groups; each group is assigned to one theme, such as Gods, religious world, or cultures. Students then go on fieldtrips with mobile devices in hand to explore the temple in person. Students visit spots of interests guided by the pre-designed hints in each theme in the PDA. At the same time, they gather more information with the PDA by finding out answers of the hints in each theme and taking notes when there is open-ended question. The hints require them to conduct detailed observations on the architecture and placement of gods, and interview temple keepers and people living in the neighborhood regarding their thoughts and impressions about the temple. With wireless connection, students can even link up to the Internet and search for more information about what is not taught in class.

After they come back from the fieldtrip, students synthesize and categorize their collections, and make reports to share with classmates. The discussions and feedbacks stimulate a higher level of thinking. Learning assessments are conducted from various perspectives, including teacher, peers, and themselves. At this point, multiple assessments are performed. Learning effectiveness is perceived and reviewed from their group discussions, collaboration, and communication behaviors, learning achievements with oral and artifacts reports, and feedbacks they give to others.

4. Research Method

The research process was planned to correspond to the instructional design (Figure 1). To initiate the learning process, the teacher gave the orientation to the use of PDA. Then, after students filled out the pre-class questionnaire, which was for researchers to understand students' preliminary understanding to the course materials, they started to conduct field inquiry in Peace Temple with two learning tasks assigned.

Throughout the whole process, researchers performed observations to students' learning attitudes and behaviors by filling out observation forms. The learning process was deemed as three stages, including physical exploration stage, presentation preparation stage, and presentation stage.

After completing the learning tasks, students returned to the classroom and filled out the learning sheets with regard to their thoughts to the learning process and results. Meanwhile, a post-class questionnaire was distributed. After researchers obtained the preliminary results of the questionnaires, a followed up focus group interview was conducted to students to explain further on some unclear parts of the thoughts.

The research questionnaires were categorized according to the research objectives. The pre-class questionnaire included personality, learning content, and social relationship; and the post-class questionnaire included learning content, peer interaction, and satisfaction. Besides the learning content section which were designed with yes/no questions that were to identify whether students were involved with specific mental activities, other sections used six-point likert scale from strongly agree to strongly disagree. Besides, the personality and social relationship sections were used to find correlations to peer interactions.

The focus group interviews were done to students in groups of six. The purpose was to clarify some questions researchers found in the process. A semi-structure interview outline was prepared to stimulate student feedbacks to all learning aspects.

5. System Design

Students are given themes, hints, and selected choices for hints. Students can use those hints to collect necessary information in order to complete the tasks. The hints are organized under themes, and are prompted consecutively and progressively. In each hint, students can look up more information from either database or the Internet (Figure 3). Learning content and inquiry questions regarding the temple were placed in the system according to the model. Themes are such as “plane sculpture”, “3-dimentional Sculpture”, “gate”, “decoration”, and “structure”. Hints are such as “How many different kinds of plane sculptures are there in Taiwan?” “How many kinds of plane sculptures are there in Peace Temple?” and “Please find related stories about the sculptures.”

On the PDA, little graphics are used for the interface in order to keep the information simple and easy to read for small screen. On top of the screen, there is the dynamic menu of the themes. Then one hint is displayed at a time with necessary selected related choices. In the field, students can also conduct digital inquiry online. When the students return to the classroom, they can retrieve their observation notes on the PDA with their own account number and password. Notes are documented according to hint orders. Students can then prepare for the task reports by comparing their notes with their peers (Figure 4).

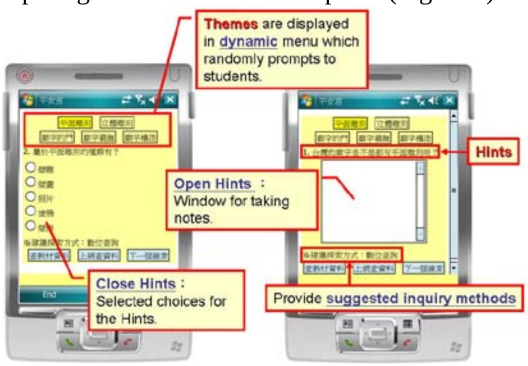

Figure 3 PDA interface for Inquiry

Figure 4 Students conducting the inquiry learning

6. Conclusion

Inquiry-based mobile learning model can be further extended to other lessons, courses, and subjects. It is proved by this research and many others that students’ learning achievements can be improved. For the future, we can conduct the research to understand other aspects of learning, such as critical thinking, creative thinking, cooperative learning, and so forth. We hope this research can provide some fundamental understanding for future researches.

Acknowledgements

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Context-awareness Mobile Learning Activity Generator

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Introduction

In the traditional learning, students get learning information and materials prepared in advance by the teacher, typically according to some textbook. Students do not have possibility in such environments to control the way of learning or get motivated in learning. In recent years though, computer technologies and internet have widely penetrated the educational processes and are being used to assist teachers' teaching and students' learning, which is called e-learning (Brodersen, Christensen, Dindler, Grønbæk & Sundararajah, 2005).

As mobile technology is getting mature, mobile devices are becoming a good facility for learning. The way in which mobile phones, PDAs, smartphones, and any devices with mobility are being used to learn can be seen as mobile learning and it has at least three benefits: (1) learning in real environment, (2) getting rid of the wired connection by using wireless connection, and (3) learning activities no longer limited by the place and can happen in the real world rather than being restricted to the classroom (Chen, Kao, Yu & Sheu, 2004). Mobile learning has potential to improve the students' learning motivations and learning performances by allowing them to use mobile devices to observe the real learning objects in the real world. In mobile learning, many unsolved questions still exist, for examples, how to enable students to enjoy the outdoor observation activities and be active in finding the knowledge which they prefer to learn. In other words, in most of cases, students still learn just because they have to.

Ubiquitous learning paradigm refers to education that is happening all around students and they may not even notice that they are learning. Ubiquitous learning can deal with the weakness of mobile learning. For example, mobile learning only provides specific domain knowledge in the specific learning environment (Chen, Hsieh & Kinshuk, 2006; Chang, Wu & Heh, 2008). It is important to recognize that the learners are not just passive receivers of the learning materials from teachers during learning. They have the abilities to learn the concepts, knowledge and skills by interacting with real-life objects in their surrounding environment (Vygotsky, 1978). Brown, Colins, & DuGuid (1989) argue that the concepts and knowledge are situation-based, and the learning is influenced by a combination of teaching activity, situation and interactions, called situated learning. The research in ubiquitous/pervasive learning aims to exploit this dimension (Thomas, 2005).

Generally speaking, the personalization can be achieved via two adaptive approaches: (1) the learning service can adapt to learners' characteristics such as learning styles, requirements, status, performances, preferences, and profiles; and (2) the learning service can adapt to the context surrounding the learners. The first approach is easy to understand, for example, the learning service can deliver multimedia materials to learners with a visual learning style or provide step-by-step instructions to the learner who has difficulty in solving specific problems. The second approach applies context-awareness ability to the learning service, for example, it will probably be useless for a learning service to deliver botanical materials to the learner who is inside an art gallery.

This paper uses context-awareness knowledge structure to generate personalized learning activities for learners according to the learning objects and relevant domain knowledge that exist in the surroundings of the learners.

Context-awareness Activity Generation Process

The context-awareness activity generation process is composed of two phases, as shown in figures 1 and 2. The first phase of information preprocessing has two steps: the knowledge structure construction step (step 1) and the preferred feature selection step (step 2). Step 1 adapts the learning service to the context of the learner's surroundings. Step 2 adapts the learning service to the learner's preferences. The second phase of personalized learning experience has three steps: the personalized learning activity generation step (step 3), the activity realization step (step 4), and, the personalized experience update step (step 5).

First of all, it is common for the real world to have a lot of learning objects that belong to various topics and knowledge domains in different areas/floors. When a learner visits a place, the learning service must have some idea about what learning objects are in the learner's surroundings, and what characteristics do the learning objects have that are suitable to be used by learning activities. This is part of 1st phase - the information preprocessing. Figure 1 shows two steps in phase 1. The system first discovers the characteristics of the learning objects by using context-awareness knowledge structure and rough set. The context-awareness knowledge structure is typically analyzed and designed by the pedagogical experts for storing and retrieving multidisciplinary knowledge and relevant learning objects (Wu, Chang, Chang, Liu, & Heh, 2008). After the system has constructed the knowledge structure about the learning objects that are available in the vicinity of the learner, the system then offers the learner some relevant features that the learning objects may have and let the learner select his/her preferred ones.

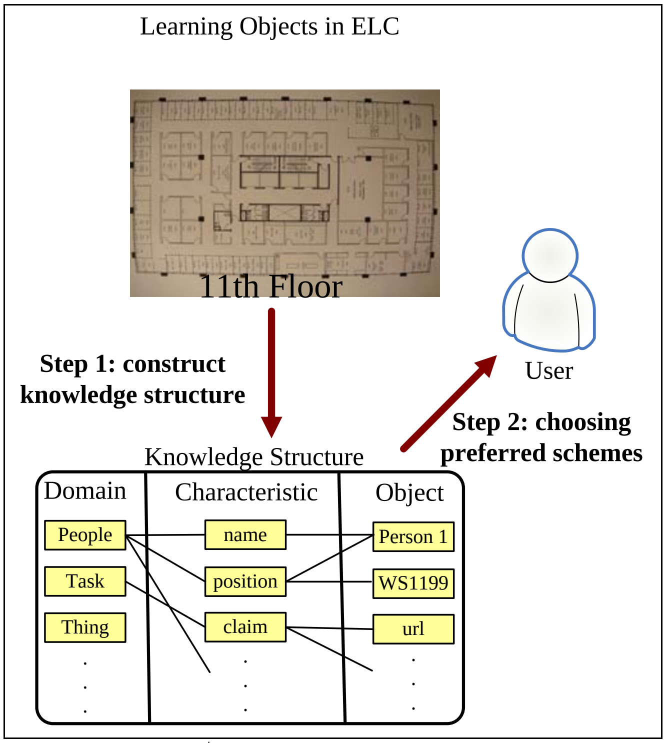

Figure 1. 1st Phase - Information Preprocess.

As Figure 2 shows, the second phase enables personalized learning experience. In this phase, there are three steps. Step 3 follows step 2 where the learner has selected preferred features. Different learning topics involve different learning objects in the place and these learning objects may have the feature(s) the learner is interest in, hence, the learning service can take the learner's preferred feature as the learner's preferred topic to generate personalized learning activity. The system picks suitable learning objects from the context-awareness knowledge structure and puts these learning objects into the activity generation engine in order to get different activity series, as shown in the "Topic" box in Figure 3.

In step 4, the learner can choose and undertake one of the learning activities that are generated by the activity generation engine in step 3. Each activity has one or more missions which the learner needs to complete, and every mission has descriptions to indicate the mission goal. The learner has to find out the learning objects required by the mission by observing or touching them on the device interface. When the learner accomplishes a mission, he/she gets permit to take the next mission in specific activity. The difficulty levels of missions get increasingly harder; the next mission being more difficult than the former one. Finally, the learning service records and updates the learner's progress into personal experience database in step 5.

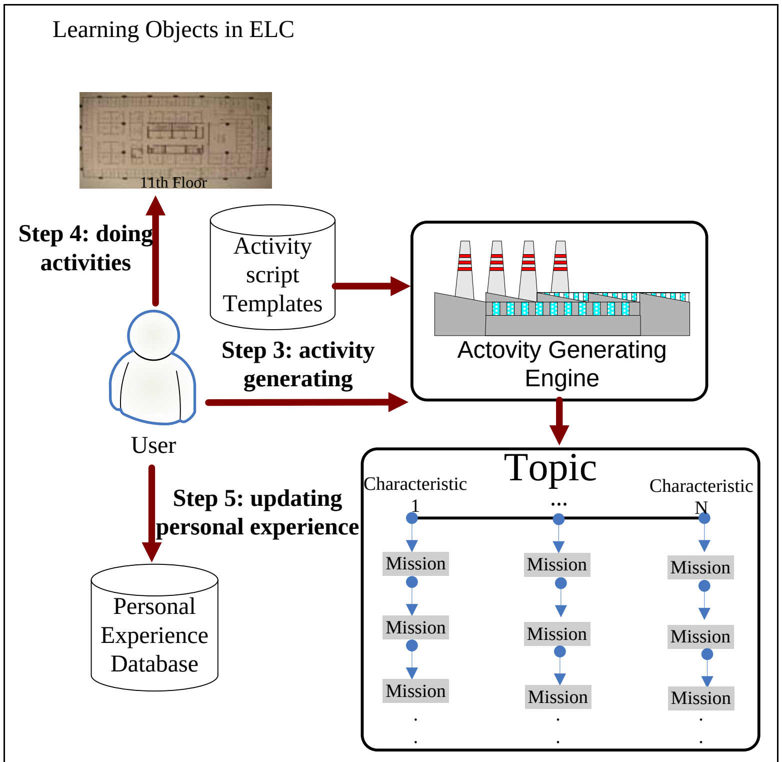

Figure 2. 2nd Phase - Personalized Learning Experience.

Scenario and Activities in Mobile Role-Playing Game

Game-based learning takes the digital games to the front of the students to improve and facilitate the learning process (Pivec, Dziabenko & Scinnerl, 2003). Some educational mobile games use Global Positioning System (GPS) to locate the students' locations and to give the appropriate tasks, i.e. the game will never ask the students to "find a book" in a zoo and "identify a plant" in a historical museum. For example, Frequency 1550 is a GPS-supported educational mobile game and students can learn Amsterdam's history by playing the game (Admiraal, Raessens & Van Zeijts, 2007).

We are developing a mobile educational game and putting the learning activity generator into the game as the kernel. The game world is based on the 11th floor of Edmonton Learning Centre (ELC), Athabasca University, in Edmonton. There are different types of learning objects: (1) people, e.g. Associate Vice President of Research, researchers, staff, and visiting scholars; (2) places, e.g. workplace, drop-in, iCORE space, kitchen, washroom, and meeting rooms; (3) things, e.g. printer, coffee machine, poster, and chart. In the game, the learners can play two different roles, new employee and visiting researcher. By playing the mobile role-playing game, the learners can get themselves familiar with ELC and also get themselves the necessary information and knowledge. The learning activities generated by the game will be different according to the roles the learners have chosen. For examples, if a learner plays the role of new employee, he/she may have an activity like "where can I get signature for an institute support letter?" If a learner plays the role of a visiting researcher, he/she may have an activity like "I printed a paper from my laptop, where can I pick it up?"

Current Progress and Plan

This research has designed and developed the theory and algorithms of context-awareness learning activity generation. We are focusing on the educational mobile role-playing game and would like to have experiment on it. The learning activity generator mainly focuses on allowing people to do informal learning when they want. The experiment will be taken by several international researchers and new hired staffs at 11th floor of ELC. The participants will play different roles and pick-up series of related learning activities. After they completed all learning activities, a post-test and questionnaire will be sent to them in order to get their learning achievements and feedback. An obvious plan is how to make the series of learning activities much more like a story. We want to bring the narrative elements and interactive storytelling into our research.

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Designing a Context-Aware Ubiquitous Language Learning Environment: Issues & Challenges

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Abstract

The development of wireless networks and sensor technologies (Hwang *et al.*, 2008; Liu & Hwang, 2009) is transforming the ways that next-generation learning may lead human developments in many fields, including computer-assisted language learning (CALL) and computer-mediated communication (CMC) which are fundamental elements and targeted topics in human language developments & communications via the Internet. Context-aware ubiquitous technologies have been evolving and their applications have been constantly developed to facilitate users' various aspects of language learning, including the four language skills (speaking, listening, reading and writing) and the three major language areas (vocabulary, grammar, and culture). In this work, the researcher summarizes the introduction, major aspects, research design, issues and challenges when designing a context-aware ubiquitous language learning (CAULL) environment in the study, with a focus on the investigation of receptive language abilities (reading and listening skills).

Introduction

Lately context-aware ubiquitous technologies have been providing an innovative way for written and oral communications by using a mobile device with sensors and RFID readers and tags (Liu & Hwang, 2009). Some researchers have investigated the potential, effectiveness, and impact of language learning in a CAULL context with formal or informal learning ways in terms of reading and writing (Chen *et al.*, 2008) and vocabulary (Chen & Li, 2009). However, there is little research concerning the design, use, and development of a CAULL context in terms of receptive language abilities (reading and listening skills) as well as of vocabulary, grammar and cultural awareness development. Thus, there is a potential for interested researchers to think about and explore how a CAULL context can be designed and developed in order to facilitate human language learning with selected and focused language skills and areas for the purpose of language development. CAULL, as a new form of computer-assisted language learning (CALL), is the target that the researcher intends to realize how it can be applied in the language (English as a foreign language, EFL) learning processes with the use of Communicative Language Teaching (CLT) Approach in the research.

The CLT Approach is the latest language teaching paradigm that dominates most foreign language teaching and education programs at Taiwanese universities today (Liu, 2005). Both British and American proponents of this approach identify the major goals of CLT as to (a) help learners develop communicative competence, and (b) assist teachers to develop instructional procedures for teaching the four language skills, as well as acknowledging the interdependence of language and communication (Richards & Rodgers, 2001). Because communicative principles of CLT can be used to teach any language skill at any level (Richards & Rodgers, 2001), students learn not only the linguistic structures and grammar rules, but also how to use the language to communicate with others properly. In the research, the CLT approach will be used as the way to promote language learning processes with the application of RFID sensors and context-aware ubiquitous technologies in order for the researcher to explore the effects of language learning in a CAULL context.

The Major Aspects of the Study

In this study, there are four aspects that the researcher would like to explore in a context-aware ubiquitous language learning (CAULL) environment, including (a) the CAULL context, (b) users in the CLT-guided CAULL context and human-computer interaction (HCI), (c) sensor-embedded learning objects, and (d) the integration of the CAULL context, users, and learning objects. Figure 1 illustrates the interrelationship among the key players in such a learning environment.

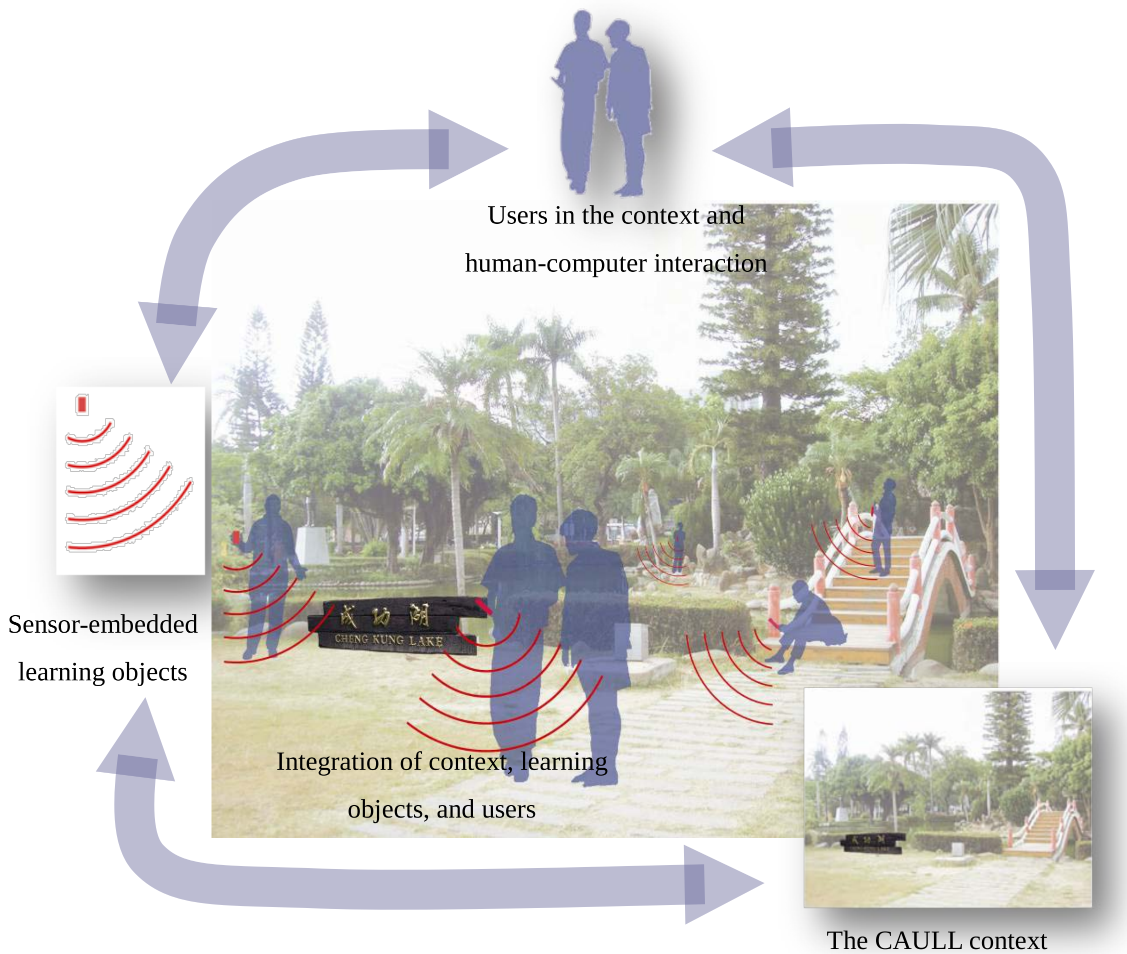

Figure 1. The key players in a context-aware ubiquitous language learning environment

Research design

In this study, the researcher would like explore the effectiveness, potentials, best practice, and even the problems when users are applying a RFID reader embedded net-book computer (portable computer) to interact with the RFID tag embedded learning objects in the EFL learning processes with the practices of CLT. The learning content will be developed for intermediate proficiency-level EFL users to learn the surroundings of Cheng Kung Lake on campus. The target participants will be the first-year graduate students who attend the university for the first time. The researcher will recruit around 40 participants (twenty males and twenty females) through email. In order to find out the real value of this new form of e-learning with innovative learning technology tools (Liu, 2008), he will address the research questions in the study:

- What is the best practice for using context-aware ubiquitous technologies to learn EFL with a focus on the investigation of receptive language abilities (reading and listening skills)?
- What are the most appropriate roles of the instructors and students in such a CAULL environment with CLT for developing receptive language abilities (reading and listening skills)?
- Are there any obstacles when students engage in a CAULL context with CLT? If so, how can we overcome them?
- What are the best functions for sensor/RFID embedded objects in the surroundings, and how can we select the best locations for them to foster a meaningful CAULL context with a focus on reading and listening developments?

Design issues

There are two kinds of language abilities: receptive and productive abilities. The former refers to the ability that people apply reading and listening language skills; the latter refers to the ability that people apply writing and speaking language skills. In this study, with a research focus on the development of receptive language abilities and with the use of context-aware ubiquitous technologies in an open environment, the researcher will explore:

- In terms of learning activity issues: among the three identified major e-learning approaches (de Jong, 2006)—guided learning with practice, collaborative learning, and inquiry learning—which should be taken in order to foster the practice for CLT-guided CAULL?
- In terms of human-computer interaction (HCI) issues: in a CLT-guided CAULL context and with a focus on reading and listening developments, can sensor-guided questions and answers always be the solution to help users develop the receptive language abilities?
- In terms of sensor/RFID embedded learning object development issues: for the purpose of helping intermediate proficiency-level EFL users develop reading and listening skills, the language areas of vocabulary, grammar and cultural awareness should be learned at the same time?
- In terms of integration issues: the sequence for the use of sensor/RFID embedded objects and for the collaboration with other users in a CAULL context.

Challenges

The possible challenges include:

- How much collaboration do the users need in the EFL learning processes—with a focus on reading and listening developments—in order to realize the CLT-guided CAULL?
- In order to realize the authentic values of CLT-guided CAULL and to help users develop reading and listening skills, should we provide strict, principled guidance for the students (guided learning with practice) or should we let follow their interests from the beginning to the end (inquiry learning)?
- What is the return on investment for CAULL tools and other equipment in terms of cost and benefits (Liu & Hwang, 2009)?

Conclusion

The researcher will share his ideas with the experts and the audience in the workshop and would like to seek any constructive and practical comments to improve the research design.

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