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Using Participatory Simulation Support Learning Algorithms

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Abstract

During learning computer science theory, it is essential to learn sorting algorithms, but it is not easy to understand the concept of the different sorting algorithms. This paper describes a system called PLASPS (PDA-based Learning Algorithm System Using Participatory Simulation). This is an interactive simulation system to learn the sorting algorithms. Learners use it to deeply understand the sorting algorithms. Using this system, the teacher can assign tasks to his student and ask them to sort a list of numbers according to a certain algorithm. Learners receive these tasks, collaborate together and send the result to the server. The system will check it and feedback the student with the positions of the numbers if there is a mistake. The learners will correct the number positions and send it back to the server. Learners can understand the algorithm through the dissections and their errors.

This system is like ‘scaffolding’. Scaffolding is a great technique that can help the students to master understanding the sorting algorithm. At the beginning, this system assists the students by supporting some instructions, and later the fading process is starting where the students have to practice independently. There are two parts in this system, one is the system-driven, which uses scaffolding technique, and the other is the learner-driven, which allows the student to work independently.

This system was developed and evaluated. In this paper, we describe how the system uses participatory simulation environment for sorting algorithm learning, how we use the scaffolding technique to develop this system. We also describe the implementation of the PLASPS, the evaluation of the system and the plan of the future work.

Using Participatory Simulation Support Learning Algorithms

1. INTRODUCTION

Recently, with the evolution of improved wireless telecommunications capabilities, open networks, continued increases in computing power, battery technology, and the emergence of flexible software architectures, these technologies can be commonly used in mobile learning. Mobile devices (e.g., PDA's or notebooks) provide different services aiming at the improvement of interactivity and creating additional, computer-moderated channels of communication between the learners and the teacher (Papert, S. and Harel, I. 1991). The poor communication between students and teacher is one of the major problems in mass lectures. However, mobile devices can reduce this problem and by improving the interactive communication help to increase the motivation of the students (Papert, S. and Harel, I. 1991). Further, mobile handhelds can easily be used in any classroom or field site; hence they can be used more often than computer labs (Vahey & Crawford, 2002). Using mobile devices for supported collaborative learning is known as MCSCL (Mobile-Computer Supported Collaborative Learning). Nowadays, there are more and more supported learning researches about MCSCL in order to enhance learning and teaching (Okada et al. 2003;Chen et al., 2002). Many studies have examined the use of wireless mobile devices in learning. According to (Roschelle, J. 2003), "90% of teachers in a study of 100 palm-equipped classrooms reported that handheld was an effective instructional tools with the potential to impact learner learning positively across curricular topics and instructional activities." The MCSCL is classified as follow (Roschelle, J. 2003):

(1) **Classroom response systems**: This is a system where learners can answer the teacher's question immediately with a mobile device, and the system will then display the total result. According to this result, the teacher can grasp the understanding condition of each learner

about the course content. The system turns every learner into an active learner. For instance, "ClassTalk" [http://www.bedu.com] is a classroom response system that shows teachers the statistics of learners' answers in the classroom immediately.

(2) **Collaborative data gathering**: The mobile learning environment changes the monotonous way of teaching in the classroom whereby the learners are only listeners. It lets the learners gain experience from real life, and deeply understand what they have learned. The learner touches and feels the actual object. For example, the Bird Watching Assistance System (Chen et al., 2002) was developed for this purpose to support the learning environment.

(3) **Participatory simulations**: This is to let the learner understanding the course content better through the participation/practice. The learner uses a mobile device to take part in a common participatory simulation. Through this active participation, the learner can discuss and get the correct answer, consequently understand what they have learned better. For example, the Virus Game was developed by the MIT (Vanessa et al., 2002) to explain the process of how virus is spread.

(4) **Others applications:** As like other researches, the system is being developed in the university, which uses PDA to support the study activity. For example, in Tokushima University, we have a project called BSUL (Basic Support for Ubiquitous Learning) (Saito, et al., 2005) to aid study activity.

In this paper, we use the scaffolding technique to design a participatory simulation framework to support collaborative learning, called SPS (Scaffolding Participatory Simulation). Based on the SPS framework, we have implemented a system support to learning sorting algorithm called PLASPS (PDA-based Learning Algorithm System Using Participatory Simulation). This system was then implemented and evaluated.

There are 3 important keywords in most CSCL papers and researches, authenticity, scaffolding and reflection. SPS framework uses the participatory simulations method to realize authenticity, and it was designed using the scaffolding technique, and in the framework, history records are then used to realize reflection. In the following sections, we describe how scaffolding technique is used to design the SPS framework and the characteristics of the SPS framework, and how the SPS framework uses participatory simulation for learning. Finally, we will describe the implementation and evaluation of PLASPS and the plan for the future works.

2. PARTICIPATORY SIMULATION

During the past ten years, computers have been used increasingly as simulation machines. The widespread popularity of game software like SimCity and SimEarth give a clear indication of the extent to which simulation has permeated popular culture, participatory simulations grew out of an age-old tradition of using role-playing to help people develop personally meaningful understandings of complex or nuances situations (Vanessa et al., 2002). Students engaged in participatory simulations act out the roles of individual system elements and then see how the behaviour of the system as a whole can emerge from these individual behaviours (Wilensky, 1999). Participatory simulations are learning games where players play an active role in the simulation of a system or process. Simulations of this type have recently come to the attention of educators through the work of Colella (Colella, 2000). Students participate in an active way, analyze information, make decisions and see the outcome of their actions. This increases the motivation and the learning success improves.

The SPS framework focuses on the participatory simulation that is to learn the concept (or rule) through doing it. Using SPS-based system, the teacher can assign tasks to his learner and ask them to do the task, and learners receive these tasks, collaborate together to do the task.

The system supports the learner to do the task step by step, the system will check every step and feedback the learner, learners can understand the concept (or rule) through their trial and errors, when the learner masters the concept (or rule) on a certain level, the system will reduce the help function gradually and more responsibility is shifted to the learner. As mentioned above, the SPS framework is used to build the PLASPS system. In this system, all the learners stand in a line with PDA, and the teacher can assign tasks to his learner and ask them to do the task by using the system, and learners receive these tasks, collaborate together and exchange their physical positions according to the algorithm. This system helps the learner to deeply understand the feature of the sorting algorithms.

This research is advocated by pedagogical theories such as hands-on learning and authentic learning. Brown, Collins, and Duguid (Brown et al., 1989) define authentic learning as coherent, meaningful, and purposeful activities. When classroom activities are related to the real world, learners receive great academic rewards. There are four types of learning to ensure authentic learning: action learning, situated learning, incidental learning, and experimental learning (Ogata and Yano, 2003, Ogata and Yano, 2004). SPS framework employs two forms of authentic learning; action learning and experimental learning based on face-to-face communication. SPS framework brings the learners to learn in the 'real world'. The SPS framework also employs interactive learning. Interactive learning involves interactions, either with other learners, teachers, the environment, or the learning material.

3. SPS FRAMEWORK

The SPS framework comes from the traditional education and can be seen as an extension of the traditional education. In the traditional education system, teachers give priority to the learners, and learners are normally very passive. For example, in learning computer science theory, when the teacher teaches some complicated concept or algorithms, they only explain literally but it is difficult to make it clear to the learners. So making use of this framework, a mobile system to help students to understand the concept easier and clearer is developed. Besides, it improves the interactive communication, and increases the motivation and enthusiasm of the learners.

3.1 What is scaffolding?

Before moving on to the framework, we would like to explain the term 'scaffolding'. The term 'scaffolding' comes from the works of Wood, Bruner and Ross (Wood et al., 1976). It can be explained better with the following sample. For example, earning to ride a bicycle gives children a wonderful sense of accomplishment. Many of us can recall running alongside a child, holding the bike steadily as the youngster gained speed and then wobbled off independently, unaware that he or she was pedalling without support (Feldman, 2003). Scaffolding, as provided by human tutors, has been well established as an effective means of supporting learning (Soloway et al., 2001).

The timing of the scaffolding is very important. When the children are just learning to ride bicycle, it is necessary to hold the bike steady for giving s/he wonderful sense, when s/he can pedal without support, if we still hold the bicycle, it will hinder s/he to achieve more speed. Now we should begin the process of "fading", or the gradual removal of the scaffolding, which allows the learner to work independently.

3.2 Design of SPS framework with scaffolding technique

The design of SPS framework is divided into four sequential parts (see figure 1), the first one is the initial process, the second one is the system-driven part, which is the process of scaffolding to support task execution, and the third is the learner-driven part, which is the process of "fading" to train the learners to think by themselves and the last part is the reflection part.

During the initial process of learning and problem solving, the teacher will provide general ideas, concepts, rules, examples and etc to the learners to guide them and to make sure the learner have a basic idea of what has to be learned. Following that, the system-driven component will assist the learners by providing some instructions, the learner will gain experience from the aid and help messages provided by the system to tackle the problems presented in the PDA. After some practices using the PDA to solve problems, the learner will gradually learn and understand the methods and techniques to solve the problem, when the learners become more experienced with the concept (or rule), the fading process is started where the learners use the learner-driven to practice independently. On the other hand, the system will reduce help messages gradually and more responsibility is shifted to the learner. Lastly, the learners will be able to solve the problem themselves without the help of the system. At the end learners can reflect with the history record.

Insert Figure 1 about here

3.2.1 Initial process. The teacher explains the concept (or rule), and point out the major emphasis, and then explain to learners how to use the system, at the end explanation will be conducted using the examples in help page. This is very useful to help learners to understand.

3.2.2. System-driven. In the system-driven part, the system guides the learner to do the task step by step. The system-driven acts like a bridge used to enable learner to master the concept (or rule). All the learners do the task using PDAs. The system will give guide them on how to do the task. The learner could discuss and compare with his other learners by indication, before exchanging the position. Here, mistakes are expected from the learners, but the system will provide the learners with some information, which points out the position if it is incorrect and how to correct them for the learners to be able to achieve the task. The learner comprehends through participation in the discussion and help from the system to understand the feature of this concept (or rule). There are three characteristics to support learners in system-driven:

1. Discussion and help with each other.
2. Pointing out the error position.
3. Providing messages to correct the error.

3.2.3. ***Learner-driven***. The learners use the learner-driven system to practice doing the task by themselves. When the learner masters the concept (or rule) on a certain level, the process of fading begins. The teacher will judge according to the level of understanding of the learners and reduce the system's help function gradually.

We design the learner-driven into three levels depending on the process of fading as in Figure1:

Level 1 only points out the error, but the method on how to correct it must be completed by the learners, and they can discuss and compare with his neighbouring learner, before exchanging the data.

Level 2 does not point out the error, and the learners have to correct it by themselves. They can discuss and compare with their neighbouring learner before exchanging the data.

Level 3 (see Figure 2) lets everyone do the task with the PDA. For example, there are 5 learners with PDAs named A, 1, 2, 3 and 4. Learner 1, learner 2, learner 3 and learner 4 each one represents a number and Learner A will have to rearrange the numbers according to the task. Learner A stands before them indicating how to do switch positions and do the task. Facing the other learners, leaner A orders them to exchange their position without discussion. If Learner A passes the third level, we can say s/he can complete doing the task independently.

Insert Figure 2 about here

3.2.4. Reflection. Every step is stored in the history record, after finishing the task, the learners can see the history of the each step, which points out the wrong positions for the learners and its corrections. With the history record learner can reflect the algorithm.

3.3 Characteristics of the SPS framework relating to Educational Scaffolding

Here are the characteristics of the SPS framework relating to educational scaffolding as below (Jamie, 1999):

3.3.1. Provision of clear directions. SPS framework offers step-by-step directions to explain just what learners must do in order to meet the expectations for the learning activity. A message about how to do the task will be provided to support every step.

3.3.2. Clarification of purpose. SPS framework keeps purpose and motivation in the forefront. Scaffolding aspires to meaning and worth. At first teacher should explain the concept of algorithm, and point out the major emphasis includes what target will be achieved. The SPS framework will help learner to do the task based on the target every step.

3.3.3. Keeping learners on task. By providing a pathway or route for the learner, each time a learner or team of learners is asked to move along a path, the steps are outlined extensively. SPS framework checks every step, and the right step will be shown to the learners.

3.3.4. Assessment to clarify expectations. From the very start, SPS framework provides examples. By these examples they can know what result will be at the end. Right from the beginning, learners are shown rubrics and standards that define excellence. In traditional school research, learners were often kept in the dark until the product was completed. Without clearly stated criteria, it was difficult to know what constituted quality work.

3.3.5. Reduction of uncertainty, surprise and disappointment. SPS framework designers are expected to test each and every step in the lesson to see what might possibly go wrong. The idea is to eliminate distracting frustrations to the extent this is possible. The goal is to maximize learning and efficiency. Once the lesson is ready for trial with learners, the lesson is refined at least one more time based on the new insights gained by watching learners actually try the activities.

3.3.6. Efficiency. If done well, a SPS framework should be efficient. This perception is achieved, in part, by virtue of comparison with the old kind of school research that was mostly about wandering and scooping. Boredom fed by irrelevance slowed the passage of time. It took forever to get the job done. SPS framework still require hard work, but the work is well centered on the inquiry, focused, clear and the learners are well channeled, avoiding unnecessary effort.

3.3.7. SPS framework creates momentum. In contrast to traditional research experiences, throughout which much of the energy was dispersed and dissipated during the wandering phases, the channeling achieved through scaffolding concentrates and directs energy in ways that actually build into momentum. It is almost like an avalanche of thoughts, accumulating insight and understanding.

We use the SPS framework to develop the PLASPS system, which was modeled following the standard specifications of Java 2 Platform, Standard Edition (J2SE), and using Apache Struts, which used the MVC (Model-View-Controller) architecture scheme. We chose this architecture because the re-usability components and the previous experience in developing web applications under this specification (Ayala and Saito, 2003). Apache Struts is based on the structure of MVC (Model-View-Control). Struts-config.xml is an important partial disposition file of Control, which defines alternations between the pages, and works like the event mechanic for the user's interface.

An exciting aspect of wireless mobile technologies for education, as described in the literature today, is that tools that first existed only on expensive desktop machines are now being made available on inexpensive handheld units (Soloway et al., 2001). We used wireless LAN (IEEE 802.11b), Tomcat 5.0 as the server, run it on desktop computer, and learners run this system on Pocket PC2003, and Access database. We have finished the development of the System. The system is described as the following:

Insert Figure 3 about here

4.1 Architecture

There are 6 sorting algorithms in this PDA participatory simulations' system. They are Bubble Sort, Insertion Sort, Selection Sort, Quick Sort, Heap Sort, and Shell Sort. We set the number of learners between 3 and 9 in the same time. There are three modules in the system driven part (see Figure 3).

4.1.1. Server module. The server will send messages to the teacher or the learners. Each time after sorting, the server will receive data records from the learner module and the server will save these data records automatically. With these records, the server will validate the sorting whether it is correct or not, and send messages to the learners or teacher.

4.1.2. Teacher module. The main job of the teacher module is to select the sorting algorithm and set the number of the learners. After the random data is generated, the teacher sends this data to learners. The teacher can use a desktop personal computer or a PDA for this purpose.

4.1.3. Student module. The learners will get the data to be arranged from the server according to the ID of the learners. Then the learners have to analyse, compare, discuss, and swap the obtained data. The result will then be sent to the server and the server will make a comparison of the correctness of the result. At the same time, the teacher can view the result and also measure the understanding of the learner and revise any new ways to explain the compilation of data.

4.2 User Interface

We have designed the system as a central server, with four interfaces, the first one is a user interface for login, the second one is a learner interface, the third one is a teacher interface, and last one is a help interface.

There are two types of users, the teacher and the learner. The system can detect the user type from his account and display the correct interface accordingly.

4.2.1. Help interface. Before using the system, the learners should know the concept of the sorting-algorithms, and how to sort these algorithms.

Insert Figure 4 about here

4.2.2. Teacher Interface. As shown in figure 4, there are three check options in this interface, for error checking, a help message to correct the error and a choice for either ascending or descending sort. When the error checking option and help message option is on, it is in the system-driven mode, if one or all of them are off, this system is in the learner-driven mode.

The teacher logins as a teacher user, the teacher window will appear as shown in (A) In 'Selecting for teacher' window, the teacher can select the sorting algorithms and set the number of the learners. If the selection is ok, the numbers and first-time position will appear as in the (B) In the ‘Saving for teacher’ window, the system will generate a list of random of numbers and send this list and the position number to the learners. P1，P2, P3···PN are the positions of the number and this data will be saved in the database, these are all the setting for the teacher. Then, when the teacher clicks 'next' the sorting will be started. The system will assign one number in this list to each learner. The system also will assign one number in this list to each PDA.

4.2.3. Student Interface. As shown in figure 4, when learners login with the user ID, the (C) 'Initialization for learner' window will be shown. When it is refreshed, the number of the users will appear as in the (D) 'Step for learner' window. There are also messages from the server and the position of each number. The learner will change his location and the number position according to the sorting algorithm. The 'upload' button is used to send the result to the server after every step. Students can also review the sorting algorithm here and also the number of loops for the algorithm.

4.4 Scenario

This is a scenario about using the system. The teacher assigns an array of numbers to his learners and asks them to sort these numbers according to a certain algorithm. Learners receive these tasks, collaborate together to do the task and the result of each step is sent to the server. The system will check it and feedback the learner with the positions of the numbers if there is a mistake. The learners will correct the number positions and send new position again to the server. Learners can understand the algorithm through discussions and their errors.

Figure 5 is a sample using the system-driven of learning bubble sort algorithm with ALGOS. In the evaluation conducted in a sorting algorithm class, there were altogether 30 students and a teacher. The students were divided into 3 groups and were instructed to use this system at the same time. In the case, the teacher chose the bubble-sorting algorithm. The system generates the data randomly and sends them to the learners. In the example shown, the array list "84,94,43,93,96,83,14,93,99,58" will be sorted descending. Learners will stand in a line with a PDA, which displays their numbers and positions.

Insert Figure 5 about here

At the beginning the system will give hints and instruction to solve the problem. In loop 1, a help message like this will appear initially: "The first person (in this case P1) has to compare and change his position with the neighbour if it is not in descending order". After the comparison, the new position is uploaded to the server. The students will also change their physical standing position in the line. The server will evaluate the change of positions and send an error message if the change was done incorrectly.

In case of mistake in the change of positions, the message will then ask the learners to correct it such as: "Numbers 84 and 94 are not in descending order, please change your positions". Conversely, if the positions were changed correctly, the server will generate a message like this: "P2 and P3, please compare your order and upload the new positions". As in the case of P1 and P2, if the change was incorrect, the server will generate a message to aid the learners again and vice versa if the change was correct. This process is also carried out for the other learners until P10.

As we move on to Loop 2, each learner will discuss and compare with his neighbour learners according to the messages from server as in Loop 1 and this process goes on for a few loops depending on the problem until the whole array is sorted. In each loop, circled numbers are correct and fixed while the underlined numbers indicate that these positions require changes in next loops.

5. EVALUATION AND EXPERIMENTAL RESULTS

5.1 Single group

In order to evaluate the usability and get some feedback for this system, we asked 10 learners to evaluate the system twice. 10 PDAs were used in this system too. They are all master students who learned the sorting algorithm about 3 years ago when they were undergraduate students. Each student holds a PDA with a number and stands in a line to sort (see figure 6). Most of them have not used the sorting algorithm for a long time so they have forgotten the rule of the sorting algorithm. We are proposing that they can use the system to review the algorithm again.

Insert Figure 6 about here

We chose learners who have not used sorting algorithm for a long time to get their feedback and the efficiency of re-learning the sorting algorithm again using the system.

Most of the learners commented that they could learn how to sort algorithm using this system, and it is a good way to explain the algorithm by the participatory simulation. This system gives the opportunity to the learners to see in practical how the sorting algorithms are done.

After completing these two experiments, we get the comment from these learners for improving the interface such as “please change the position of the buttons”, after we improve the system, we evaluated system again. In these two experiments, we obtained some comments as in table1. According to the comments, we concluded that it is a good method to study by this system, which is similar to playing games in class. It is more interesting than just learning by teaching material.

Insert Table 1 about here

5.2 Multiple groups

Multiple groups can use this system at the same time. For the third experiment, we asked 30 learners to evaluate the system and divided them into 3 groups. Figure 7 shows a scene of different groups learning. And we divided the learner into 3 groups and named them A, B, and C.

Insert Figure 7 about here

After completing the experiment, a system evaluation questionnaire was given out. The learners evaluated the system by grading each of 10 questions, which is given from point one being the lowest to five being the highest (1: totally disagree, 2: partially disagree, 3: Neither agree nor disagree, 4: partially agree, 5: totally agree). The average of the points was 4.0. Table 2 shows the results of the evaluations by the questionnaires.

According to Question (1), the system is helpful for learning algorithm. Question (2), the system checks each step and gives helpful information, the result was not as good because they said there are some message not point out the error position. Question (3), the evaluation was not as good because this was the first evaluation and the interface of system were not user-friendly enough. After that, we did some modifications on the interface the result of the evaluation improved. Modifications will be made gradually from time to time to improve the userfriendliness of the system. We also need more explanation for the learners how to use it. Question (4) shows they like using this kind of system to help learning.

From the results of question (5), they can understand the algorithm better after making mistakes. Question (6,7) using this method, they can help each other well. Question (8, 9) shows that they can understand the algorithm deeply and was enlightened by the discussion. Thus, we are also thinking about how to enlighten and help to improve the understanding of learners learning sorting algorithms. In the discussion, they can tell each other what they have comprehended. And they like the way of studying by discussion. Question (10) uses this history record to reflect the process of the sorting; they can reflect the process again. Some learner commented that by the history record they can know the whole process, and they can ponder and reflect the algorithm from the history records.

Insert Table 2 about here

Most of the learners commented that they could learn how to sort algorithm using this system, and it is a good way to explain the algorithm by the participatory simulation. This system gives the opportunity to the learners to see in practical how the sorting algorithms are done. But the system is not easy to use.

From the evaluation, we can observe that the students were able to learn better and enjoy the learning process in such group settings. Each group would compete with each other to be the fastest to sort the algorithm.

6 CONCLUSION AND FUTURE WORKS

This paper describes the SPS framework, which was designed using scaffolding technique The SPS framework uses the participatory simulations method to realize authenticity, and in the framework, history records are then used to realize reflection. Based on this SPS framework, the PLASPS system was implemented and then evaluated. The teacher can use this system to help the learner to understand the algorithm deeply. We found that it was very easy for learners to understand and the main goal is achieved, whereby each learner understood the algorithm deeply.

The PLASPS system can help learners learn sorting algorithm. The scaffolding technique is suitable to support teachers in interactive lectures. A major advantage of participatory simulations is the fact that it is easier for learners to see patterns and understand coherences. With all the technical advances it is of particular relevance to keep in mind that only a part of the learning can be done with participatory simulations. The communication and discussion is always an essential part of the learning process. We believe that the emerging field of mobile interactive services and participatory simulations improve learning especially in the case of complex problems.

This system is still not that user-friendly. Thus, we are planning to improve the interface and ease of usability, which will be a new topic to be explored in the future. We will have more evaluation of this system in the class to get more in-depth feedback from the learners in order to test and improve it to achieve the goal of using it in class.

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Author Note

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Table 1

Insert Table Title Here

Table1: Advice of interface.

	What do you think about this learning method?
1	It is very easy to be understood using this way of teaching algorithm.
2	We can exchange our views on the solution of the algorithm and get the best way to solve the problem.
3	In this way I can get help from the other learner
4	Studying in this way is quite easy to understand, just like studying in games.
5	Learning from using the system is more interesting than learning from teaching material in a normal class setting.
6	We can do revision on the algorithm learned in class with this system.

Table 2 Results of questionnaire.

	Questionnaire	**AVG**
1	Do you think this system is helpful for learning algorithm?	4.0
2	The system checks each step and gives helpful information; do you think it is helpful?	3.5
3	Do you think this system is easy to use?	3.2
4	Do you want to keep using this kind of system to help learning?	3.9
5	Can understand the algorithm better after making mistakes?	3.9
6	Can you understand deeply when you get help from the other learners?	3.7
7	Can you explain well when you help some else?	4.1
8	Do you understand deeply and enlightened by the discussion?	3.5
9	Do you think it is interesting to study while discussing with other learners?	4.2
10	How about using this history record to reflect the process of the sorting?	4.0

Figure Captions

Figure1. Design of SPS framework

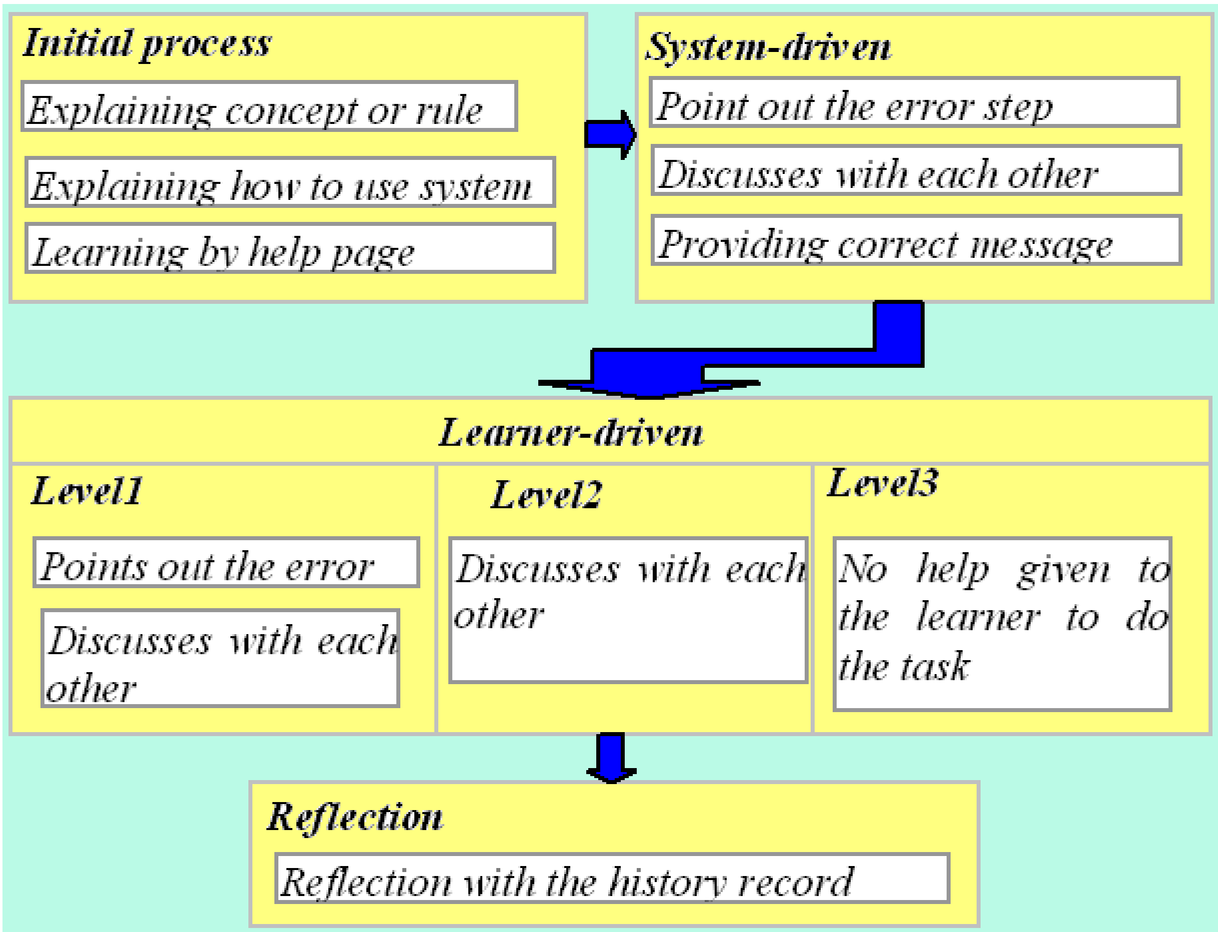


Figure2. Overview of Level3

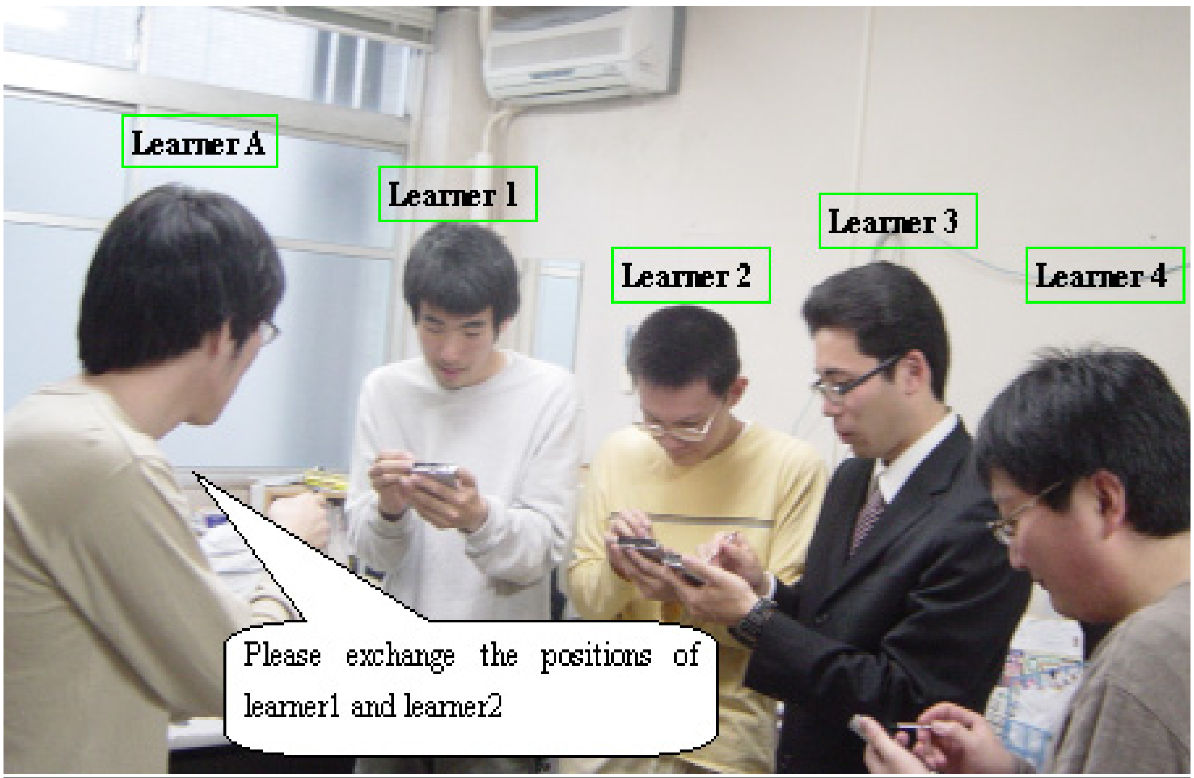


Figure 3 Architecture of system

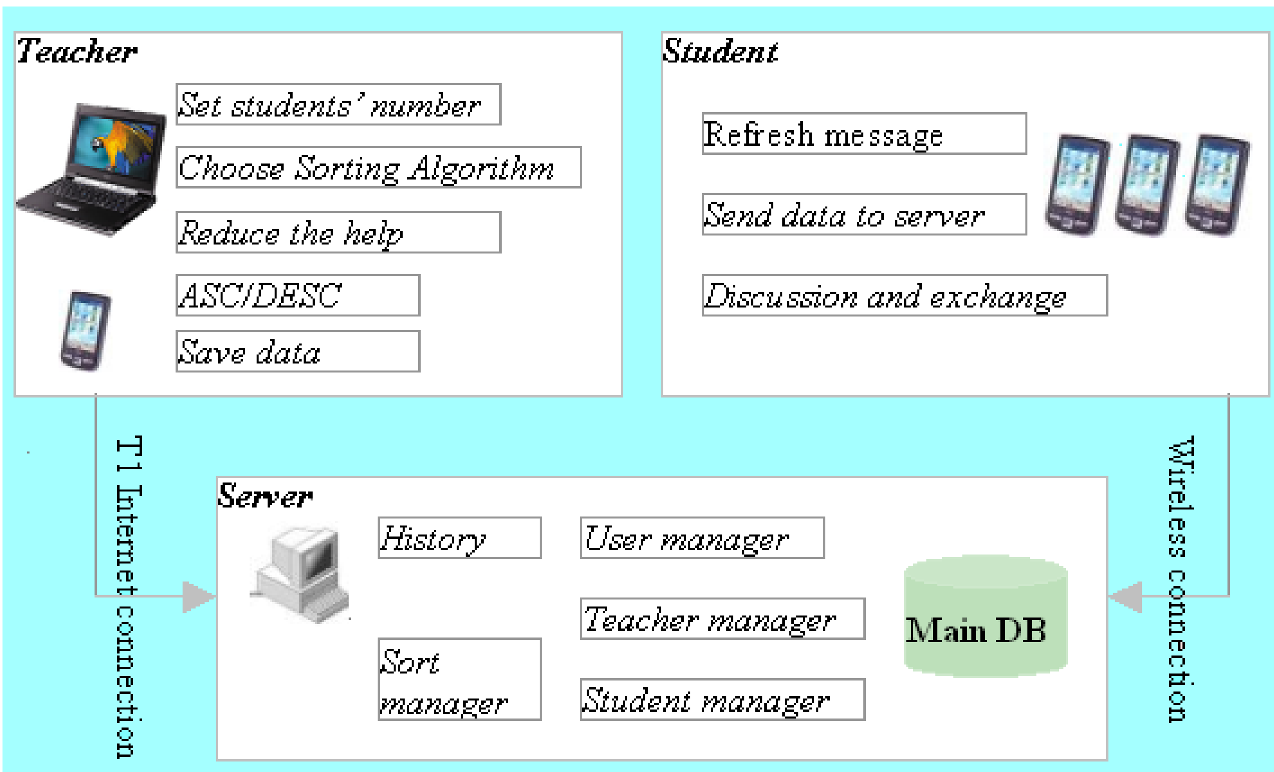
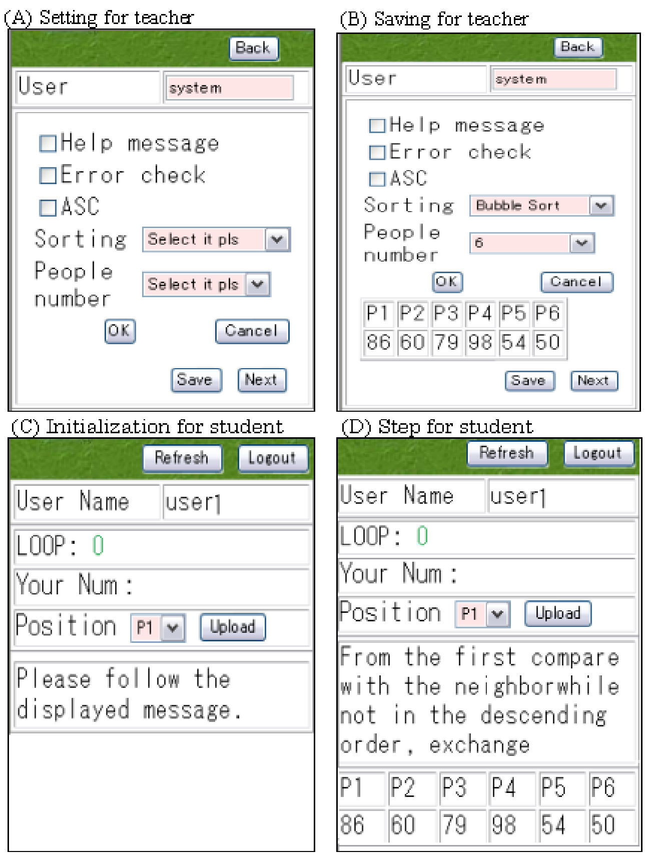


Figure 4 Interface of system



	P1	P2	P3	P4	P5	P6	P7	P8	P9	P10
Start	84	94	43	93	96	83	14	93	99	58
Loop1	94	84	93	96	83	43	93	99	58	14
Loop2	94	93	96	84	83	93	99	58	43	14
Loop3	94	96	93	84	93	99	83	58	43	14
Loop4	96	94	93	93	99	84	83	58	43	14
Loop5	96	94	93	99	93	84	83	58	43	14
Loop6	96	94	99	93	93	84	83	58	43	14
Loop7	96	99	94	93	93	84	83	58	43	14
End	99	96	94	93	93	84	83	58	43	14

Figure 5 Bubble sort

Figure 6. View

Figure 7. A scene of different groups learning