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Developing learning anytime, anywhere, and any device using CAI (Computer Assisted Instruction) synchronization

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ABSTRACT

This paper discusses about development data synchronization system of Computer Assisted Instruction (CAI). The CAI system complements the use of the Learning Management System (LMS) which is very popular in Indonesia. The use of CAI to simplify learning activities is very helpful because students can learn anywhere and anytime, both online and offline. CAI allows to store all activities data and to send learning results to LMS at any time. The data become important information for the lecture to carry out the task of supervising the activities and development of students learning. One of the advantages of using CAI is that students can run CAI modules with the various devices, e.g. computer, laptop, smartphone, and tab. But this appears a new problem because the use of various types of devices make the data generated are also scattered in various devices. Lecture needs complete information. Therefore, CAI modules must be equipped with a data synchronization system. With synchronization, students can make learning activities comfortably without feeling like losing their activities data. An important result of this study is the students becomes freer to study because they can do it anywhere, anytime, either internet is available or not, and with any devices.

Keywords
CAI, data synchronization, mobile learning.

1. INTRODUCTION

E-learning system, e.g. Learning Management System (LMS) becomes a popular tool for teaching and learning in Indonesia. The function of this system is to simplify online learning between lecturer and students. Learning system uses web LMS as a means of learning and communication with huge flexibility. Students and lecturer conduct learning activities anytime and anywhere freely. In Indonesia, using an online learning system is very suitable because it can reach wide areas. E-learning system can fulfill the needs of students and lecturers who are diffuse geographically and have clash schedules [1]. However, one of the main problems in implementing e-learning is the limited internet access, especially in rural areas due to inadequate telecommunications infrastructure. Low quality and quantity of internet connections is the reason for the biggest difference between rural and urban people who do not have internet access at home [2].

Another method to overcome the limited internet access is to use Computer Assisted Instruction (CAI). CAI is the personal learning technique, both online and offline, which aims to enclose users so that they can interact with well-programmed instructional materials [3]. With CAI, students can learn anywhere by using the computer and the internet connection or without internet connection [4]. In addition, to overcome the limitation of the internet, several CAI studies have proven to improve learning in student academic achievement [5], [6], [7], [8], [9], [10], [11], [12].

The implementation of CAI is always related to devices. Nowadays, students have more than one device to have attention. Portable communication devices e.g. laptop, PDA, and smartphone that connect to the internet are very helpful for learning activities. Currently, students prefer to use mobile devices than computer. Mobile devices increase the flexibility of learning and communicating [13]. Wireless handheld devices e.g. tablet, smartphone, laptop, and personal computer are always active to support students' academic activities, e.g. download material, watch the video, read the article, or answer questions [14].

This will provide convenience for students because students have high mobility, so that some portable devices become the choice as learning media. Have a lot of devices choice is very helpful for students to learn, yet it turns out with the many devices to be a new obstacle that appears in using CAI.

There is a time when students uses different devices and works on different tasks. The server receives new data and it will cause data loss from the previous device. If the data changes on one device, it requires updating all devices using a synchronization session [15]. Data synchronization is an operation where there is an exchange of data between two or more devices in such a way that all the similar data[16]. The task of data synchronization is to identify data changes, resolve possible conflicts and disseminate updates to various devices [17]. Thus, CAI module needs data synchronization to overcome data loss due to the use of multi-devices.

This research develops the synchronization technique to avoid unequal data when using two or more different devices at the same time. With the synchronization technique, each students devices have the most complete, the latest and same data. So that, the evaluation of optimal learning outcomes and the system is able to realize the concept of learning whenever, wherever use any tool.

2. METHOD
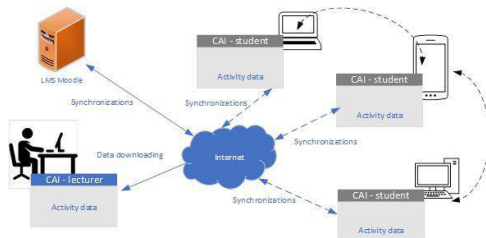
Figure 1. CAI architectural design.

The CAI network in Figure 1 shows that the correlation between the CAI module and Moodle server through the internet. Moodle Server is a college management system to help online learning [18]. There are two types of CAI modules, lecturer runs monitoring modules and students who run learning modules on various devices. Every student can run the learning module on several computer and mobile devices, regardless of the sequence of tasks. Besides, one of the important characteristics of CAI is that it runs learning even though it is offline. During offline position most likely the data module is different with data stored in LMS. This condition causes by learning activity data stored in various places with different data sequences. Yet, each lecture evaluates, there must be one of the most complete, the latest and the same data. System requirements need data synchronization process. The synchronization process will run at the beginning of the module and every time there is a change of data. The identification of data exchange is between module and LMS based on students' ID.

There are two processes while using CAI module, i.e. registration process and synchronization process. When students use a new device, they must download the CAI module from the server, then do the registration process by entering their name, id number, and password. Before students save the data in the local device, the CAI module matches the data in the server. If students send the correct data and they register as participants, the data is valid. Students do not have to re-register when using the CAI module continuously because students' device keeps previous data.

After the registration, students can use the CAI module to learn the material that saved in it, include complete the task. Learning activities can run both online and offline, anytime, anywhere and use any devices. Also, the lecturer can check what activities the students has carried out and as far as students understand without having to meet each other.

The synchronization process occurs anytime when there is a change in activity data, if the students reads the material then the local device will save the activity data which means there is a change in data. Likewise, other activities e.g. answer the questions or have communication with lecturers. Scores and activities are always stored in student devices which means that there is also a data synchronization process. The initial synchronization process is reading activity data on the server, then synchronizing will compare this data with the data that is on the student device. If there are data differences whether the date, assignment name or score, the synchronization process occurs. After completing the synchronization process, the CAI module will update the data in the server and the local device.
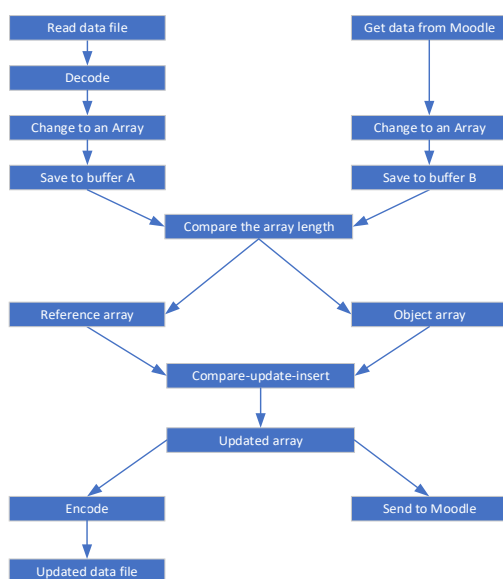
3. SYNCHRONIZATION CONCEPT

This synchronization, concept requires data format that has the unique structure as shown in Figure 2.

Module Name	Student ID	Student Name	Module Status	Latest Date	Activity 1	Score	….	Activity n	Score

Figure 2. Data format.

CAI stores data in form of the text file that has encoded. First, data format is the name of the course. Second, students ID number. Third is name of students pertinent. Fourth, the status of students. Fifth, the date of the assignment has submitted. Sixth, the tasks that have been done. The last, score obtained after completing the tasks.

Figure 3. Synchronization concept.

Figure 3 shows that the flow of the synchronization process. The first step download data from Moodle and read data stored in the local device, the synchronization process is basically the process to compare the contents of these two data [19]. CAI system uses the technique of sending data as soon as possible, meaning that the CAI module always sends the result of data synchronization to Moodle when students have finished working on an activity. The CAI module specially designed for lecturer, CAI module of lecturer can download data from the server for the evaluation process and to determine the type of learning treatment. There is no synchronization process in CAI module used by lecturer.

Buffer stores data from Moodle and data from the device. Both of data are still in the form of text. It needs to change an array form so that it is easy to compare it. Then the result array stores the results of the comparison.

The comparison process begins by measuring the length of each array. There is a possibility that both have the similar or different length. Longer arrays become reference array and shorter ones become array object. If the array length is the same, then the data takes the reference array from Moodle. The comparison process is a repetitive process with the number of repetitions equal to the length of the reference array. The system will compare each content of reference array with object array and many-to-many relations. If the comparison process is complete, it will repeat the process once again by setting the reference array to be an array object and the result array as a reference array.

The principles of comparison that used in this synchronization process are:

1. Comparison process is only for contents of index with similar assignment name.

2. If it is not found, so the contents of index will be the result of comparison.
3. If the comparison result shows both tasks have the same score, take one as result of the comparison.
4. If the comparison result shows the different of task score, the highest score is taken as result of the comparison.
5. If you cannot find the task, then assign the name and score to the reference array as result of the comparison.

4. RESULT
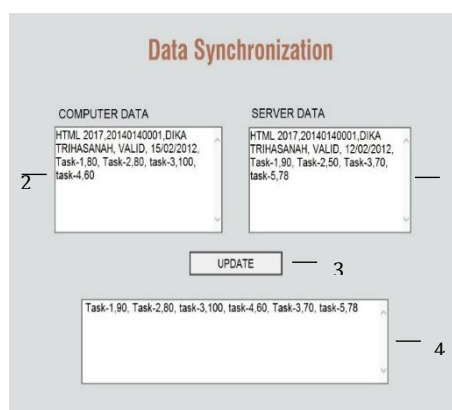
Figure 4. Synchronization data.

Figure 4 shows that the amount of data on the server is different from the data on the device that is being used. So, it requires a comparison of data between the computer and the server. Students work on tasks with the computer where before they used different devices. The result of data comparison produces new or array data.

Number 1, 2, and 4 use object library which is the text area useful for storing large amounts of text. As you can see that number 1 is the previous device data that has submitted then stored in the server. Then, number 2 is new or different device data of students that use to do the tasks. Number 1 and 2 have different data amount because the needs of students working on their tasks can diverse each time. Number 3 is the button to start executing data from server and computer. Number 4 is the result of executing the update button.

Servers and computers compare data. But there are some predefined data, so as it does not cause the data change, they are:

- Module name e.g. HTML 2017, which contains course what students learn.
- Students ID e.g. 20140140001, which contains students ID number that has determined by college.
- Students name e.g. Dika Trihasanah, which contains the identity of students who access the module.

- Module status e.g. valid or invalid, which contains information either students are valid or not to access the module.

Then unregulated data or data which can change when make comparison include:
- The latest date, useful to know the detailed time when students work on their tasks. In this case, as shown in figure 4 that date in the server is 12/02/2012 and in the computer is 15/02/2012 becomes date when the synchronization occurs e.g. 15/02/2012.
- Activity e.g. Task-1, to identify the tasks have been done. If the tasks are only in one of the devices, so synchronization is inserting the tasks. In this case, to test the insertion of tasks, I tried to add task-4 and task-3 to the computer which is task-3 have different writing with Task-3. As a result, we can see in figure 4 that data from the computer is successfully inserted with data from the server.
- Score, to find out how far the students' achievement is in carrying out the tasks given. If the task is in two devices, the results of assignment score are in a comparison and the result is the highest value among them. In figure 4 that Task-1 and Task-2 between computer and server have a different score, but the synchronization result is the highest score from Task-1 in server and Task-2 in the computer.

In figure 4 also shows the synchronization result has the same amount of data in the server and computer.

5. DISCUSSION
The initial purpose of this research is to make a synchronization system for CAI data. Thus, data loss would not occur if students change devices. Synchronization itself helps students and lecturer to remain aware of the authenticity of data. By using data synchronization, user can always use the same data even when using different devices [20]. So, the synchronization system solution, CAI-based learning can still run well even though students use different devices. Lecturer carries out monitoring activities are greatly helped with the synchronization process because they do not need to collect and process data. Lecturer simply observes the data as a basis for making an evaluation and providing help according to students learning problem.

According to the result of the experiment, synchronization carried out on devices successfully e.g. computer, laptop, windows tab, and Android smartphone. Using CAI, students are free to learn anywhere and anytime, whether there is internet or not. The ability of synchronization in CAI allows students to learn with any device without fear of losing data. Lecturers can also access with different devices to check the extent their students' achievement. Yet, when the synchronization process occurs, each learning devices must be connected to the internet.

6. CONCLUSION
The internet is very helpful for learning to be easy and it accesses with various devices. With various devices supported by adequate internet facilities, students and lecturers can learn anywhere. Yet, CAI does not restrict the students to learn either using internet or without internet. The synchronization process makes CAI running on various devices. To align data on devices and server, it is necessary to implement a synchronization system. With the use of CAI both online and offline, it helps students not only to learn anytime, anywhere but also with synchronization system, students learn to use any devices. Learning characteristic anywhere, anytime, and using any devices overcomes the uneven internet proliferation in Indonesia, and it is very convenient with students' second nature with laptop and smartphone.

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