

Information Education Using TA and CAI System

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Abstract

This paper describes new style of information education using TA and CAI system. The authors describes information education with TA to discuss about advantages and problems and then information education with TA and CAI system is proposed in this paper. CAI system called DA(Domain Application) for information education is explained in detail. DA assists students to learn in the exercise class and shares educational tasks for teacher and TAs. This paper describes the architecture of DA: system configuration and provided three learning environments. We are currently developing two DAs called DOSCOI (ms-DOS learning Computer assisted Instruction system) and FUN2 (FUNDamental FUNction of word processor). This paper also describes these systems.

1. Introduction

Information education has become more important and has been more widely practiced at educational institution, because information technologies have developed and it is thought that information system become the foundation of a highly information-oriented society[1, 2].

In the exercise class of information education, the teacher must deal with a lot of additional tasks such as managing exercise progress, answering student questions and monitoring learning status of all students besides usual instruction. The load of these tasks is very heavy. For this reason, a new class form in which several Teaching Assistants (TAs) assist the teacher becomes popular at many universities recently[3]. In this class form, TAs deal with some parts of teacher tasks. For example, they advise students who cannot understand the teacher instruction and guide students who have understood the instruction to stabilize their knowledge. As a result, the load of the teacher becomes light and s/he can deal with important and substantial tasks in this exercise.

The above-mentioned style is a good solution for reducing teacher tasks. As for TA assistance to students, it is known that TAs cannot assist students effectively when the number of students who need help highly in-

creases. To guarantee TAs to well-assist students effectively in such case, we propose introduction of CAI system into the class. We think the CAI should work to reduce the load of TAs and even teacher in the case. Based on this idea, we have been designing and developing CAI system for information education[4]. The CAI system consists of subsystems: DAs(Domain Application) and TAMALEARN (Teaching Assistant and coMputer Assisted LEARNING system). Especially, this paper describes DAs in detail.

This paper is organized as the following: In Section 2, we describe the outline of class with TAs and discuss the advantages and problems. In Section 3, we propose a new class form for the exercise of information education. In Section 4, we describe the architecture of DA based on its generality. In Section 5, we describe the prototyping systems. Finally, Section 6 summarizes the paper including future works.

2. Class with TAs

Recently, information education adopts a new class form in which a few TAs share teacher's tasks in order to reduce her/his load. This form becomes popular. We call this form "class with TAs" hereafter. In this paper, we consider the class form adopted in the exercise of information education. We suppose that the exercise consists of two phases:

- (1) Instruction by teacher to all students, and
- (2) Exercise with TA assistance.

Especially, we focus on the latter phase in this paper.

2.1 Form of class with TAs

Fig. 1 shows the form of class with TAs. After instruction by teacher described in 2.2, students can be classified into two groups. Student-As have not understood the instruction yet and Student-Bs have already done it. In the situation shown in Fig. 1, the teacher gives TAs the following requests:

- (1) advice for Student-As who need early help for understanding the instruction, and

(2) guidance for Student-Bs to apply the knowledge to high-level problems and so on

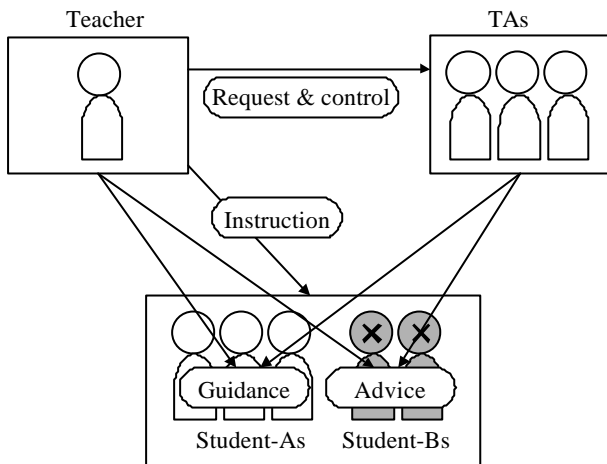


Figure 1 Class with TAs

2.2 Advantages of class with TAs

Compared with usual class style, the class with TAs has the following advantages in exercise:

- (1) The students can easily ask questions, because TAs always go students' rounds while doing exercise, and
- (2) TAs can well-recognize student knowledge status, because they can watch students at the close range. For this reason, TAs can advise and guide them more smoothly than the teacher.

These advantages also reduce the teacher load in the exercise class.

2.3 Problems of class with TAs

Focusing on the balance between the numbers of Student-As and Students-Bs, excessive increase of Student-As causes several problems in the following:

- (1) TAs cannot guide many Student-As at once because of the number limitation, and
- (2) Students-Bs cannot get advice from TAs while they guide Student-As.

In addition, general assistance process causes the following problem:

- (3) The time lag occurs before TAs start guidance and advice because they have to check current understanding status and learning flow of students.

3. Introduction of CAI system

There are several solutions to three problems of class with TAs described in 2.3. For example, increasing the number of TAs is one of simple solutions if possible. This solution is based on adding new instructor resource. On the other hand, we consider solutions based on utilizing existing things as instructor resource. We think computers used in exercise can be quasi-instructor and propose introducing CAI system in the class with TAs as the solution. In this section, we describe the class with TAs and CAI system.

3.1 TAMALEARN and DA

Considering the functions of CAI system in our proposed class form, we divide the system into two subsystems: a class management system called TAMALEARN (Teaching Assistant and coMputer Assisted LEARNING system) and a target domain depend CAI system called DA (Domain Application). Strictly speaking, plural DAs exist in the class form, because one DA only covers one target domain. If a student select a target domain, one DA for it works and other DAs are suspended while selecting the domain.

In the exercise of information education, TAMALEARN works on the teacher computer and DA works on the student computers. LAN connects all computers. The details of TAMALEARN are omitted in this paper (refer to [5] about them).

3.2 Form of Class with TAs and CAI system

Fig. 2 shows the form of the class with TAs embedded CAI system. The following are educational behaviors of DA:

- (1) DA answers the questions and generates drill problems in stead of TAs,
- (2) DA always monitors learning progress of each student so that it can show the learning progress to TAs,
- (3) DA sends learning progress data of each student to TAMALEARN, and
- (4) DA gets commands from TAMALEARN for assisting students and then it generates appropriate advice and guidance message.

TAMALEARN use the learning progress data to show learning status of all students to the teacher. Based on the progress data, the teacher can effectively navigate TAs move to students who need help.

3.3 Advantages of the proposed form

Focusing on the problems of the class with TAs described in 2.3, the following are advantages of our proposed class form:

- (1) DA can assist many students at once so that they do not have to wait for assistance such as advice and guidance while TA assist other students, and
- (2) The time lag before assistance by TA decreases.

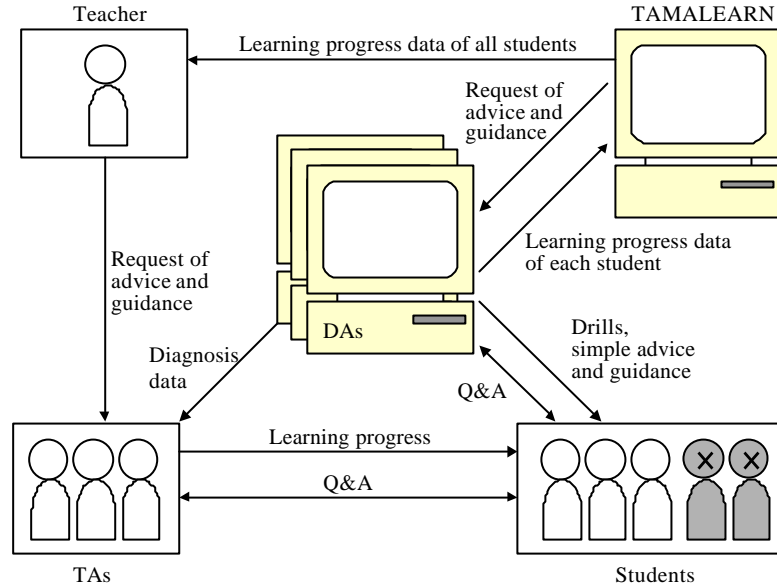


Figure 2 Class with TAs and CAI system

4. Domain Application

DA has the following educational functions:

- (1) DA provides students with three learning environments for each domain,
- (2) DA gives students drill problems and evaluates their answers,
- (3) DA gives students simple advice and guidance according to the result of the drill problems, and
- (4) DA answers frequently asked questions instead of teacher and TAs.

In this section, we describe three learning environments of DA and elaborate on the system architecture based on generality.

4.1 Learning environments

In general learning, students acquire knowledge and then stabilize the knowledge by solving drill problems and so on. Considering the learning process, DA should provide plural learning environment corresponding to each learning process. From this reason, DA provides a Learner Centered Learning Environment for knowledge acquisition and two System Centered Learning Environments for knowledge stabilization. We describe three learning environments in the following:

Learner Centered Learning Environment (LCLE):

This learning environment is mainly designed for students

who have little knowledge about target domain. Student-As also use this learning environment. In this environment, students can acquire target knowledge by trial and error.

System Centered Learning Environment I (SCLE I):

This learning environment is designed for intermediate students between Student-As and Student-Bs. They check if they have enough knowledge to go to next step. After checking their knowledge, next learning environment is indicated to them.

System Centered Learning Environment II (SCLE II):

This learning environment is only for students who intend to stabilize their knowledge. Student-Bs are belonged in this student group. The students solve the application drill problems to apply the knowledge in various situations.

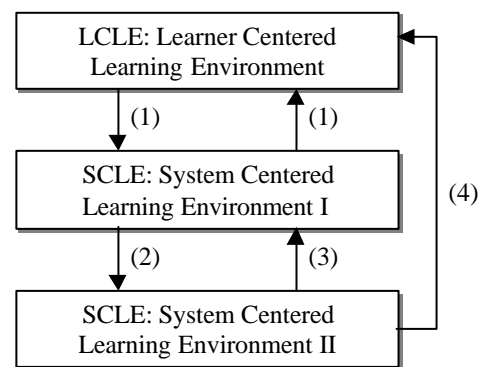


Figure 3 Learning environments

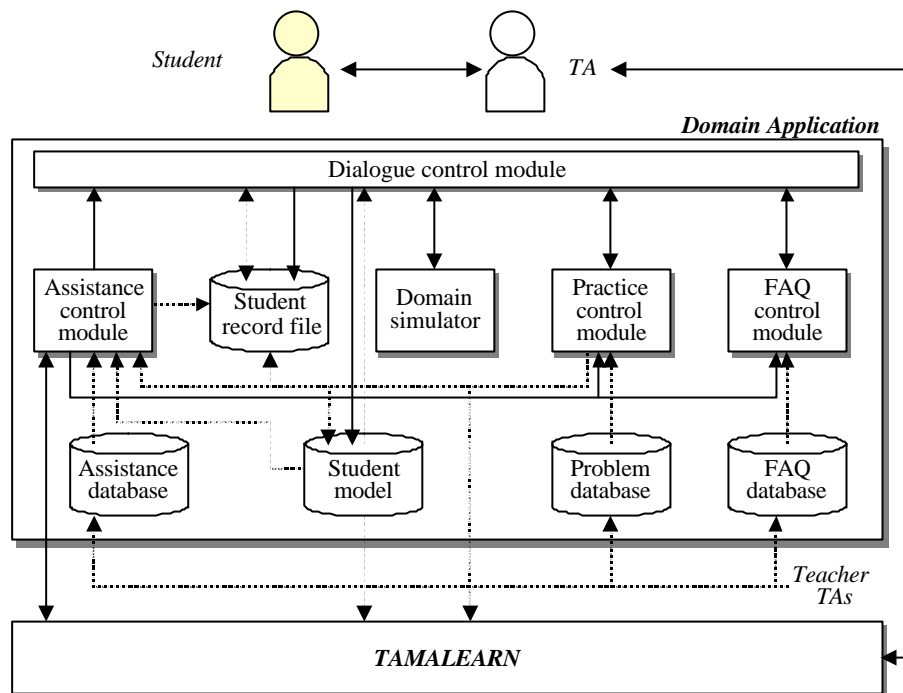


Figure 4 System configuration of DA

Fig. 3 shows relations among three learning environments. The arrow (1) shows that students can move freely between LCLE and SCLE I. If a student passes the drill problems in SCLE I, the system move her/him to SCLE II shown as the arrow (2). If the system judges that s/he cannot solve application drill problems in SCLE II, it moves her/him back to SCLE I or LCLE shown as the arrows (3) and (4). In addition, s/he can freely return to LCLE and SCLE I from SCLE II.

4.2 Configuration of DA

For covering various learning domains and topics, our proposed class form has to include a lot of DAs. It is easy to image that development cost becomes so much. As for time cost, it is well known that utilization of common modules in system implementation reduces developing time. Based on this idea, we extract common modules from DA architecture and classify modules and internal database of DA into domain dependent parts and domain independent parts. **Fig. 4** shows the system configuration of DA focusing on the viewpoint of domain dependence. When system developers implement DAs, they have only to domain dependent parts.

The following are domain dependent modules of DA.

Domain simulator: realizes DA interface to indicate learning materials.

Problem database: contains materials, templates and additional information for generating drill problems.

Student model: saves student knowledge status. TA and the Assistant control module use the model to identify the knowledge of students and then they can quickly find students who need help.

Assistance database: contains templates for generating assistance messages. The Assistant control module uses it in SCLE I and II.

FAQ database: consists of frequently asked questions and the answers. These are represented by hypertext. Student can freely search answers of her/his questions on DA.

The following modules are domain independent modules of DA.

Student record file: contains of learning actions of each student such as the list of drill-problems s/he solved, the answers and do on.

Practice control module: generates drill problem using the Problem database. This module also checks student answers and returns the results.

Assistance control module: generates assistance message for wrong answers using the Practice control module and the Student model.

FAQ control module: controls access of the FAQ database.

Dialogue control module: integrates all data sent from inner modules and manages interaction between DA and students.

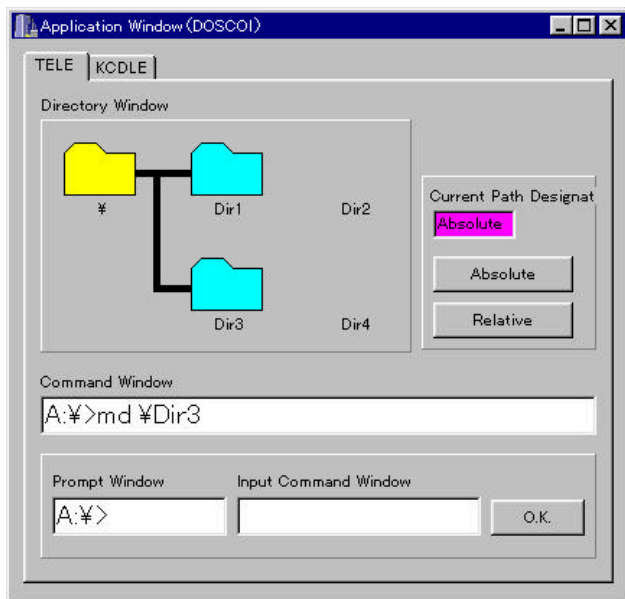


Figure 5 DOSCOI

5. Concrete examples of DA

We have been developing two DAs called DOSCOI and FUN2. We describe the outlines of DOSCOI (ms-DOS learning Computer assisted Instruction system) and FUN2 (FUNdamental FUNction of word processor) in this section.

5.1 DOSCOI

DOSCOI is a DA for learning command line operations. Students use it to understand making, deleting and moving of directories using commands such as MD, DEL and so on of MS-DOS. MS-DOS is originally CUI based OS. For this reason, it is not easy for students to image the operation results. DOSCOI displays the result of directory operation graphically shown in Fig.5. DOSCOI provides a direct manipulation interface wherein students can operate directory using only mouse. In addition, DOSCOI gives students drill problems. Students must input right commands for the problems in the Input Command Window.

5.2 FUN2

FUN2 is a DA for learning basic operation of word processor. We suppose that students have little knowledge about word processor. FUN2 aims that students understand basic functions of word processor and acquire skill for writing various documents using word processor. We extract common functions from representative word processors. Students can, therefore, acquire common knowledge which can be applied to a lot of word processors. The exercise style of FUN2 is the following:

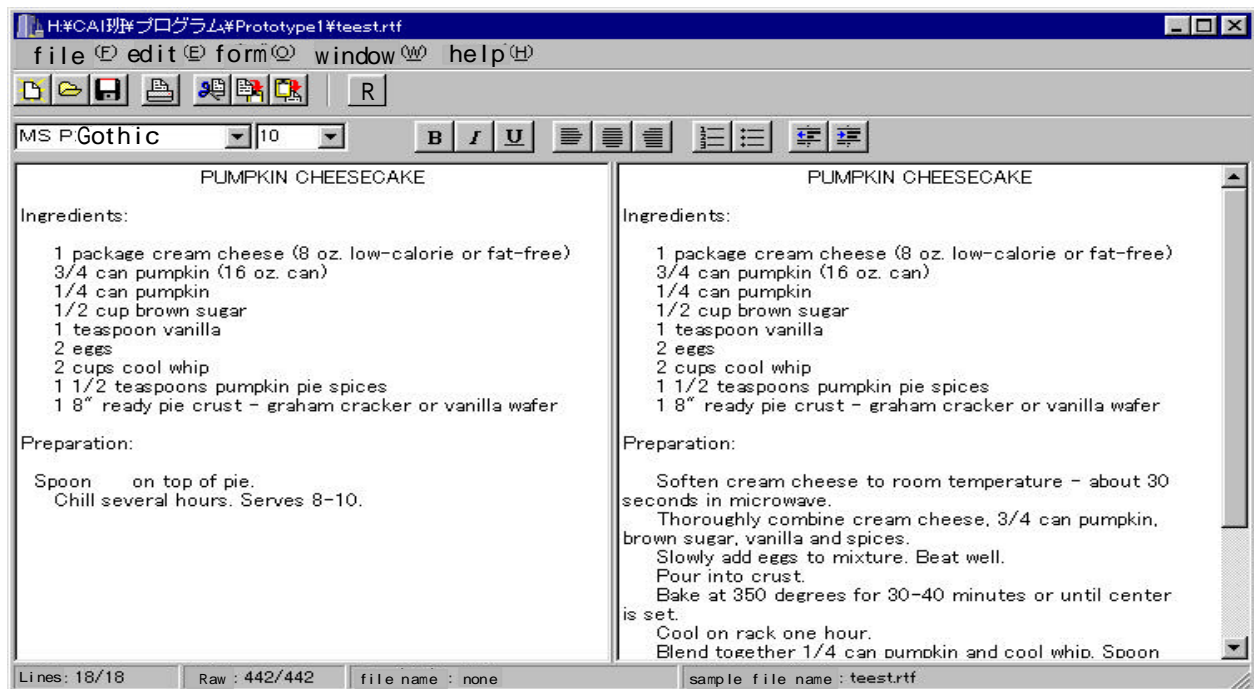


Figure 6 FUN2

Table 1 Learning environments of DOSCOI and FUN2

DA	DOSCOI	FUN2
Learner Centered Learning Environment	Trial and Error Learning Environment	Trial Learning Environment
System Centered Learning Environment I	Knowledge Confirmation Drill Learning Environment	Basic Drill Learning Environment
System Centered Learning Environment II	Knowledge Stabilization Drill Learning Environment	Application Drill Learning Environment

- (1) FUN2 displays a model sentences as exercise problems to a student,
- (2) The student writes same sentence with referring the model sentence, and
- (3) FUN2 checks the sentence and indicates right and wrong parts.

FUN2 gives various kinds of model sentences. **Fig. 6** shows the interface of FUN2.

5.3 Three learning environments of DOSCOI and FUN2

We designed DOSCOI and FUN2 under the guideline of DA architecture described in 4.2. For this reason they have three Learning environments. We describe the learning environments of DOSCOI and FUN2. **Table 1** shows correspondence of learning environments between original DA architecture and implemented systems.

DOSCOI has the following learning environments.

Trial and Error Learning Environment (TELE): Students can freely manipulate MS-DOS directory to acquire knowledge about directory operation.

Knowledge Confirmation Drill Learning Environment (CDLE): Students check their knowledge acquired in TELE.

Knowledge Stabilization Drill Learning Environment (SDLE): If students clear given drill problems in CDLE, they can move to SDLE. They solve application drill problems to get skill to apply the knowledge in this environment.

FUN2 has the following three learning environments.

Trial and Error Learning Environment (TELE): Students can learn how to use word processor through operating simple text window with basic word processor functions. As a result, they know names, usage and effects of the functions.

Basic Drill Learning Environment (BDLE): Students check the above mentioned knowledge about basic functions of word processor.

Application Drill Learning Environment (ADLE): If students clear drill problems in BDLE, they move to ADLE. They solve application drill problems to get skill for writing practical documents.

6. Summary

This paper proposed a new form of class with TAs for information education. In the proposed form, CAI system is introduced as instructor resource. Next, we described architecture and features of the CAI system. Especially, this paper elaborated on the architecture of Domain Application focusing on the generality. Then, we have already developed of two Domain Applications shown in **Fig. 5** and **6** based on the architecture. In this way, we finished analysis on the target problems, proposal of the solution and system prototyping based on the solution. As for feature works, we put emphasis on the following points:

- (1) investigation about change of time cost by utilization of common modules in system development,
- (2) computer simulation of behavior of teacher, TAs and students in our proposed class form, and
- (3) evaluation of system performance at real class of information education.

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