WATCMI - THE WATERLOO COMPUTER MANAGED INSTRUCTION SYSTEM

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ABSTRACT

This paper describes the features and capabilities of a new computer-assisted instruction system which operates using APL PLUS via standard interactive terminals. The design criteria for the system are presented together with a full description of the major sub-systems which comprise WATCMI. In its present form, the latter consists of a Student Assistance Programme (SAP), an Author Assistance Programme (AAP), and an authoring language. The SAP is used to assist students who wish to interact with instructional modules on the WATCMI system. The AAP provides assistance in the creation, deletion and editing of instructional modules. It also provides facilities for examining student performance records and student comments. Instructional modules are created in a special authoring language which is relatively easy-to-learn. Illustrative examples of the use of the WATCMI system are provided in the paper.

WATCMI (WATERLOO COMPUTER MANAGED INSTRUCTION SYSTEM) - SYSTÈME D'ENSEIGNEMENT À L'AIDE D'ORDINATEURS

ABRÉGÉ

Le présent mémoire décrit les caractéristiques et capacités d'un nouveau système d'enseignement à l'aide d'ordinateurs qui utilise APL PLUS par l'intermédiaire de terminals standard à action réciproque. On y trouve les critères de conception du système ainsi qu'une description complète des principaux sous-systèmes comprenant, entre autres, WATCMI. Sous sa forme actuelle, ce dernier consiste en un programme d'aide aux étudiants, en un programme d'aide aux auteurs et en un langage de composition. Le programme d'aide aux étudiants permet aux étudiants qui le désirent l'interaction avec les modules d'enseignement dans le système WATCMI. Le programme d'aide aux auteurs favorise l'établissement, la suppression et la préparation de modules d'enseignement; il permet également d'examiner les dossiers de rendement des étudiants et les remarques de ces derniers. Les modules d'enseignement sont créés dans un langage de composition spécial qui est relativement facile à apprendre. Des exemples de l'utilisation du système WATCMI sont donnés dans le mémoire.

WATCMI - THE WATERLOO COMPUTER MANAGED INSTRUCTION SYSTEM

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INTRODUCTION

This paper describes the features and general capabilities of a new computer-assisted instruction (CAI) system called WATCMI (for WATerloo Computer Managed Instruction) which operates via interactive remote terminals. At present, it is estimated that there are over 60 different languages available for CAI[1][2] and thus it seems important to clearly state the reasons underlying the development of yet another one.

Recently, some CAI research has been focussing attention on the difficulties which confront course authors who have little or no previous computer programming experience[3]. The ratio of course preparation time to student consumption time (currently estimated to be in the range from 20:1 to 200:1) gives one quantitative indication of the effort required of course authors in their task. It is also an indication of the reason why many potential course authors are not coming forward to add their thoughts and ideas to the field of CAI. Without these important inputs, CAI is in danger of remaining under control of computer specialists and a few dedicated educators and thus will not rapidly grow in the directions which will promote widespread adoption.

It has been amply demonstrated that the present state of computer and terminal technology can provide CAI systems which are sophicticated and exciting. The University of Illinois PLATO system[4] and the Mitre Corporation TICCIT system[5] are but two examples. This technology must, of course, continue to be developed but attention must also be given to the problems of the accessibility of CAI to educators who are more interested in their role as teachers than in their possible role as users of a new technology. Moreover, instructional programs and course material will not be subject to criticism and careful review until more educators are participating actively in CAI even at an elementary level.

The WATCMI system described in this paper is certainly not put forward as a proposed solution to the problems alluded to in this brief introduction. It has, however, been created with these problems very much in mind.

WATCMI DESIGN CRITERIA

The design criteria for the WATCMI system included the following:

1. The system should be relatively simple for students and course authors to use and should not require either to have a capability in or, in fact, a knowledge of any general interactive computing language such as APL, for example.

2. The system should be implementable using standard hardcopy or CRT computing terminals.

3. The system should minimize data storage by separating the course material from the operating software and should also permit the construction of variable length instructional units.

4. The system should provide the "standard" capabilities found in other CAI/CMI/CAL* systems of the stimulus-response-feedback type.

5. The system should be modular and open ended to facilitate changes and additions for special applications. It should also permit each course author to have his own version of the system in order to suit his particular needs.

All of the above general criteria have been met by the WATCMI system. Several experimental courses in a number of diverse areas have been programmed and are currently being evaluated. Some of the course material in the WATCMI system at the present time has been implemented by educators with no previous computing experience.

ELEMENTS OF THE WATCMI SYSTEM

Figure 1 provides a schematic overview of the WATCMI system which at present is implemented using APL PLUS.

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* CAI - (Computer-Assisted Instruction)
CMI - (Computer Managed Instruction)
CAL - (Computer-Aided Learning)

Neither course authors or students are required, however, to have any knowledge of APL.

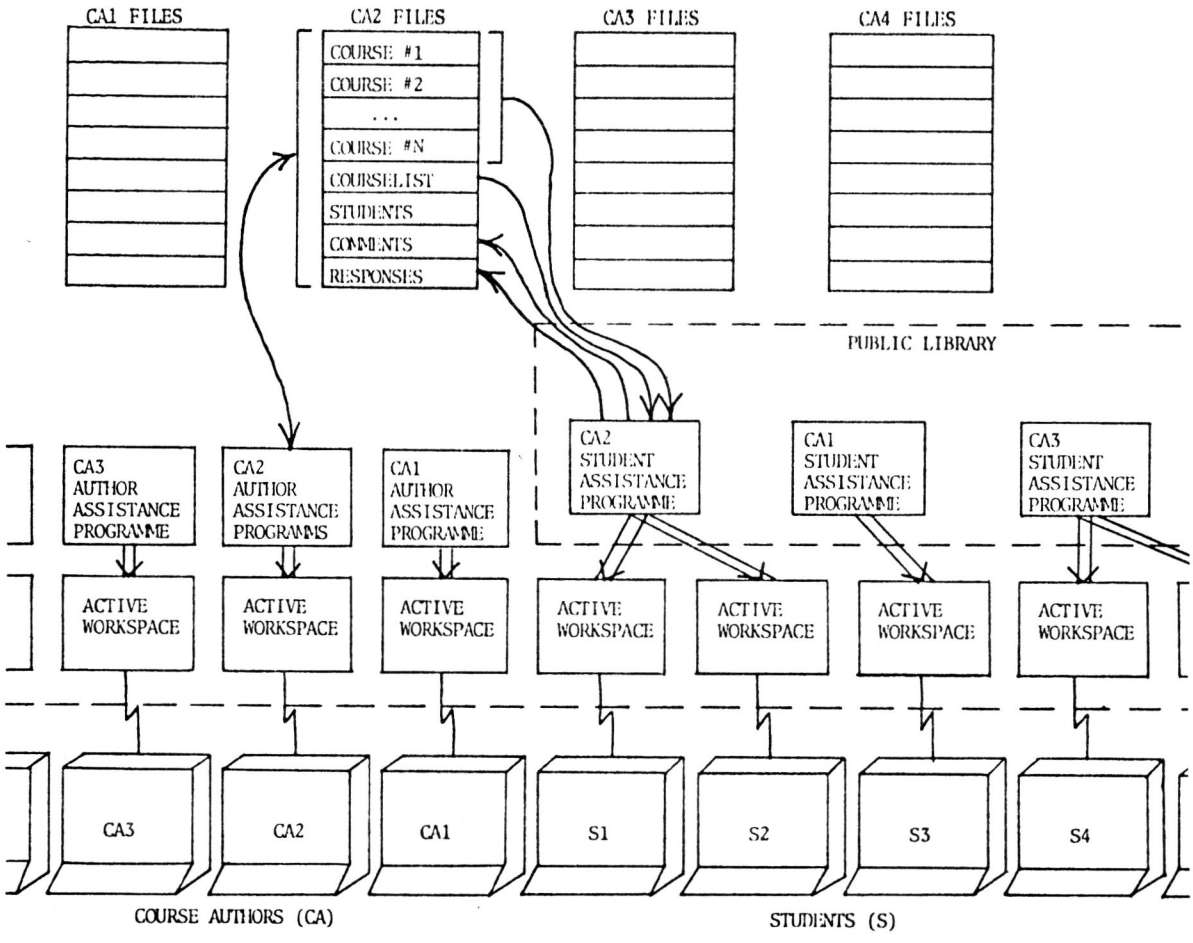

FIGURE 1: OVERVIEW OF THE WATCMI SYSTEM

Students communicate with the system via remote interactive terminals under the guidance and control of a student assistance programme stored in one of the APL Public Libraries. Course authors are assisted in the creation, editing and listing of course material and files by their own personal author assistance programme. Course material is stored in APL PLUS files together with four other file types:

1. A COURSELIST file which lists all courses presently available for student use and also serves as a noticeboard for the students.

2. A STUDENTS file which contains the students' identification numbers, names, etc. This file is updated to indicate the date and score obtained whenever a student uses any course material.

3. A COMMENTS file for storing students' comments on the course material at the end of each terminal session. This facility provides a feedback route on the system from student to course author.

4. A RESPONSES file which keeps a detailed audit of each student's responses as he uses the course material.

The file security features of APL PLUS are retained to prevent course authors from interfering with each others files inadvertently and to subdivide the available courses into convenient subgroups for student use.

THE STUDENT ASSISTANCE PROGRAME (SAP)

The SAP is provided to assist students who wish to interact with course material on the WATCMI system. Under the guidance and control of the SAP, the student can obtain lists of available course material and any messages from his instructor, can identify himself by number and obtain one of the courses for his use, can record his comments on a course for later perusal by his instructor, can obtain information on his performance during a terminal session, etc.

The standard SAP contains four basic functions which are invoked simply by typing their name followed by RETURN. These functions are:

RUN - to start a terminal session and get general directions (if required).

COURSES - to obtain the list of available courses and any messages from the instructor.

INSTRUCT - to access a course.

EXIT - to end a terminal session.

There are two additional functions which can be used by a student while he is using a course. These are:

STOP - to stop the course before the end. In this case the system assigns the student a restart number so that he can continue the course from where he left off in a subsequent session if he wishes.

RESULTS - to provide the student with an output of his performance record since the start of the current terminal session. After this output, the course is resumed.

THE AUTHOR ASSISTANCE PROGRAMME (AAP)

The AAP is provided to assist course authors in the creation, deletion, editing and listing of course material in the WATCMI system. It also provides facilities for examining and updating student performance records, listing student comments on the course material, and preparing notices for students to be stored in the COURSELIST file.

A typical AAP contains the following seven functions which are invoked by entering their name followed by RETURN:

DESCRIBE - to obtain general information on the capabilities and functions in the AAP.

WRITE - to input course material interactively or to initialize the STUDENTS and COURSELIST files.

MAINTAIN - to edit files. i.e. to empty or erase a file; alter the file size allocation; replace, add, or edit WATCMI blocks and file components.

SHOW 'filename' - to list a file or a portion of a file.

FILELIST - to obtain a list of all file names associated with the AAP being used.

RELEASE 'filename' - to release a course file for student use.

CLOSE 'filename' - opposite of RELEASE.

Figure 2 shows a course author creating a new course on the WATCMI system during a terminal session by interacting with the Author Assistance Programme.

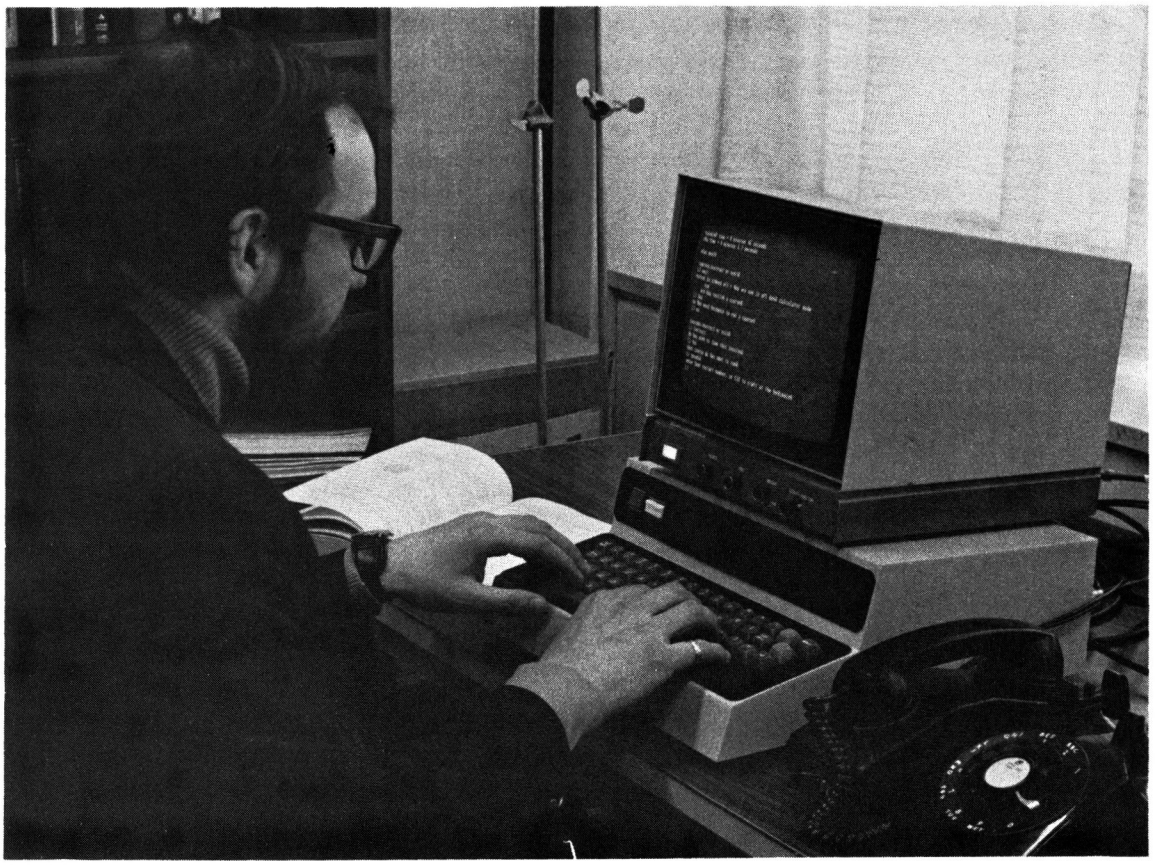

Figure 2: COURSE AUTHOR USING THE AAP TO CREATE A NEW COURSE

THE WATCMI AUTHORING LANGUAGE

Course material for use on the WATCMI system is created in a special block-oriented authoring language which provides a relatively easy-to-learn way of converting a rough flowchart of an instructional module into machine understandable format. Most course authors can learn the authoring language in a few hours and then begin creating course material via an interactive terminal under the guidance of the Author Assistance Programme.

Table 1 provides a summary of the block types currently available in WATCMI with a brief description of their function. The symbols N, N1, N2.... indicate block numbers, K1 and K2 are integer constants. Parentheses, ( ), are used to indicate optional information. A complete description of the WATCMI operating procedures and authoring language is contained in (6).

TABLE 1: SUMMARY OF WATCMI BLOCK TYPES

B L O C K T Y P E	D E S C R I P T I O N
BEGIN (N)	first block in each course
END	last block in a course (logical end)
MESSAGE (N) STIMULUS (N) FEEDBACK (N)	used to send textual information to the student
RESPONSE (N1),(N2) RESPONSET (N1),(N2)	used to determine if a student's response matches an anticipated response.
KEYWORD (N1),(N2) KEYWORDT (N1),(N2)	used to determine if a student's response contains an anticipated response.
GENERAL (N)	used to release the student so that he can use APL to calculate an answer before continuing.
BRANCHR N1,N2,N3...	used to access sub-sections of the course material in random order.
BRANCHS N1;N2,N3...	used to access sub-sections of the course material in sequential order.
CHECK N1,(N2);(K1),K2	used to monitor the student's performance and to alter the material presented to him accordingly.
OPEN CLOSE	delimiter blocks used to group several WATCMI blocks together to form a subroutine.

CONCLUSIONS

While the WATCMI authoring language is not as comprehensive as other existing languages such as CAN-6[7] or NATAL-74[8], for example, it has the advantage that educators who are not expert programmers can learn and use it easily. In this way they can obtain first-hand experience in the programming and use of computers for instructional purposes without the high initial investment of time to

learn a complex system and without the disadvantage of setting up and evaluating course material through an intermediary. Moreover, the usefulness of preparing course material interactively has been very apparent, particularly when this interaction is guided by a facility such as the Author Assistance programme.

The WATCMI system has been used by several user groups and at present there are a number of experimental course segments under evaluation in such areas as Human Systems Engineering, Physical Systems, Design Methodology, Mechanical Engineering Design, Population Dynamics, the use of WATCMI, Canadian Geography, and Primary School Remedial Mathematics.

ACKNOWLEDGEMENTS

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