

## THE USE OF WATCHMI TO IMPLEMENT A STRUCTURED APPROACH TO CAI COURSEWARE DESIGN

B.L. Wills and J.G. Wilson

Department of Systems Design, University of Waterloo

### Abstract

The basic and fundamental objectives of the WATERloo Computer Managed Instruction System (WATCHMI) have remained unchanged since the original 1973 prototype. These are to place in the hands of the front line educator a tool which enables him to generate CAI courseware himself without having to acquire any specialist programming skills.

The purpose of this paper is to illustrate how certain features available in WATCHMI permit overall course strategy to be planned in a structured manner. Three levels of courseware structure are recommended: a *module*, which contains material (*submodules*) on selected topics from the total area to be covered, and a *set* which links the component modules together into a suitable package. The result of this method of courseware organization is to further reduce the complexity of courseware development and implementation by dividing the overall task into smaller more manageable units.

## UTILISATION DU WATCHMI POUR ABORDER DE MANIÈRE STRUCTURÉE LA RÉDACTION DU LOGICIEL PÉDAGOGIQUE

### Résumé

Les objectifs fondamentaux du WATERloo Computer Managed Instruction System (WATCHMI) sont demeurés inchangés depuis la création du prototype initial en 1973. Ces objectifs sont de mettre à la disposition de l'enseignant avant-gardiste un outil lui permettant de créer lui-même un logiciel pédagogique d'EAO, sans qu'il n'ait besoin d'aucune connaissance spécialisée en programmation.

Le but de la présente communication est d'illustrer comment certaines caractéristiques du WATCHMI permettent de planifier de façon structurée la stratégie pédagogique globale. Trois niveaux sont recommandés pour la structuration du logiciel pédagogique: un *module*, qui comprend la matière (*sous-modules*) de sujets choisis parmi l'ensemble de la matière couverte, et un *ensemble* qui établit le lien entre les modules de façon que l'on dispose d'un programme-produit approprié. Grâce à cette méthode d'organisation du logiciel pédagogique, il est possible de réduire davantage la complexité du développement et de la mise en application de ce logiciel, la tâche globale étant divisée en des unités plus petites et plus maniables.



THE USE OF WATCHMI TO IMPLEMENT A  
STRUCTURED APPROACH TO CAI COURSEWARE DESIGN

B.L. Wills\* and J.G. Wilson\*\*

Department of Systems Design  
University of Waterloo  
Waterloo, Ontario, Canada

The WATERloo Computer Managed Instruction System (WATCHMI) has been the subject of ongoing development work since 1973 when the original prototype system was designed<sup>1, 2</sup>. During this period, it has migrated through three different host computer languages to the current VSAPL and has spawned a parallel system known as WATEST<sup>3</sup>, which provides interactive examination and survey facilities.

The basic and fundamental objective of WATCHMI has remained unchanged since the original prototype was developed. This goal is to place in the hands of the front-line educator a tool which enables him to generate CAI courseware for his students without either having to go to programmers, or having to acquire comprehensive programming skills which are not normally part of his technical repertoire. The fact that the WATCHMI system is in the form of two discrete interpretive packages, and that each sub-module of courseware is a separate file, also serves to eliminate any necessity to become dependant on expensive **commercial** hardware/courseware packages and ensures that control of instructional strategy remains where it should be - with the instructor.

The preceding points have all been covered in other papers<sup>4, 5, 6</sup>, however one immediate result of giving the educator a CAI authoring facility is that he now needs some guidance in planning an appropriate courseware package to serve his needs. It should be emphasized, at this point, that WATCHMI has been produced by system designers not educational researchers. It is our experience, in responding to author needs, that the professional educator can define the instructional tactics, content and objectives for a specific sub-module of instruction and can define an appropriate sequence of these sub-modules for his students. This is implicit in an experienced educator's professional background.

---

\*Associate Chairman, Undergraduate Studies

\*\*Systems Analyst

We have found that the need for our consultative input and advice seems to fall into the following three areas:

1. Emphasizing for the novice CAI author the realities of an interactive dialogue system. This includes illustrating that a planned response strategy must be generated for all answers, not just for the correct answers. This requirement represents a significant departure from planning conventional class lectures, although it is a feature which is common to all CAI courseware design whatever the host system may be.
2. Advising the CAI author how to make optimum use of the WATCMI facilities in order to implement specific objectives in the instructional tactics.
3. Advising the CAI author wishing to generate a broad spectrum of material in a general curriculum area, how to plan and implement a suitable structure consisting of a *set* of *modules* each containing an appropriate group of *sub-modules*.

The first two items are areas where such support would be expected in a system of this nature. The third item, however, is more unusual. This is not to suggest that there is anything innovative about a planned structure of instructional modules per se. However the implementation of such a structure easily, automatically and interactively, is implicit in the basic design of WATCMI and the purpose of this paper is to illustrate how these basic features permit overall course strategy to be planned on a structured basis.

Analysis of a general and complete courseware package to serve a specific curriculum area suggests that it should possess three levels of structure. The lowest of these three levels is called a sub-module, (the basic unit of instruction), and consists of small units of pre-test, instructional strategy, drill and practice, post-test or evaluation material, as required. Sub-modules are grouped together appropriately into the next higher level structure, called a module, which covers a well defined segment of the material to be presented. Finally, a set of modules when linked together identifies the complete CAI course.

The novice CAI author can identify easily with the lowest level of structure and can usually generate usable material without much help, since this is where the detailed front-line instructional strategy is contained. However, a little material goes a long way and if the total instructional strategy is comprehensive and extensive it can become very complex and unmanageable. This is typical of 'complete' courseware packages and leads to an understandable reluctance on the part of educators to consider creating them in the first instance and/or updating them at a later date. It is this potential explosion of complexity that reinforces the modular, structured approach to courseware design. Conveniently, WATCMI provides the tools for structured design in a form which can be readily understood and used by the CAI author.

Our first response to an author is to get him to consider the overall curriculum area that he wishes to cover and to visualize it in modular form. This can then be organized on a diagram such as Figure 1 which consists of identified course modules listed in a master index. The basic presumption is that such modules are not interdependent and may be run in any order, subject only to the basic prerequisite knowledge level required for the curriculum area being covered.

This diagram now serves as a basis for expanding the structure so that each module is broken up into a number of sub-modules. These sub-modules contain the actual instructional material and pre-requisites can be defined with student progress being performance-dependent. At this point a diagram such as Figure 2 becomes most useful to the CAI author. From it, he can now plan his work around the pre-defined objectives of each box on the diagram, whether it be an index or a sub-module of instruction.

The fundamental WATCMI feature that makes structured courseware implementation possible is the fact that each unit of material generated by the CAI author using the author assistance package becomes a discrete file in the host system. Add to this a capability to construct a family of filenames having a common generic root but differing in the last two character positions which contain digits and we can now have up to 99 sections of a single course. Go one step further and provide facilities for reconstructing a filename based upon the user input of a section number and we now have a mechanism for getting from one file to another automatically, based upon interactive dialogue with the user. All these capabilities have been implemented in the WATCMI system.

The usual starting procedure for the author is to generate special course sections which function as module or sub-module indexes. These are identified syntactically as indexes in the WATCMI authoring language and usually contain one message block consisting of tabular information which lists the section number and content of further sections. The user then selects an appropriate next section and the system retrieves it automatically. The overall structure is thus linked together by what can be described as an interactive pointer system based upon displayed index information at various levels.

Once the structure has been planned, indexes and sub-modules can be generated in any order. The various indexes are written quite simply as further sections of the course and, if lengthy, can be presented to the student via 35mm slides using a random-access projector controlled by the author's defined strategy. The result is an effective and easy-to-use system which reduces the potential complexity of the overall courseware to a manageable level and makes it easy to plan the instructional content of each sub-module.

References

1. F.V. Crowley, M.A.Sc. Design Project, Department of Systems Design, University of Waterloo, 1973.
2. J.G. Wilson and B.L. Wills, "WATCMI Userguide for Version 4.0, Department of Systems Design University of Waterloo, October 1976.
3. A.C.H. Lai, M.A.Sc. Design Project, Department of Systems Design, University of Waterloo, 1976.
4. B.L. Wills, "WATCMI - The Waterloo Computer Managed Instruction System", Proceedings of the Fourth Man-Computer Communications Conference, Ottawa, 1975.
5. B.L. Wills, "An Interactive Dialogue Program Generator for Computer-Assisted Instruction", Proceedings of the 1975 Frontiers in Education Conference (IEEE & ASEE), October 1975.
6. M.W. Dowsey, "Easy Author-Entry Systems". A Review and Prototype", International Journal of Man-Machine Studies, Vol. 4, 1974, pages 401-419.

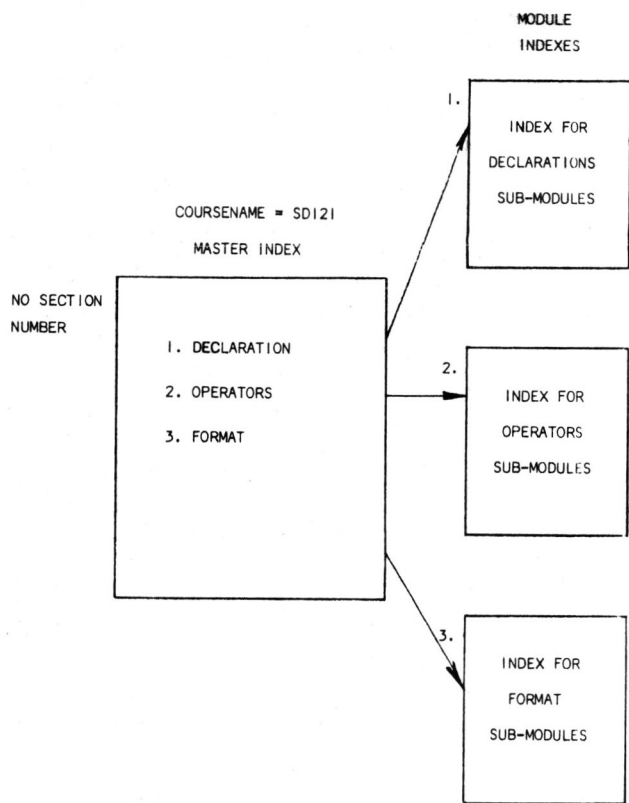


FIGURE 1

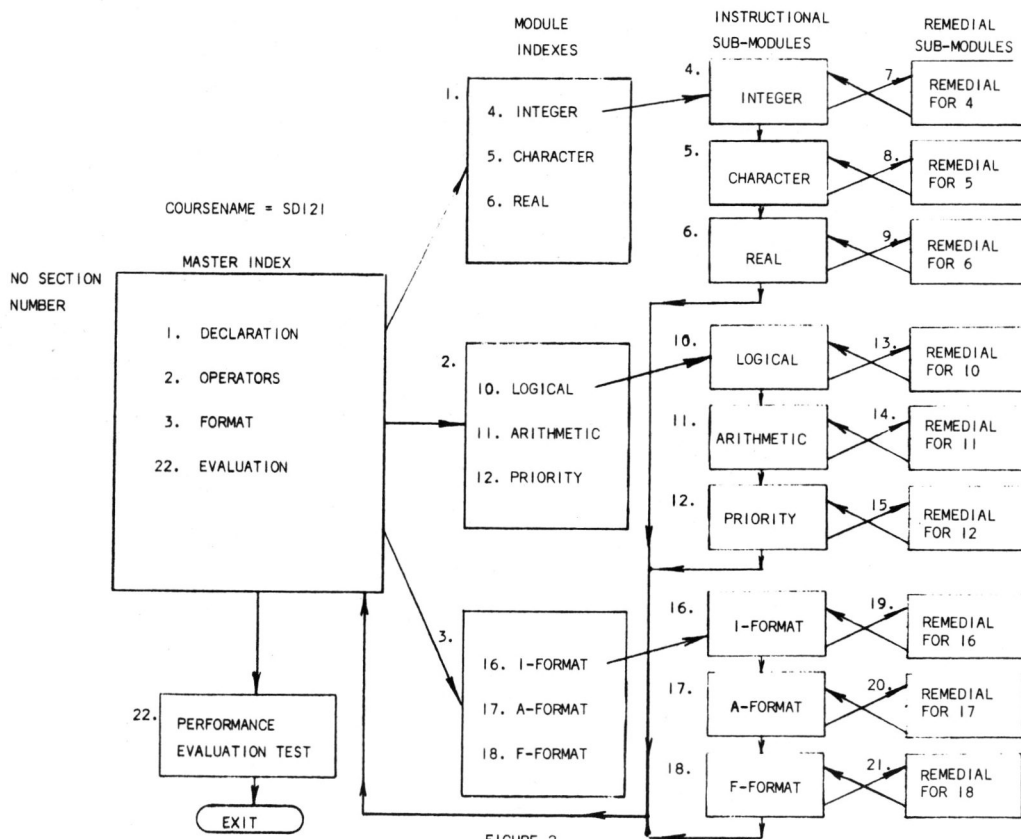


FIGURE 2