

*e-content, distance learning,
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THE INTERACTIVE E-CONTENT UNIT STRUCTURE AND ITS DISTRIBUTION CONDITIONS VIA WEB PORTAL

The paper concerns e-content characteristic features development to be used in Internet distance learning database. The elaborated e-applications development platform; Multimedia Applications Management Shell (MAMS) was elaborated for simplification of the application structure and for management of the unit. The MAMS platform works together with Quality Repetitions Unit (QRU) that controls the application flow and its repetition. Then, it produces the status of the application transmitted into the user personal data record. Both platforms provide the user with several standards, formats, objects and toll boxes used as an e-learning system library. The standardisation simplifies the application development and the application exploration. The defined standards are needed for Distance Learning System organisation that is at present under development at the University of Silesia.

1. INTRODUCTION

The Computer Aided Learning (CAL) systems allows us making the learning process flexible and smart, in accordance with well known principles of Programmable Teaching (PT) model that was formulated by Burke in 1982. The learning course runs in an individual schedule in the presentation content and in time of the lesson.

The pioneer works in CAL systems usage were defined by several frames of the CAL resources organisation and the lesson flowchart execution, well defined in couple of works, among them in Eberts, 1986 [1] and in Piecha, 1989, 1991 [3], [4]. The algorithmic way of problems solving and a multiple choice of the problem solution make the computer encouraging for e-learning units development.

Function of the lesson

The author of e-learning package has to consider the function of the lesson to distinguish all means, by which and what for the lesson is presented. This way several physical characteristic features has also be found as a pattern solution for the courseware solutions. They will determine a presentation subjects, according to a paper-pencil traditional screenplay.

The linear structure of the application is not satisfying the idea of a good guiding of the distance learning databases.

The interactivity of the application content brings the control unit with conditions establishing for several paths of the lesson selection. These interactivities are strictly combined with the question-validation system. This branching abilities control the application into the user individual needs, providing a personal learning experiences for every lesson.

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The literature brings several models of the interactive lesson structure [3] with Kay's strategy, the most flexible structure of programmable teaching unit, with several distinctly different levels of the available courseware.

The highest level of the application track is the shortest one, with modest set of explanations and complex questions. The lowest track of the application is the longest one, with many comments and interactions. Between these boundaries many additional lesson levels can be considered.

Organisation solutions

Problem orientation, concerns one of the most important aspect of Computer Aided Learning (CAL) unit structure. The orientation means that the user knows, at any time, when and why to go ahead or back. When the lesson's-run depends on additional comments means that the courseware was not properly oriented.

The *problem succession* defines fundamental techniques implemented for filling up a computer screen. How successive information layers are entered to the screen by the user. The automatic timing system is not recommended, as:

- duration of the CAL lesson can not be individualised,
- the application user can not control a lesson route,
- the "time competition" is very depressing for the user .

Screen format defines the courseware composition:

- textual information reduced to a minimum range,
- the screen display can not be overloaded,
- well-matched graphic forms, comments and animation.

Question system provides the application with high quality measures, judging the user responses and the repetition conditions:

- interacts with the subject,
- estimates distance to mastery,
- gives key measures for individual route through the lesson.

The e-content is presented on the computer screen in portions, of successive information layers. The final data screen, was called a frame; the smallest data unit of the lesson that was assigned with an identification index – j, in Fig.1 (branching index of the unit).

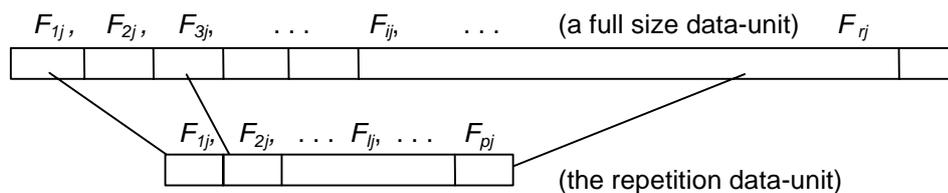


Fig. 1. The data frames of the lesson L_j^k relationship

Frame types

The e-content consist of two frame types: teaching frame and criterion frame.

The *teaching frame* contains all instructions given in the lesson unit, assigned by its unique identifier, to which the obtained score by criterion frames has its relations. After several teaching frames questions are given. The interactivities within the teaching frames are usually not validated.

The *criterion frame* contains questions or tasks, validated by the application engine. For the *criterion frame* construction several formats (protocols) have to be considered:

- *alternative responses* with multiple choice, the simplest question format. It gives very simple validation algorithm although high number of questions has to be given (for establishing the user knowledge stage).
- *response fill-up* format, where the application shows a part of the answer then a student is requested to fill up the remaining part of the frame. This protocol is carrying valuable data for validation unit. In sequence of questions the student's way of thinking can also be analysed.
- *one-way-choice* format within a sequence of answers, where the user selects the application path with several quality values.

2. THE E-CONTENT DEVELOPMENT MAIN STEPS

The screen play analysis

The application developer starts from the course screenplay analysis, for finding break points, where the course program can be divided into separate parts or group of problems. Then, these units are analysed from possibility of interactions (of putting questions and answers) and validation measures finding, as a fundamental engine of the application.

In programmable teaching principles defined in [3] two main classes of questions-answers formulation can be recognised:

- using an anticipated correct answers table,
- using an anticipated wrong answers table.

The interactions-results analysis, in majority of applications, uses the anticipated correct answers table. Although the answer is correct, with slight difference from the pattern, it is assigned wrong. That is why, for this choice the responses judgement has to be prepared very strictly, avoiding formal mistakes and remedial comments.

In case the anticipated wrong answer table is used for the conclusions making, the mistake is simply extracted. What is more, the mistake controls the remedial block of the presentation sequence. This way individual route through the lesson can easy be selected. Considering types of the lesson we can also distinguish several logical principles that govern the application, as *didactics* – where the student obtains information in small portions asked to do the elementary synthesis or manipulations with data.

Anyhow the portions of the data can not be reduced into the size where any synthesis will not be possible. The good example of this over gone limit concerns microlearnig, a recent distance learning extraordinary idea. The modern e-learning systems (computer based systems) have to be equipped with interferences that allow going to the conclusions.

The content development steps

The screenplay actions:

- key problems selection for lesson,
- separate units extractions,
- define the lesson functions,
- suitable criterion frame selection,
- a primary screenplay of the lesson,
- the interrupting forms and help layers definition.

The program part:

- work out a prototype program of e-learning unit with their control sections.

The revision part:

- make the initial revision of the application; developer-assistant student,

- improve all troubles making structures,
- check the program in small groups,
- make the validation in a full teaching cycle with group of students.

Verification:

- make the final improvement of the application.

The initiation part:

- write the lesson guide-book, for the user,
- write the lesson guide-book, for the teacher.

3. THE E-CONTENT EVALUATION

Evaluating the lesson

First step of the evaluation involves the application author (or an assistant) training with one student at a time, carefully observing the appearing problems. After it the lesson is redesigned as required, then a next review is done.

Field testing

The program is not considered as an eligible product until it is not empirically evaluated. It is done in field-testing with a sample of students who are representative for a future didactics. The evaluation concerns:

- relationship evaluation of the application to other curricula materials,
- the teacher's guide-book compatibilities to the e-content unit,
- the effectiveness of the e-unit usage (not a necessary condition).

The e-lesson effectiveness

Effectiveness of the e-lesson is a term used in scientific investigations. It is tiresome, expensive and long lasting procedure – anyhow it is strongly recommended procedure. In frames of pedagogical measures it is considered as a necessary stage in the evaluation processes.

For the effectiveness evaluation several methods can be used. In our experiments three of them were applied: pedagogical experiment, pedagogical tests and a supplementary form – active observation.

Traditionally, the effectiveness measurement is done by comparison of *two parallel working groups*. Taught by the e-lesson and for comparison by traditional methods. The group selection is done by an *initial test*. The selection gives equivalent groups in pupils' number and in their initial knowledge stage.

The duration of the lessons, the lesson program and the examination methods are the same. It would also be desirable that the courses in both groups are done by the same teacher.

After a full cycle of the course final tests have to be done. They consist of several questions (the most advanced - 20%) of the initial test and the final questions and tasks (80%).

The test statistics estimate the student's/ pupil's knowledge increase. After a short period of time (three or four weeks) repetition of the same check-up (*distance tests*) have to be done. These new statistics indicate the *knowledge persistence*.

The active observation is an evaluation method, was used for initial experiments then recommended for experiments with small e-lesson applications.

The e-lesson flow is also observed by the experienced teacher in time of any screenplay structure analysis.

4. THE APPLICATION PLATFORMS CHARACTERISTICS

Many works has recently been done within Internet services development; among them multimedia databases constructions, access laws, content protection and distribution principles.

Although many efforts have already been done in this field new challenge one can observe at present [5], [6], [7].

Number of interfaces needed to be used for a remote (terminal) usage of a mainframe databases. Complexity of database content implies an interface structure that makes possible to go through the data via sequence of questions, to extract a specified data part.

The e-lesson structure has to allow going through the application with the user knowledge current analysis.

Trying to find an adequate solution for the given principles the Multimedia Applications Management Shell (MAMS) has been elaborated. It is co-working with Quality Repetitions Unit (QRU) completing the interactions measures. These two platforms were made for e-content units standardisation working in Macromedia Authorware and Flash environment.

Complexity of these programming facilities makes troubles with these e-lessons development. Trying to find satisfactory characteristics of the application the CAL (Computer Aided Learning) model was chosen, working in frames of Distance Learning (DL) University.

The MAMS platform consists of two parts:

- the application development shell,
- the interactions unit quality judgment.

This platform allows:

- to unify applications structure,
- to simplify tasks for applications developer,
- to control the application repetition,
- improve the interactions quality analysis.

The e-learning unit organisation has been presented in Fig.2, where three machines were established:

- | | | |
|--------------|---|---|
| DLIE Server | – | Distance Learning Interactions Evaluation for QRU unit, |
| DLIE library | – | set of functions for client usage that link servers of the network nodes, |
| API for DLIE | – | the Application Programs Interface for DLIE server. |

The MAMS & QRU integrated platforms were made as a client/server application tool for all units coordination as it is indicated in Fig. 2. The client role plays the MAMS presentation platform where the server role plays the QRU. For data communication the TCP/IP protocol has been implemented.

The data transmission concerns a local-host address; after the user is identified the MAMS (client) starts execution of the programs in server.

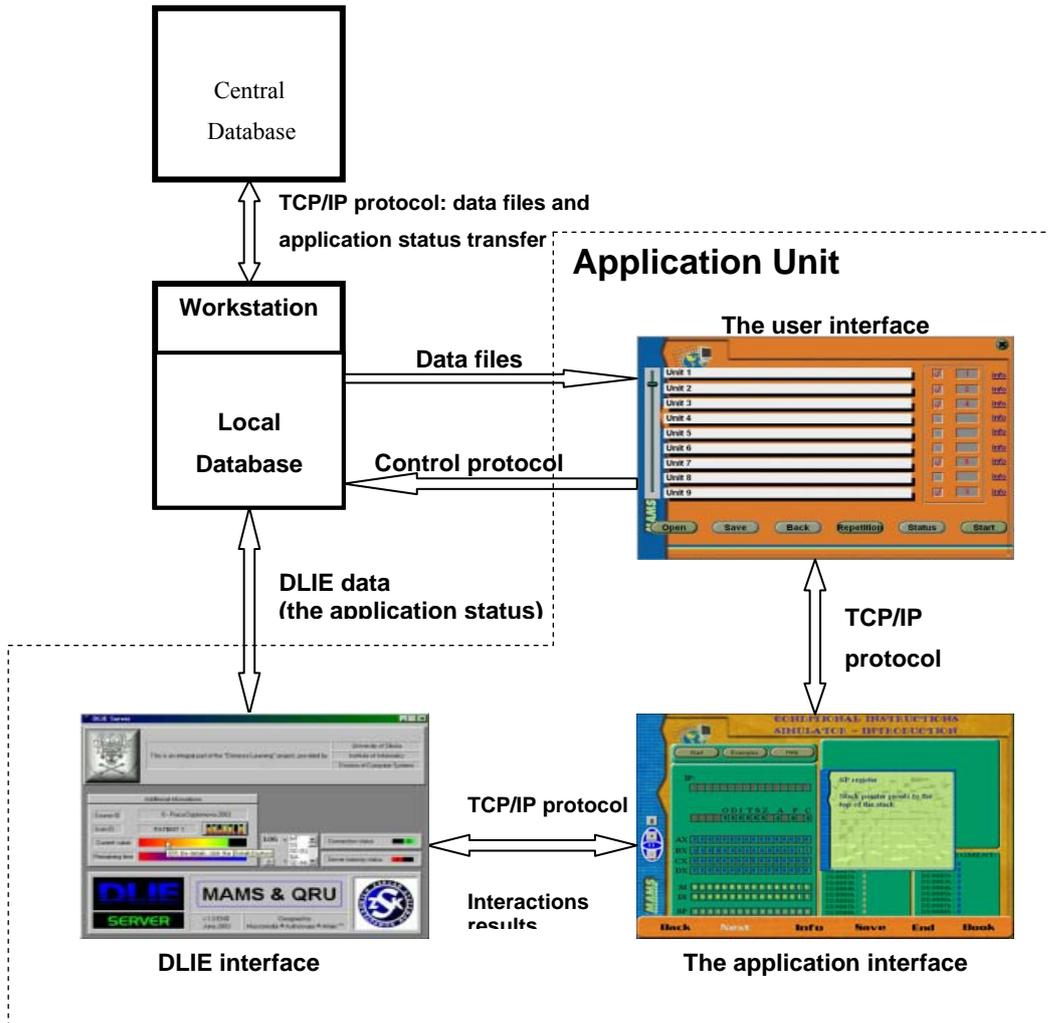


Fig. 2. The distance learning interfaces and organisation

The DLIE functions

The well done screenplay provides comfortable mechanisms for decision making solutions; in accordance with the user’s actions. They provide the user with:

- a nonlinear repetition mode, including presentation and question frames of the application,
- multi-level *Key’s* strategy implementation [6], [7] with flexible interfaces through the application.

The application start-up uses default screenplay settings, as a main path of the application execution. After the application is completed the QRU unit judges the interactions results, for controlling the application repetition content.

The nonlinear screenplay

The QRU allows defining the repetition cycle in a flexible way, where presentation frames are put into the selected sequence. What is more every answer can be provided by its own weight, with limited number of repetitions.

The answers are analysed in hierarchical way, with its fill-up format interactions – a fundamental structure of the answers analysis.

The judging unit distinguishes subsequent fields in the answer protocol. Each part of the answer is described by an adequate record, assigned by its unique identifier and its local weight.

Instead of binary value of the answer (usually applied in well known units) multi-valued measures have been provided.

The DLIE server analyses the answers using various measures and algorithms to combine the set of answers into a final statement.

The QRU engine is used for frames selection to the application repetition as the user interactions results control the selection process. Let us consider that the database consists of files-set containing courses (C^k) with several lessons L_j^k in each course [??].

$$^k = \bigcup_{j=1}^m L_j^k, \text{ where: } k \in K, K = \{1, 2, \dots, m\}, j \in J, J = \{1, 2, \dots, n\} \quad (1)$$

The ability of an individual path selection, within the application, means that several branches in the data file are available.

Each lesson L_j^k of the course k consists of selected frames F_{ij}^k linked into a sequence by the MAMS shell. The i index denotes the frame-number joined into the lesson L_j^k of the course C^k , where j denotes current number of the lesson.

$$\text{he lesson } L_j^k = \bigcup_{i=1}^r F_{ij}^k, \text{ where: } i \in I, I = \{1, 2, \dots, r\} \quad (2)$$

This way, the user chooses an own route through the main presentation and repetition sessions. The mentioned above data frames selection controls a question system (QRU) of the application.

The assumptions to the database composition are related to programming platforms used for the application development. For development process simplification several programming technologies have been involved in.

5. CONCLUSIONS

The paper shows several aspects of the e-lesson development procedures, with its complexity and validation processes. The application developer has to consider plenty factors of his works before the computer lesson will be assigned as a finished product. The e-content units have also integrated many interdisciplinary rules to achieve the final result.

Very important role in the Computer Aided Learning development processes plays the project manager, who has to be not only very experienced in computer programming but also in art of this very specific pedagogical regulations. The e-content frames with not satisfying results of interactions have to be assigned for repetition, defined number of times. Every answer value has also to be estimated by its own weight and number of eligible repetitions.

All the discussed solutions show are brief description only of efforts that have been undertaken at the University of Silesia, Department of Computer Systems, in the field of e-learning and distance learning technologies establishment.

Anyhow several steps towards the modern learning and teaching system within the Internet technology were successfully made. The Distance Learning Technologies Centre was established for distance learning technology implementation at the University of Silesia. Majority of works concentrate now on e-content development and evaluation; within our various research programmes.

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