

E-courseware Characteristic Features Implementation on its Content Development Platforms

Author:

Jan Piecha, Silesian University of Technology, Faculty of Transport, Informatics Systems
Department of Transport, Katowice, jan.piecha@polsl.pl

Abstract — *The paper concerns e-content characteristic features definition and analysis. They all have to be taken under consideration before an application development process is undertaken. They also have to be defined in case a developer wants to run the on-line application mode, within a distance learning environment. To fulfil the given goals several items of multimedia application management platform were discussed. They were defined for simplifying the application structure and for smooth control of the application unit. The example platform was combined with a specific unit of quality measures for the application's repetition, controlling the training progress and the repetition components. Finally, both units produce the status of the application, transmitted into the user's personal data record. The given ideas simplify both the procedures of e-learning units development and their control processes.*

Index Terms — *e-learning, e-content, e-courseware, distance learning*

INTRODUCTION

The algorithmic way of problems solving and a multiple choice of the problem solution make the computer encouraging for the e-learning technology implementation. The introduced Computer Aided Learning (CAL) systems regulations allow us making the programmable teaching and learning processes very flexible and intelligent.

The e-learning applications have to work in accordance with well known principles of programmable teaching models that were formulated by Burke in 1982 [1]. The learning course has to run in an individual schedule of the user's needs, both in the presentation content and in duration of the lesson. The pioneer works for Computer Aided Learning (CAL) systems defined several frame theories for electronic resources structure and for a computer lesson execution. Although, they were defined many years ago (in works as Eberts, 1986 [1], Piecha, 1989, 1991 [2], [3]) these fundamental solutions in today's e-content units are still not visible.

Functions

The author of an e-learning package has to consider functions of the lesson to distinguish all means, by which and what for the lesson is used. This way several physical characteristic features have also be found - pattern solutions for the courseware. They will determine a presentation approach and subjects, working in accordance with a paper-pencil traditional screenplay. The linear structure of the application is not satisfying today ideas of a good guiding, through databases located at remote computers of the distance learning technologies.

The interactivity of the lesson content brings the control unit with conditions establishing several possible paths of the lesson selection. These interactivities have to be strictly combined with the question-validation system. These branching abilities control the application into the user's individual needs, providing a personal learning experiences for every lesson. The literature brings several models of the interactive-lesson structure [3] introduced by Kay's strategy. It produces enough complex and flexible structure of the programmable teaching unit, with several distinctly different levels of a courseware. The highest level of an application track is a shortest one, with modest set of explanations and complex questions. A lowest track of the application is the longest one, with comments and interactions. Between these boundaries many additional lesson's levels (at least one) can be considered.

Organisation

Problem orientation, concerns one of the most important aspect of the 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 flow depends on additional comments means that the courseware was not properly oriented.

The problem succession is an item that defines fundamental techniques implemented for filling up a computer screen. And how successive data layers are put onto the screen by the user's actions. The often used 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.

The screen format, defines the courseware composition, with respect of:

- textual information reduction into a minimal range,
- avoiding a high data load on the screen display,
- properly balanced graphic forms, with well selected comments and animations.

Question system has to provide the application with high quality measures, judging the user’s responses and the repetition conditions, as:

- controlling interactions within the subject,
- estimating distance to mastery,
- giving key measures for an individual route selection through the lesson.

The e-content unit is presented on the computer screen in portions, of successive information layers. The final load of the data placed on one screen, was called a frame. It is the smallest data part of the lesson, assigned with an identification index – j, shown in Fig.1 (it is used for branching conditions analysis; indexing the unit’s parts).

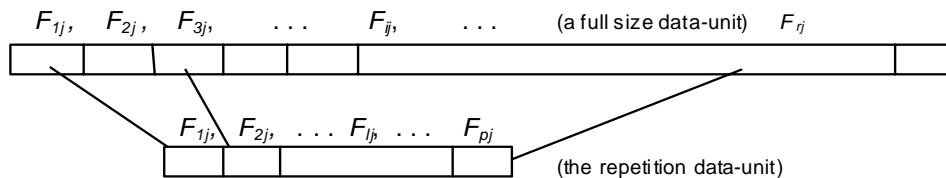


FIGURE 1
The data frames of the lesson L_j^k relationship

Frames

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, in the criterion frames has its relations. After several teaching frames the question frames are placed. The user’s interactions within the teaching frames are not validated. The **criterion frame** contains questions or tasks, validated by the application conclusions engine.

For the criterion frame construction several formats (protocols) have to be considered, as:

- **alternative responses**, with multiple choice, being the simplest question format that gives very simple validation algorithm, although high number of questions have to be provided (for establishing the user’s knowledge stage).
- **responses 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 that is assigned by several complexity levels.

THE APPLICATION CONTENT DEVELOPMENT STEPS

The screen play part

The application developer starts from the course screenplay analysis. Assigning break points, where the course program is divided into separate frames and group of problems; for extracting the courseware repetition unit. Then, possibility of the user’s interactions (questions and answers format) with validation measures are analysed.

Looking at the programmable teaching principles, with multiple choice answers table, one can find [3] two classes of formulas:

- using an anticipated correct-answers table,

- using an anticipated wrong-answers table.

The interactions-results analysis, in majority of applications, concerns 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 judgment has to be prepared very strictly, avoiding formal mistakes and remedial comments. In case the anticipated wrong answers' table is used, for the conclusions making method construction, the mistake is simply extracted. What is more, the mistake controls the remedial block of the presentation sequence. This way an individual route through the lesson can easily 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 the data. Anyhow the portions of the data can not be reduced into the size where any synthesis will not be possible (as in micro-learning). The modern e-learning systems (computer based systems) have to be equipped with interferences allowing to go to valuable conclusions.

The development steps recommendations

In majority cases the e-learning resources, available today on the market, are made behind any methodological principles. In case the application developer is willing to do a good product, the following fundamental recommendations have to be considered.

The screenplay actions, with:

- the courseware units extractions,
- the lesson's key problems selection,
- functions of the lesson's definition,
- criterion frames selection,
- a primary screenplay of the lesson's construction,
- interrupts with adequate remedial files definition.

The Program Part, for:

- working-out a prototype program of e-learning units, with their control sections.

The Revision Part of the e-content:

- making initial revisions of the application; developer-assistant-student,
- improving all troubles-making structures,
- checking the program in small training groups,
- making the validation processes in a full teaching cycle, with group of students.

Verification, for:

- making the final improvement of the application.

The Initiation Part, with:

- writing the lesson's user guide-book,
- writing the lesson's teacher guide-book.

THE PRODUCT CONTENT EVALUATION

Field Testing

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

The Evaluation Process concerns:

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

The Lesson's Effectiveness Measures

Effectiveness of the lesson is a term used in scientific investigations. It is tiresome, expensive and long lasting process, anyhow it is recommended action. What is more, in frames of pedagogical measures it is considered as a necessary stage in a didactics evaluation processes.

For the training effectiveness evaluation, several methods can be used:

- pedagogical experiment,
- pedagogical tests and a supplementary form – active observation.

Traditionally, the effectiveness measurement is done by comparison of **two parallel working groups**. One group is taught using the e-content and the group for comparison, by traditional methods. The group selection is usually 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 carried-on by the same teacher. After a full cycle of the course final tests are organized. 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 (so called distance tests) is required. The obtained final statistics indicate the pupil's **knowledge persistence**.

The active observation, is an evaluation method, used for the initial experiments. Also recommended for experiments with small, e-lesson groups and small applications. The e-lesson flow is observed by the experienced teacher in time of any screenplay structure analysis.

THE APPLICATION DEVELOPMENT PLATFORM CHARACTERISTICS

Many works has recently been done for an Internet services development. Among many of them several needs to be indicated, as: multimedia databases construction with an access and restrictions methods, the data base's content protection or content distribution regulations. Although many efforts have been undertaken, in this area, new challenge one can observe continually [4], [5], [6]. Number of interfaces are needed to plug a remote terminal into a mainframe databases. Complexity of this database implies an interface structure that makes possible to go through the content by sequence of questions, to extract a specified data part. The e-lesson structure has to follow the user needs; the user's knowledge level.

Trying to find an adequate solution for the given principles the Multimedia Applications Management Shell (MAMS) has been elaborated. It is co-working platform with Quality Repetitions Unit (QRU) completing the interactions measures and the user's training results. These two platforms were made at the University of Silesia, Distance Learning Technologies Centre for e-content standardisation, working in Macromedia Authorware and Flash environment (Fig. 2). Complexity of the content programming facilities makes troubles with e-lessons' proper development. For gaining satisfactory results the CAL (Computer Aided Learning) training model was implemented by these two platforms.

The MAMS platform was provided with:

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

The platform allows:

- unifying the application structure,
- simplifying the applications development,
- controlling the application's repetition,
- improving the interactions quality analysis.

The e-learning unit organisation shell product, has been presented in Fig.2, where three machines are distinguished:

- DLIE Server - a Distance Learning Interactions Evaluation for repetition measures (QRU),
- DLIE library - providing the developer with a set of client functions,
- API for DLIE - the Application Programs Interface for the DLIE server control.

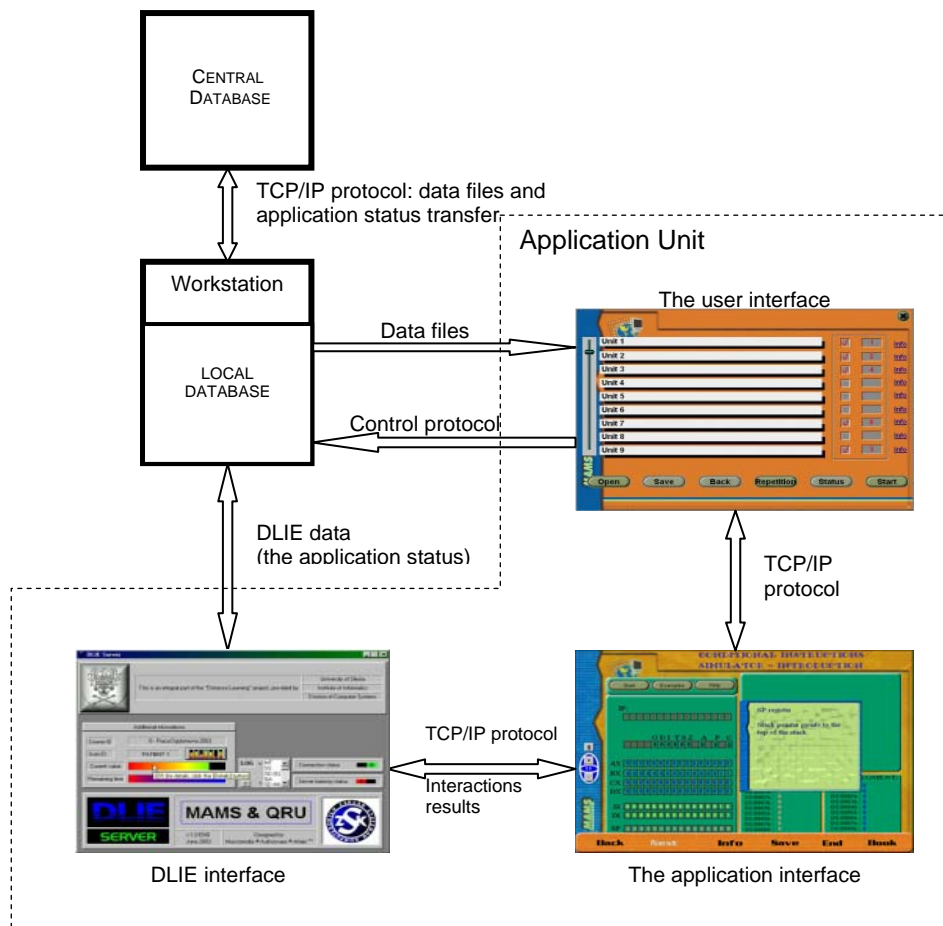


FIGURE 2
The distance learning system interfaces and organisation

The MAMS & QRU integrated platforms work in a client/server mode, supporting the application frames coordination (as indicated in Fig. 2). The client role plays the MAMS presentation platform, with the server of the QRU. For the network data communication units the standard TCP/IP or http protocols are available.

The DLIE Functions

The well done screenplay provides the application developer with adequate ideas of the decision making solutions; spotting the user's actions. They have to provide the application user with:

- a nonlinear repetition mode, including not only presentation but also satisfying question frames, within the application unit,
- multi-level (Key's) interactive course implementation [6], [7] with flexible interfaces guiding 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, 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, following their fill-up format interactions; it is a fundamental structure of the answers analysis. The judging unit distinguishes subsequent fields in the answer protocol [8], [9]. Each part of the answer is described by an adequate record, assigned by its unique identifier and its local weight. Instead of binary values of the answers description variables (usually applied in well known units) multi-valued measures were 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 the application frames selection to the repetition lesson, as the user's

interactions results control this 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.

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

The ability of an individual path selection, within the applications content, 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's-number joined into the lesson L_j^k of the course C^k , where j denotes current number of the lesson.

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

This way, the user chooses an own route through the main presentation and repetition sessions. The discussed above, data frames selection process is executed by the answers analysis system of the QRU.

The assumptions to the database composition are related to programming platforms, used for e-content development [10], [11]. For simplifying this development process, several programming technologies have been involved into.

CONCLUSIONS

The author is trying to draw the all complex aspects of the e-content development processes, with its various validation aspects. The application developer has to consider many factors of his works before the lesson will be accepted; as a finished product. The e-content units have to integrate many interdisciplinary rules to achieve the final result; before the product will be distributed on the market. Very important role in the Computer Aided Learning development processes plays the project manager, who has to be not only very experienced in programming but also in an art of multimedia applications development. These very specific pedagogical applications, with their various fundamental 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.

The discussed above solutions show a brief description of the efforts undertaken under the author's supervision (in majority case studies carried on at the University of Silesia, Distance Learning Technologies Centre), in the field of e-learning and distance learning technologies platforms establishment [6].

The MAMS platform

The MAMS platform provides the developer with a smooth control of the application flow. It is also a frame courseware that has to be installed before the application content starts running. This characteristic condition protects the application from illegal copying, as every new installation has to be confirmed by the training system operator, otherwise the application refuse working. Our distribution platform (USE-LMS) was provided with handshaking protocols transferring into the user's personal record many data, being a status of the application; controlling further conditions of the application's work. This way several remarkable steps, towards the modern Internet training system, were successfully made.

REFERENCES

- [1] Eberts R.E. Learning strategies in CAI design. *The International Journal of Applied Engineering Education*, No. 2/86, Oxford 1986.
- [2] Piecha J. The multilevel model for microcomputer ICAI systems. *The International Journal of Applied Engineering Education*, Vol.5, No 3/89, Pergamon Press.
- [3] Piecha J. Remarks to CAL systems designs. *Proceedings of the Int. Workshop "Computer Aided Learning and Simulation Technologies*. Prague, June 1991, pp.26 - 31.
- [4] Piecha J. The programmable shell for multimedia applications development. *Journal of Applied Computer Science*, Vol.7, No 2, pp.31-43, ISSN 1507-0360, Łódź 1999.
- [5] Piecha J. The Intranet Databases and some Approach Troubles into Multimedia Files. *Proc. Int. Conf. Computer Based Learning In Science - CBLIS'99*, Enschede, the Netherlands, 1999, G7.
- [6] Piecha J. Król R. (2004). The MAMS an interactive applications management engine. *Proc. of Int. Distance Learning Workshop' 04*. June 2004, University of Silesia, Katowice, Poland ISBN 83-909518-6-X pp. 25-37
- [7] Piecha J., Bernaś M., Interactions Validation Methods for Training Resources Control Engine Development, *Journal of Information and Organizational Sciences*, Zagreb University of, Technology, 2009. Vol. 33., No. 1, e-ISSN: 1846-9418, pp. 165-177.
- [8] Bernaś M., Piecha J., Remote Access into Virtual Web Laboratory - Application in Medicine, *Journal of Medical Informatics & Technologies* 2009. vol. 13, ISSN 1642-6037, pp. 91-96.
- [9] Piecha J., Bernaś M., Digital Control Systems Training On A Distance Learning Platform, *Transport Problems Scientific Journal*, Silesian University of Technology, 2009. vol. 4/3, ISSN 1896-0596, pp. 21-34.
- [10] Bernaś M., Piecha J., Web Databases Descriptors Defined By Means of Pseudo-natural Language Items, *Proc of Int. Conference on Computational Aspects of Social Networks*, Published by the IEEE Computer Society, Los Alamitos, USA 2009, pp 165-170.
- [11] Bernaś M., Piecha J., The Graph Descriptors of e-Content Unit Organisation And Controlling Features, *Proc of Int. Conference on Computational Aspects of Social Networks*, Published by the IEEE Computer Society, Los Alamitos, USA 2009, pp. 119-126.