A Flexible Model of the ICT Supported Educational Process

PETRA POULOVÁ, IVANA ŠIMONOVÁ, MILOSLOVA ČERNÁ, PAVEL KŘIŽ, PAVEL JANEČKA
Faculty of Informatics and Management
University of Hradec Králové
Rokitanského 62, 500 03 Hradec Králové
CZECH REPUBLIC
Petra.Poulova@uhk.cz http://www.uhk.cz

Abstract: Information technologies have become inseparable part of our lives. Currently, electronic services are being applied in numerous fields of social life where the area of education is no exception. The importance of technologies has got reflected in the process of education, the position of ICT got unsubstitutable. History of e-learning is in its second decade. Development of this phenomenon can be tracked from the quantitative phase to the qualitative phase. At the beginning there was a significant quantitative increase in eLearning services which were observed, at present phase qualitative factors are followed, mainly the effectiveness of the educational process. The process of instruction supported by ICT is considered suitable and beneficial for learners of all styles. The strength of ICT implementation in the process of education is in its flexibility. A wide range of activities can be created to fit various learning styles.

Key Words: Application, eLearning, ICT, LCI, Learning Combination Inventory, LMS, Learning Management System, learning pattern, learning style, teaching style, virtual learning environment.

1 Introduction

Information and communication technologies (ICT) have reached a substantial position in today's society. We can meet with them in numerous fields of human activities. Twelve years ago a new term appeared – eLearning. The term of eLearning (e-learning) arose similarly to other ones, which appeared in the last decades and relate to the Internet in various fields of human activities, e.g. e-mail, e-banking, e-commerce, e-business, e-book, by joining the word learning and prefix e-. The word learning covers all activities relating to the process of education, instruction, cognition and forming knowledge. The e- prefix is used as electronic equivalent of existing products or services. It indicates relation to Internet.

Putting the prefix and word together (i.e. prefix e - which means electronic, and learning, which covers the process of forming knowledge), another term arises which means a modern way of education using computing technology and appropriate applications, i.e. the educational process supported by information and communication technologies. [1] Large experience gained in the process of ICT implementation in education lately received has started new discussions. Instead of technical problems, new technologies and approaches the questions on the theory of learning and teaching styles are the topic of the day. They play an important role in the process of instruction, especially if it is managed by a Learning Management System (LMS). [1] LMS provide a wide range of tools available to authors of eLearning courses which can accommodate all learning styles, and students choose those activities which suit them best.

The process of instruction supported by ICT may become suitable and beneficial for learners of various styles. [2], [3] The reason is it offers a wide range of tools and activities which can be tailored to any learning style and used by any teaching style instructor. The possibility to individualize the educational process from the both students’ and teachers’ point of view belongs to valuable advantages of eLearning. [1]

2 Utilization of Modern Technologies to Support the Educational Process

Number of options offered by modern technologies generate new questions. Numerous educators face the problem whether the educational process which is supported or managed by ICT and tailored to the preferred student’s learning style is more efficient than if the learning style in not taken into account.

The answer to this question has been discovered within the project "A flexible model of the ICT supported educational process reflecting individual learning styles". The project is currently solved by a joint team of researchers from the Faculty of Informatics and Management and Faculty of Education, University of Hradec Králové, by specialists in informatics, educational science, didactics and psychology. [4]
The main objective of the project is to find out whether using ICT-supported methods of instruction which reflect individual learning styles results into a significantly higher level of students’ knowledge in comparison to the traditional, majority (i.e. non-individualized) way of instruction. The main evaluative criteria are the quality, meaningfulness, effectiveness and limits of ICT/LMS implementation in the instructional process considering individual learning styles, and present proposals to its optimal contribution and extent. [5]

3 Learning Combination Inventory

The project "A flexible model of the ICT supported educational process reflecting individual learning styles" proceeds from the assumption that it is important for a student to be aware of his/her learning style, know what his/her strengths and weaknesses are and be provided a variety of instructional methods to choose the most suitable ones.

In the field of educational science and psychology the theory of learning styles is properly worked on. There exists a wide range of tools to define individual learning styles.

The research team has decided to use the "Learning Combination Inventory" (LCI) by Christine A. Johnston. Johnston created her model on the principle of "unlocking the will to learn". [6]

LCI is a statistically valid and reliable instrument that measures the degree to which a person uses four interactive patterns of learning and operation. Johnston distinguishes four basic patterns:

- Sequential Processor;
- Precise Processor;
- Technical Processor;
- Confluent Processor.

The word combination in the name of the inventory is used because the author states each of us uses a combination of all patterns. Each of them participates in the individual’s process of learning to some extent, while some of them are preferred, others rejected. Some people prefer one pattern which other people reject, or they use more patterns, even all four ones.

Unlike other similar tools the LCI is easily and clearly evaluated. It consists of 28 closed questions supported by three open ones, which serve for verifying the determined patterns.

These were the most cogent arguments in the decision-making process which tool suits best to the project purposes.

4 The Questionnaire Monitoring Preferred Formats of Study Materials

In the first phase the project started with a pre-activity which aimed at detecting whether student’s choice of a certain type of study materials and tools is influenced by the detected pattern.

For this purpose a simple questionnaire consisting of nine questions was prepared where students defined their relation to following types of study materials:

- books and professional literature;
- electronic study texts;
- presentations;
- video-recorded lectures;
- animations;
- self-tests;
- hands-on tasks and examples
- other supportive materials, e.g. dictionary.

Students were asked to define what type of study materials they prefer when preparing for lessons during the term and studying for exams.

Single items were in the form of statements and evaluated by a five-degree scale, e.g. question N. 4:

4. If there exists a full eLearning support for the subject containing presentation, I used them:

- never
- hardly any time
- sometimes
- almost always
- always

The questionnaire was distributed during the summer term in 2009/10 academic year to 107 students of the Faculty of Informatics and Management, University of Hradec Králové, in study programmes Applied Informatics and Information Management, who also filled in the LCI. So, consequently mutual relations can be researched among single patterns and preferred types of study materials.

The received results proved some expectations. Today’s students seldom work with printed sources. Only 1% of students almost always buy the recommended books, one third (33 %) does this sometimes and two thirds (66 %) do not buy books at all. This fact could be influenced by the price. Nevertheless, similar results appeared in question dealing with borrowing printed sources which are available in university library. Only 7% of students borrow books regularly, half of them (48 %) sometimes and 45 % never or hardly ever borrow the recommended books.
As following responses show, today’s students mostly prefer electronic study materials.

In electronic courses various types of study materials are available, mostly in HTML format, presentations summarizing basic structure of the course, topic or subject, and some supportive tools, e.g. dictionary.

Vast majority of students (87 %) always and almost always works with electronic study texts, 10 % use them sometimes. Nearly all students (93 %) always and almost always use presentations of the topics. Other types of study materials (e.g. dictionary) are used in a considerably little extent. 42 % of students always and almost always use them and another 41 % sometimes.

In some eLearning courses animations, video-recorded lectures or case studies are available which make some difficult parts of learning content easier to understand.

The research proves these materials are used less than presentations or study texts. Animations are more frequently used; more than half of students always and almost always use them (53 %) if they are available. Video-recordings, which are more demanding to be prepared and can be found only in selected eLearning courses, are less popular among students. More than one third of students (38 %) never and hardly any time uses them, one third (33 %) sometimes and even fewer students (29 %) always and almost always work with them if they are available.

The value higher than 24 means student prefers the given pattern in his/her process of learning; the value between 18 and 24 means this pattern is tolerated, accepted without problems; and the value lower than 18 means student rejects the given pattern.

According to the results, students preferring the Sequential Processor prefer electronic study texts, books and professional literature, video-recorded lectures and presentations; they reject self-tests and other supportive materials, e.g. dictionaries.

Students preferring the Precise Processor work with books and professional literature, animations, examples, electronic study texts and other supportive materials, e.g. dictionary; they do not like video-recorded lectures.

Students preferring the Confluent Processor prefer books and professional literature and self-tests; they do not use electronic study texts, video-recorded lectures,
presentations and other supportive materials, e.g. dictionaries.

Table 1: correlations between types of study materials and patterns

<table>
<thead>
<tr>
<th></th>
<th>Sequential</th>
<th>Precise</th>
<th>Technical</th>
<th>Confluent</th>
</tr>
</thead>
<tbody>
<tr>
<td>Books</td>
<td>0.11</td>
<td>0.27</td>
<td>0.05</td>
<td>0.11</td>
</tr>
<tr>
<td>Borrow books</td>
<td>-0.01</td>
<td>0.34</td>
<td>0.12</td>
<td>0.22</td>
</tr>
<tr>
<td>El. study text</td>
<td>0.12</td>
<td>0.11</td>
<td>-0.18</td>
<td>-0.17</td>
</tr>
<tr>
<td>Presentation</td>
<td>0.01</td>
<td>0.01</td>
<td>0.11</td>
<td>-0.10</td>
</tr>
<tr>
<td>Video</td>
<td>0.09</td>
<td>-</td>
<td>0.20</td>
<td>-0.16</td>
</tr>
<tr>
<td>Animation</td>
<td>0.01</td>
<td>0.24</td>
<td>0.23</td>
<td>-0.02</td>
</tr>
<tr>
<td>Selftest</td>
<td>-0.04</td>
<td>0.11</td>
<td>0.12</td>
<td>-0.14</td>
</tr>
<tr>
<td>Examples</td>
<td>-0.11</td>
<td>0.00</td>
<td>-0.12</td>
<td>0.09</td>
</tr>
<tr>
<td>Dictionary</td>
<td>0.05</td>
<td>0.12</td>
<td>0.02</td>
<td>-0.04</td>
</tr>
</tbody>
</table>

6 Application Supporting Individual Learning Styles

Currently, Internet applications provide the electronic support of the educational process. Learning Management Systems (LMS), or Learning Content Management Systems (LCMS) are usually used for distribution of study materials, communication, feedback and management of the process of instruction.

These applications provide numerous tools which may suit students with various learning styles. Nevertheless, as in the face-to-face instruction, one "universal" course is designed which is expected to suit most students, or it reflects the teaching style of the designer.

But modern approaches enable to create interactive applications which react to user’s instructions. That is why the research team decided to apply a similar approach to individualization of eLearning courses.

The main idea is based on adding an application to running courses, which will arrange various types of study materials in order according to student’s individual preference.

Before students start the work in a course, they will take the LCI and set the results, if received before, in the application. The results are in the easy form, they are four figures meaning the sequential, precise, technical, confluent pattern, where -1 means reject, 0 means tolerated, 1 means preferred pattern. The application puts the study materials on the entry page in such order which reflects the individual learning style. The most appropriate materials are located on the top left position, the rejected materials on the lower place. Above all, the preferred types will by emphasized in colour and size of the pictograms. This approach requires form authors of study materials to evaluate each of them according to the same criteria as students were evaluated, i.e. the author matches each material to the type of learning style (pattern) it suits best using the figures -1, 0 and 1.

During the year 2010 a team of Ph.D. students was creating the application within the project of specific research “Application supporting the flexible model of the educational process”. The application will be used in the LMS WebCT.

6.1 Main Objective

The plugin was designed so that (with the purpose) to re-organize the introductory page of an on-line course (e-course) running within the LMS WebCT where the Course Content is presented to students. The criterion under which the application works is the student’s individual learning style. Single items of the Course Content, i.e. Study Materials, exercises, assignments, assessments and other activities applied within the process of instruction, are presented in such order which accommodates student’s preferences. All items and tools of the course are accessible to each student but the plug-in is to provide single items on the introductory page according to the student’s individual learning style. To reach this objective not only each student’s learning style is detected but also single items of the Course Content and relating activities undergo the classification according to their suitability to a certain style of learning. Finally, single items are matched to each student’s pattern and the course is tailored to the individual student’s requirements.

6.2 The Process of Implementation

The whole plug-in is implemented in the JavaScript language and inserted in a e-course (section) directly in the source form to the Heading of the introductory page. The plug-in is activated in the student’s browser at each access to the Course Content page, and it accomplishes following sequence of activities:

- It hides the Expand button of the Course Content in Student view of the e-course so that the student could not access the Course Content tree; the entire tree is not adjusted to the student’s individual learning style and contains the numeric classification of various types of Study Materials and other activities and tools.
- It hides the original content of the Course Content page.
- Applying the AJAX inquiry it detects the student’s ID.
- Applying the AJAX inquiry it uploads data containing classification of single study materials according to their suitability to each learning style and the evaluation (i.e. pattern) of the logged-in student according to his/her user name.
Applying the AJAX inquiry it uploads the tree of links to single types of study materials (learning objects).

Thus having the evaluation of each study material and the student, it considers and counts the adequacy of the material to the learning style within the topic.

Finally, it re-organizes the Course Content page according to the provided data and displays it instead of the original content.

If the process fails of any reason, the original Course Content page is displayed with caution a mistake appeared. In such a case the Error report is created in the browser, which is commonly hidden to the user.

6.3 Requirements of the Plug-in Implementation

The source code must be included in the Headings of the introductory page of the e-course (Designer view – Course Content - Edit Heading - HTML Creator: Plug-off, tick Use HTML, Insert the Plug-in code, Save). Single topics of the Course Content must be structured into folders - one folder for each topic containing links to single learning objects (i.e. various types of study materials).

Each learning object in the folder is classified by four figures (of the value of -1, 0, 1) which correspond to four types of processors and define its suitability for each style of learning. The four values must be presented at the beginning of the link to the object in the field of “User name of link”, e.g. in the form “(0,1,-1,-1) Basic terminology”.

The studeni.csv file containing the classification of the each student’s learning style must be placed into the root directory of the e-course using the File managers. The appropriate form of classification is presented in Figure 1.

The data should be taken from a spreadsheet, e.g. Excel, in the CSV format, separated by semicolon. For the purpose of the Student view of any e-course the user name of each student is required to be included in the studenti.csv file. It is available in “My Grades” in Student view, presented in brackets on the first line.

For running the plug-in appropriately each student is required to have the Internet access for purpose of uploading the jQuery from the ajax.googleapis.com server.

The plug-in has been designed for the WebCT, version CE 6.0.3 (12.0.11.15), and considering the strong dependence on the concrete HTML page structure it is highly presumable the potential adaptation to another version will require additional modifications.

6.4 Detailed Insight in the Process of Implementation

Because of impossibility to adapt the WebCT source codes and absence of suitable API, it was necessary to implement the plug-in on the client side using JavaScript which modifies the content of the presented page and uploads other necessary sources from the WebCT server using AJAX requirements. The data are received by parsing of the uploaded HTML pages.

The implementation uses the jQuery of 1.4.2 version mainly for the manipulation with the page content (of the DOM model) and defining the AJAX requirements to receive additional data from the server.

6.5 Current Limits

The WebCT shortens file names in the Course Content tree, which the plug-in uses to receive links to learning objects, up to approx. 11 characters plus the length of the classification chain including brackets. That is why the file names in the newly generated Course Content are shortened and filled with three dots. The problem can be solved by re-naming the links using the appropriate length (i.e. number of characters) or making a relatively complicated change in the plug-in code, which will result in the increase in higher frequency of inquiries on the server (total number will correspond to the number of topics in the e-course).

7 Conclusion

ICT in the process of education raise changes. Currently it is obvious that education supported by ICT enables easier and more complex realization of the instructional process, it offers choice of place, time and pace for studying. At the same time the ICT-supported education allows an individual approach to students preferring various learning styles.

The process of instruction supported by ICT is considered suitable and beneficial for learners of all styles. The reason is that it offers a wide range of activities which can be aimed at any learning style and used by any teaching style instructor.

References:


*This work was supported by the GAČR Project N. P407/10/0632 "A flexible model of the ICT supported educational process reflecting individual learning styles" a project of the specific research at the Faculty of Informatics and Management University of Hradec Králové “Application supporting the flexible model of the educational process”.*