Flexible E-learning: Online Courses Tailored to Student´s Needs

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Abstract
The paper deals with process of implementing the learning style theory in the field of e-learning. Since 2010 the three-year project “A flexible model of the ICT supported educational process reflecting individual learning styles” has been running at the Faculty of Informatics and Management, University of Hradec Kralove, Czech Republic. The main objective is to verify whether accommodating the individual learning style within the ICT-supported process of instruction results in increasing the level of student’s knowledge. The core part of the project is the analysis of various types of study materials which students of different learning styles consider to be suitable for their process of learning. The results are implemented in the learning strategy of the online course within which the flexible model is verified. For this purpose a software application was designed which generates the appropriate type of study materials and related learning activities. Thus the process of instruction is tailored to the discovered student´s needs.

Keywords

Introduction

The Czech educational system has undergone changes relating to the social development. New competences have been defined and reflected in the learning content, adequate teaching methods, organizational forms, ways of evaluation and new relations between elements participating in the educational process have been applied, curricula changed, the learner’s responsibility for his/her own education, creativeness and motivation supported, and economic aspects penetrated the whole system. These features have been slowly but steadily included into the new educational system. The information and communication technologies (ICT) have become standard and current approach to instruction is hardly to be imagined without computers.

It is generally agreed that people vary in the view upon the same problem; they do not do things and see the world in the same way as the others do. They differ in the way of perceiving a situation, evaluating it, judging consequences, making decisions. In spite of these differences, each person is clever and may be right in his/her own manner. Students should be aware of their learning styles, they should know what their strengths and weaknesses are, and should be provided with a variety of instructional methods and approaches to choose the most suitable ones (Šimonová et al, 2010a).
Learning styles in e-learning

Despite numerous authors dealt with the theory of learning styles and various solutions have been introduced, e.g. Felder, 1998, Coffield, 2007, Gregorc, 1979, Honey, 2011, Mitchell, 1994. Johnston presents another approach to this problem. Her concept “Unlocking the will to learn” (Johnston, 2006) arises from the hypothesis the traditional learning process is based on belief that all learning occurs as part of learner’s intelligence. The greater the intelligence, the more a child can learn. Johnston attracts attention to the verb can, as no one says will learn. When describing the whole process of learning, she uses the metaphor of a combination lock saying that cognition (processing), conation (performing) and affectation (developing) work as interlocking tumblers; when aligned they unlock an individual’s understanding of his/her learning combination. She designed an inventory for detecting individual learning styles, Learning Combination Inventory (LCI). It differs from other widely used inventories (designed by Kolb, Honey and Mumford etc.). It emphasizes not the product of learning, but the process of learning; it focuses on how to unlock and what unlocks the learner’s motivation and ability to learn. The responses form the schema (pattern) that drives learner’s will to learn, and respondents are categorized into four groups as follows (Johnston, 2006):

- Sequential Processors (S), defined as the seekers of clear directions, practiced planners, thoroughly neat workers.
- Precise Processors (P), identified as the information specialists, info-details researchers, answer specialists and report writers. It hides the original content of the Course Content page.
- Technical Processors (T), specified as the hands-on builders, independent private thinkers and reality seekers.
- Confluent Processors (C), described as those who march to a different drummer, creative imaginers and unique presenters.

Project description and method

The question is whether tailoring the process of instruction running within the LMS to student’s individual learning style results in significant increase of knowledge. To discover this is the main objective of the three-year research project currently running at the University of Hradec Kralove “A flexible model of the ICT supported educational process reflecting individual learning styles.”

The process of problem-solving is structured into several phases:

First, to detect the student’s learning style by the Johnston´s LCI questionnaire. According to the scoring sheet, responses are matched to question in a special structure which finally provides total amount of points relating to each processor. The scale, extended from 7 to 35 points, is structured into three parts:

- I avoid this scheme (from 7 to 17 points).
- I use this as needed (from 18 to 25 points).
- I use this scheme first (from 26 to 35 points).

These characteristics are later applied in the process of tailoring the online course to individual student’s needs. The sample group consists of approximately 500 students of the University of Hradec Kralove enrolled in their first year in the 2011/12 academic year.
Second, to design an e-application (plug-in) supporting the flexible model of instruction within the LMS WebCT in order to match appropriate types of study materials and activities to individual student’s learning style pattern. To reach this objective, not only data on each student’s learning style are required but also single items of the Course Content and relating activities are classified according to the suitability to a certain style of learning, i.e. whether the material is appreciated (value 1), accepted (value 0) or rejected (value -1) by the student. The data are matched to the pattern and the course is tailored to the individual student’s preferences. The list of items is not completed; other type of materials and activities may appear resulting from the topic and/or special pattern of the learner. Above all, it is necessary to have in mind that the individual learning style is a pattern combining four approaches in some extent (Sequential-S, Precise-P, Technical-T, Confluent-C).

Third, to create the on-line e-course for the pedagogical experiment reflecting / ignoring learning styles in the LMS WebCT. The content focuses on library services, which is a topic students have to master before they start studying but they often have hardly any system of knowledge and skills in this field. The e-course “Library services – information competence and education” is structured into eight parts covering the crucial content, i.e. Basic terminology, Library services, Bibliographic quotations, Electronic sources, Bibliographic search services, Writing professional texts, Bachelor and diploma theses and Publishing ethics.

Fourth, to run the pedagogical experiment, collected data and statistically process and interpret them, and provide recommendations towards improving the whole process of instruction.

Before the first phase the project started, the pre-research was done 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 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 (never—hardly any time-sometimes-almost always-always). The questionnaire was distributed to 107 students of the Faculty of Informatics and Management, University of Hradec Králové, in study programmes Applied Informatics and Information Management. Consequently mutual relations were researched among single patterns and preferred types of study materials. The received results prove that 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 any time borrow the recommended books (Figure 1).
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, PowerPoint presentations summarizing basic structure of the course, topic or subject, and some supportive tools, e.g. e-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 (Figure 2).

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 uses 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 (Figure 3).

Authors of eLearning courses include various feedback-providing tools, such as self-tests and numerous hands-on examples or tasks. Although these are to help students understand the problem, they are used less frequently than study texts and presentations. More than two thirds of students

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**Figure 1:** The use of printed textbooks.

**Figure 2:** The use of electronic study texts, presentations and other supportive materials.

**Figure 3:** The use of animations and video-recorded lectures.

**Figure 4:** The use of self-tests and hands-on tasks.
(68 %) always and almost always use the provided examples. Self-tests are even less used. More than one fourth never and hardly any time uses them, 39 % sometimes and only fewer than one third (31 %) always and almost always work with them (Figure 4).

Research results

Totally 94 students of the Faculty of Informatics and Management participated in the entire research. As mentioned above, the student’s individual learning style was detected by the Learning Combibation Inventory (LCI) within the first phase. Data were processed for a single student. An example is presented in Figure 5.

![Figure 5: Example of LCI results](image)

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

Consequently, using the NCSS2007 statistic software, relations between single patterns and types of study materials were detected. The recommended value of the correlation is 0.15 min. Results are presented in Table 2.

<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>Electronic 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>-0.03</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>

According to the results, students preferring the Sequential Processor mostly use 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 Technical Processor often use animations and video-recorded lectures; they do not work with electronic study texts, other supportive materials, e.g. dictionaries and presentations.
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.

The Internet applications providing the electronic support of the process of instruction and organizing the materials according the types within the online course in LMS WebCT was designed within the second phase of the problem solving. The LMS provides numerous tools and the course is expected to suit most students despite it reflects the designer’s and tutor’s teaching style. 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. The received results are in the simple 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 be 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. Currently, a team of Ph.D. students is 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. After piloting, it can be adjusted to using in other learning management systems.

The main objective of the e-application is to re-organize the introductory page of the e-course where the Course Content is presented to students. The criterion under which the e-application works is the student’s individual learning style. Single items of the Course Content, i.e. Study Materials, exercises, assignments, assessments, communication and other activities applied within the process of instruction, are presented in such order which accommodates student’s preferences. The LCI displays the final “pattern” which presents the combination of four approaches to processing information, i.e. it defines the Sequential, Precise, Technical and Confluent Processors. All items and tools of the course are accessible to each student but the plug-in arranges single items on the introductory page in such order which reflects the student’s individual learning style.

The whole plug-in is implemented in the JavaScript language and inserted in the e-course 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 (Šabatová et al., 2010):

It hides the Expand button of the Course Content in Student view of the e-course so that the student is not able to 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.

Having evaluated each type of study materials, activities and tools to a single learning style, and detected the individual student’s learning style, it considers and counts the adequacy (appropriateness) of the item to the learning style within the topic.

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

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

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 (Sequential, Precise, Technical and Confluent) as follows:

- **minus one (−1)** means this type of study material, activity, assignment, communication etc. is rejected, i.e. does not match the given learning style;
- **zero (0)** is the middle value, i.e. the student neither appreciates, nor rejects, but accepts this type;
- **one (1)** means this type is appreciated and matches the given learning style.

The figures are presented at the beginning of the link to the object in the field of “User name of the link”, e.g. in the form “(0, 1, −1, −1) Basic terminology”.

The data should be taken from a spreadsheet, e.g. in MS Office Excel, in the CSV format, separated by semicolon. For the purpose of the Student view of the e-course the user name of each student is required to be included in the “studenti.csv” file. It is available within “My Grades” in Student view, presented in brackets on the first line, e.g. Demo Student 69259477001 (webct_demo_69259477001).

For running the plug-in appropriately each student is required to have the Internet access for the 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.

Due to the impossibility to adapt the WebCT source codes and absence of suitable API, it is necessary to implement the plug-in on the client side using JavaScript which modifies the content of the displayed 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.

Several limits of this solution have been discovered, e.g. 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 page 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 (the total number will correspond to the number of topics in the e-course).

An online e-course for the pedagogical experiment reflecting / non-reflecting learning styles was designed in the LMS WebCT within the third phase of project solving. The content focuses on library services, which is a topic students have to master before they start studying but they often have hardly any system of knowledge and skills in this field (Poulová et al., 2010).

The e-course “Library services – information competence and education” is structured into eight parts covering the crucial content, i.e. Basic terminology, Library services, Bibliographic quotations, Electronic sources, Bibliographic search services, Writing professional texts, Bachelor and diploma theses and Publishing ethics (Figure 6).

The study materials, exercises, assignments and all activities included in the course are provided to students in a wide scale of types so that each student can choose the appropriate ones which suit him/her best according to the individual style. Students’ process of study in the course is monitored, and the tracking and study results will prove to what extent the individual learning style is reflected.

![Image of Library Services course home page](image)

Figure 6: Library Services course home page

Finally, the pedagogical runs within the fourth phase. It is designed on the “pre-test – instruction – post-test structure. More than 600 respondents participated in the pre-test. Three approaches are applied to provide the process of instruction, following (1) the teacher’s style, (2) learner’s style where the content is tailored to the individual needs, i.e. generated by the plug-in, (3) providing all types of study materials to the learner and monitoring his/her choice which is then compared to expected preferences defined by the LCI. This phase is currently running – i.e. the pedagogical experiment was closed and the collected data are being processed. The results will prove, or not whether the individual approach in e-learning is able to contribute to the ICT-supported process of forming knowledge of university students.
Conclusions

Current orientation of university education, which is changing under the influence of latest technology development and requirements of new key competences, can be researched from various, different points of view. The ICT supported education has been spreading because of growing popularity of digital technologies in general. Another reason is it enables easier and more complex realization of the process of instruction, offers the choice of place, time and pace for studying, allows an individual approach to students preferring a certain learning style. These are the key values important for the efficiency of the process. Material and technical requirements having been satisfied, strong attention must be paid to didactic aspects of instruction. To contribute to this process is the main objective of this research project.

From the results presented above it can be seen there is no definite solution. 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 days of fast technical and technological development, globalization, demand for further, lifelong education, the importance of education is increasing. These terms support the development of the whole system of education, which is often put into effect in a distance way being supported by ICT. Teachers’ and students’ awareness of styles may help substantially in this process.

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References


