Learning Styles Applied within the Process of eLearning

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Abstract: - The paper introduces a way of implementing the learning style theory in the field of eLearning. 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 individual learning style within the process of instruction supported by ICT results in increasing the level of knowledge. The core part of the project is an experiment comparing study results in the process of instruction reflecting or ignoring individual learning styles. For this purpose a software application was designed which generates the appropriate type of study materials and related learning activities and tailors the process of instruction to the student’s needs. The project will result in a flexible model of the ICT supported process of instruction. The detailed description of the application and the survey of learning activities easily used in eLearning and structured according to the Bloom’s digital taxonomy are included.

Key-Words: - Learning style, university education, LMS, project, experiment, eLearning

Motto:
How long will we be preparing today’s children at yesterday’s schools, by the day-before-yesterday’s methods for tomorrow’s problems?
K. Rýdl [1]

1 Introduction
The current information society offers a wide range of opportunities to its members but at the same time it requires more knowledge and skill from them than ever before. New challenges evoke new questions. Numerous researches, e.g. [2], have proved that there is no statistically significant difference in students’knowledge formed in the educational process supported by information and communication technologies (ICT) and within the face-to-face instruction. The question is whether tailoring the process of instruction to student’s individual learning style results in increasing the 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.“

In partial objectives the quality, meaningfulness, efficiency and limits of ICT/LMS implementation in education are evaluated.

2 On the Theory of Learning Styles
It is generally acknowledged that people vary in the view upon the same situation, they do not do things and see the world in the same way as the others do. People differ in individual learning styles, i.e. in the way and speed of collecting and processing information, forming knowledge and applying it under new circumstances. In spite of these differences, each person is clever and may be right in his/her own manner.

Individual learner differences are apparent, but what are the underlying actions in the personality? These processes relate to cognitive styles covering thinking, processing and epistemological styles which result in meta-styles. Despite some conflicts in the field of degree of learning style stability, reliability and validity of measurements, researching this field is expected to be of great importance for the didactics. Cognitive styles are commonly understood as an individual’s characteristic and consistent approach to perceiving, remembering, processing, organizing information and problem solving [3], while learning styles are frequently described as a set of cognitive, affective and psychological factors serving as relatively stable indicators of how a learner perceives, interacts and responds to the learning environment (Keefe in [4]), or as attitudes and behaviour determining an individual’s preferred way of learning [5].
There is an important difference in understanding styles and abilities. According to Sternberg [6], an ability refers to how well someone is able to do something, while a style refers to how someone likes to do something. Thus we understand the style is a preferred way of using abilities which an individual has.

Various learning style models were worked out by different researchers at isolated places; there exists a conceptual overlap of distinct extent. Newcastle University Report on learning styles [4] found 71 of them worth consideration. Applying three criteria (i.e. theoretical importance, widespread use and influence on other learning style models), Coffield [4] categorized them into 13 groups, and the following models are acknowledged to be the major ones:

- the constitutionally-based learning styles and preferences (Dunn, Dunn),
- the cognitive structure family (Witkin; Riding and Cheema),
- the stable personality type (Briggs, Myers),
- the flexibly stable learning preferences (Kolb; Honey and Mumford; Felder and Silverman),
- the learning approaches and strategies (Pask; Vermunt).

### 2.1 Conflicting ideas concerning practical application of learning styles in the educational process

Experience gained in the process of ICT implementation opened discussions on the theory of learning and teaching styles and their application in eLearning. Individual learning styles play an important role in the process of instruction, especially if it is managed by any Learning Management System (LMS). It provides designers with a wide range of tools which enable to accommodate needs of all learning style learners. Thus the process of instruction supported by ICT is considered appropriate and beneficial for learners of all styles. The possibility of individualization of the educational process from the both students’ and teachers’ point of view is its greatest advantage [7].

Despite this, there exist several conflicting ideas concerning practical application of learning styles which should be taken into consideration. It is apparent that the efficiency of the educational process is influenced by numerous factors, e.g., learner’s intelligence, prior knowledge, level of motivation, stress, self-confidence, and learner’s cognitive and learning style. It is generally acknowledged that the instructor’s teaching style should match the students’ learning styles. Felder [8] says that mismatches can cause a wide range of further educational problems. It favours certain students and discriminates others, especially if the mismatches are extreme. On the other hand, if the same teaching style is used repeatedly, students become bored. Gregorc [9] claims that only individuals with very strong preferences for one learning style do not study effectively, the others may be encouraged to develop new learning strategies. Only limited numbers of studies have demonstrated [4] that students learn more effectively if their learning style is accommodated. Mitchell [10] concludes that making the educational process too specific to one user may restrict the others.

It can be seen from the facts presented above that it is important for a student to be aware of his/her learning style, to know what his/her strengths and weaknesses are and be provided with a variety of instructional methods and approaches to choose the most suitable ones. Didactics accepting the ICT implementation is the field which is being developed quickly. It is not an easy task but at the same time there is no other way how to solve the situation.

### 3 The Bloom’s Digital Taxonomy

It is generally accepted that the efficient eLearning does not mean casual and driftless browsing on the Internet. During the 1990s the well-known and widely spread Bloom’s taxonomy of educational objectives [11] was updated under the conditions of modern technologies implemented in the process of instruction. The traditional version of Bloom’s taxonomy was revised by L. Anderson, and D. Krathwohl [12], and the new version appeared introducing changes in the process of reaching single objectives, and in the way of defining them. Briefly summarized, nouns describing the single steps were replaced by verbs to emphasize the active approach, and the order of levels was changed. The result is presented in table 1.

<table>
<thead>
<tr>
<th>Level</th>
<th>Original version</th>
<th>Revised version</th>
</tr>
</thead>
<tbody>
<tr>
<td>6</td>
<td>Evaluation</td>
<td>Create</td>
</tr>
<tr>
<td>5</td>
<td>Synthesis</td>
<td>Evaluate</td>
</tr>
<tr>
<td>4</td>
<td>Analysis</td>
<td>Analyze</td>
</tr>
<tr>
<td>3</td>
<td>Application</td>
<td>Apply</td>
</tr>
<tr>
<td>2</td>
<td>Comprehension</td>
<td>Understand</td>
</tr>
<tr>
<td>1</td>
<td>Knowledge</td>
<td>Remember</td>
</tr>
</tbody>
</table>

These days the implementation of information and communication technologies in the field of education has become standard, so subsequently the reflection of this process appeared within the Bloom’s taxonomy. The concept of the Bloom’s Digital Taxonomy and Collaboration was introduced by A Churches [13]. The
author, teacher and ICT enthusiast from New Zealand, describes digital tools which he applies in his lessons. The most suitable ones, frequently used and appreciated by students, are presented below, being structured according to the six taxonomy levels. Special attention (and column) is devoted to the field of Communication which is understood a crucial competence penetrating all teaching/learning activities. Churches emphasizes and recommends the following activities to teachers’ attention:

Within the Lower Order Thinking Skills, on the Remember level students mainly focus on retrieval of information using e.g. bulleting to mark key words or phrases for recalling, bookmarking favourite web pages or sites for future use, social bookmarking and social networking, searching (googling) etc.

For the Understand level, i.e. interpreting, summarizing, inferring, paraphrasing, comparing, explaining etc. some procedures towards refining the newly developed knowledge can be applied, e.g. blog journaling, twittering. Both techniques can easily move beyond the understanding level to higher ones of the taxonomy if these tools are used to develop greater understanding, or to collaborate with peers, for digital organizing, classifying etc.

The Apply level includes implementing and using information, and executing tasks, so examples of students’ active “doing” are provided, e.g. initiating a programme and/or operating and manipulating hardware and software applications, gaming, uploading and legal sharing of materials on a site etc.

Within the Higher Order Thinking Skills, the Analyze level involves e.g. mashing ups, where several data sources are melded into a single set of usable information, making links within documents and web pages, but also validating the information, organizing, structuring and attributing online data etc.

The Evaluate level refers to verifying hypotheses, experimenting, judging, testing and monitoring, so it is place for providing informed judgments, for blog commenting and reflecting, examining materials in context, testing e-products etc.

On the highest, i.e. Create level students focus on designing, inventing, constructing, planning and producing, which includes e.g. finding a technology and applying it in the creative process. It could involve audio- and video-recordings, films, animations, podcasts, creating a programme application or developing a game, which results in creating completely new items.

In the extra column Churches provides the communication spectrum of activities from lower to higher levels: texting, instant messaging, e-mailing, chatting, networking, blogging, questioning, replying, reviewing, videoconferencing, skyping, net meeting, commenting, debating, moderating, collaborating etc.

To sum up, Churches work gives educators an excellent framework to begin and/or assess their digital practices. We recognize that he differs from numerous teachers who tend to push the “search” concept, and provides strong support to networking, social bookmarking, blogging, and at the highest level to producing unique items to enhance the learning. The author highly appreciates Churches’ concept and considers it a wide didactic database of activities where every student of any learning style can accommodate his/her needs.

4 Project Work

The above mentioned project dealing with learning styles arises from the Ch. A. Johnston concept “Unlocking the will to learn” [14]. She designed the Learning Combination Inventory (LCI) which was applied for the learning style detection within the project. The LCI differs from other widely used inventories (e.g. by Kolb, Honey and Mumford etc.) in emphasizing 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, i.e. on the way how to achieve student’s optimum intellectual development. This was the main reason why LCI, not any traditional tool was applied for detecting respondents’ individual learning styles.

The main project objectives are as follows:

First, to adapt the Learning Combination Inventory to the conditions of the Czech university education, i.e. translate it from English to Czech language, and pilot it.

Second, to run a pedagogical experiment to find out whether using such methods of instruction which reflect individual learning styles result in statistically significant difference in the level of students’ knowledge in comparison to the situation when individual learning styles are not reflected. The experiment is based on the pre-test/post-test concept when the increase in knowledge in experimental and control groups of university students is calculated, statistically processed and assessed. Both groups study in the distance electronic course (e-course) on the Internet in the LMS WebCT. The LMS was designed as a learning environment so it provides all tools necessary for running the process of instruction. All students’ knowledge is pre-tested before the process of instruction starts. Then, students in the experimental group are offered such study materials, exercises, assignments, communication and other activities which suit their individual learning styles. The selection is made electronically by an application which automatically generates the “offer”, i.e. it provides each student with types of materials appropriate to his/her learning style. Students in the control group have access to all types of
materials, and the process of selection is the matter of individual decision, and it is tracked by the LMS. Final knowledge in both groups of students is post-tested after the process of instruction finishes, and the study results are statistically processed and compared.

Third, according to the received results a flexible model of the instructional process supported by ICT and based on individual learning styles will be designed.

Fourth, based on the results the quality, meaningfulness, effectiveness and limits of ICT/LMS implementation in the instructional process will be evaluated, and proposals to its optimum contribution and extent provided.

4.1 Course Description
An on-line e-course for the pedagogical experiment reflecting / non-reflecting learning styles was designed 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.

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.

4.2 Application Generating the Course Content
The application (plug-in) supporting the flexible model of instruction within the LMS WebCT was designed by students within the specific research activities. Its main objective is to re-organize the introductory page of the e-course 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, 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 of 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 matches the student’s individual learning style.

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, accepted or rejected by the student. Finally, single types of study materials and activities are matched to each student’s pattern and the course is tailored to the individual student’s needs.

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:
- 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 (learning objects).
- 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 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.

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 “studeni.csv” file contains the classification of the
each student’s learning style. It is placed in the root
directory of the e-course using the File managers. The
appropriate form of classification (Sequential (S),
Precise (P), Technical (T) and Confluent (C) Processor)
is presented in table 1:

<table>
<thead>
<tr>
<th>User name</th>
<th>S</th>
<th>P</th>
<th>T</th>
<th>C</th>
</tr>
</thead>
<tbody>
<tr>
<td>webct_demo_69259477001</td>
<td>25</td>
<td>18</td>
<td>14</td>
<td>20</td>
</tr>
</tbody>
</table>

Table 1: Sample classification of a student’s learning style

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 the e-course the user
name of each student is required to be included in the
“studeni.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.
Because of impossibility to adapt the WebCT source
files, 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 limitations 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 (total number will correspond to the number of
topics in the e-course).

5 Conclusion
Current orientation of university education, which is
changing under the influence of latest technology
development and new key competences, can be
researched from various, different points of view.
Education supported by ICT has been spreading because
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 the 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:


