The Implementation of the Personalised Approach for Technology Enhanced Learning

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***Abstract*—In the paper, the implementation of the personalised approach of Technology enhanced learning (TEL) for engineering education is presented and is based on "batch knowledge processing". This bottom up concept takes into account that knowledge is a key element in engineering education and educators work with knowledge when performing their activities. In terms of this, the personalised TEL approach is understood as the "automation" of all the types of activities performed by teachers. For supporting (automating) these activities a multipurpose pre-programmed desktop environment has been developed. It is built on a conventional Relational Database Management System, however, the paradigm of the batch knowledge processing is different from the conventional relational database and has not yet been described or published. Using this tailor made informatics tool the various types of the TEL outputs were worked out, e.g., learning materials for courses of study, internet forums due to better feedback, supporting study libraries at the faculty's server, other personalised applications (internet batch retrieving, advanced searches, virtual "StudyWeb", multilingual support, digitalisation of the printed engineering content and data interlinking with the academic information system, etc.).**

***Index Terms*—batch knowledge processing, e-learning, engineering education, technology enhanced learning**

I. Introduction

Within the European Union (EU) Seventh Framework Programme (FP7) for Research & Development the TEL is one of the priorities in the ICT Work programme of 2009-2010 Objective 4.2 [1]. According to European research, the TEL investigates "how information and communication technologies can be used to support learning and teaching and competence development throughout life", it represents research on the creation, distribution and exploitation of knowledge and digital content. The Commission's report on "Shaping the ICT research and innovation agenda for the next decade" rated Education and Learning Systems are among the most important societal challenges requiring ICT innovation in the next decade. The current portfolio of projects are also focused on technologies that support personalisation and adaptivity of learning systems – user modelling tools, feedback services, social tagging, tracking and storing semantic relationships as in [1].

However, it must be underlined that the TEL policy automatically requires a shared approach by both teachers (engineering content) and ICT engineers (informatics tools). Thus, only having the technology-driven approach is not sufficient without being applied in parallel with the pedagogical - driven one. In this context, the TEL approach in recent years was investigated at the Slovak University of Technology - Faculty of Materials Science and Technology (FMST SUT) [2]–[4]. At the beginning, the ICT support of Mayes' conceptualisation cycle was taken into account and inspired by [5]. Each stage of the cycle (conceptualisation, construction, dialogue and feedback) was supported by a set of programming codes. Learning materials for some courses of study were created using the database application "Writing pad" (WPD). However, it was found that the Mayes' conceptualisation cycle would be a very simply background when supporting engineering education. For example, each course of study had its own cycle and feedback history, it required specific programming codes in connection with dozens of learning and teaching activities "within the cycle". Therefore, the following TEL approach was based on "batch knowledge processing".

In this paper, there is not enough space to explain the TEL approach in detail. From an informatics point of view, the batch knowledge processing is performed by a self-developed multipurpose pre-programmed desktop environment having interoperability with Windows and common internet browsers (default with Internet Explorer and OPERA). Partly, various freeware or open source software are used. In addition, due to better communication with students, a php - mysql internet application was programmed (so called Forum).

From a pedagogical point of view, a teacher as the "key player" performs various educational activities using this supporting environment and the tailor made pre-programmed codes for their automation. Till now, this TEL approach was used or directly tested for various types of educational activities (e.g., formal, informal, blended, active, and distance learning).

II. The Batch Knowledge Processing

Although the TEL is very closely linked to the learning content it is categorised within the ICT field. From the programming point of view the TEL is commonly understood as WEB2.0 technologies using programming languages for data processing (data should be readable via machines). For instance, the widely known TEL approaches are Virtual

Manuscript received on June 07, 2010. This work was supported by the Slovak Research and Development Agency under the contract no. APVV-P01905.

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ISBN: 978-988-17012-0-6
ISSN: 2078-0958 (Print); ISSN: 2078-0966 (Online)

Learning Environments (VLE) and Learning and Course Management Systems (LCMS). The VLE systems can be viewed as *collections of integrated e-tools that enable the management of e-learning* (as the commonly used commercial VLE systems are WebCT and Blackboard mentioned) [5]. These systems "have the potential to support e-learning at the primary, secondary and tertiary levels of Mayes' Conceptualisation Model", as in [5]. Concerning the LCMS, e.g., the Moodle is well known (open-source software). At the FMST SUT an analogous Academic information system (AIS) is already used as the university's LCMS.

However, the mentioned VLE or LCMS as internet applications and management tools do not enable batch knowledge processing, e.g. to process the information from the various types of online and off-line sources. Fig. 1 illustrates the common engineering knowledge flow between the information sources and the knowledge tables of the pre-programmed desktop environment.

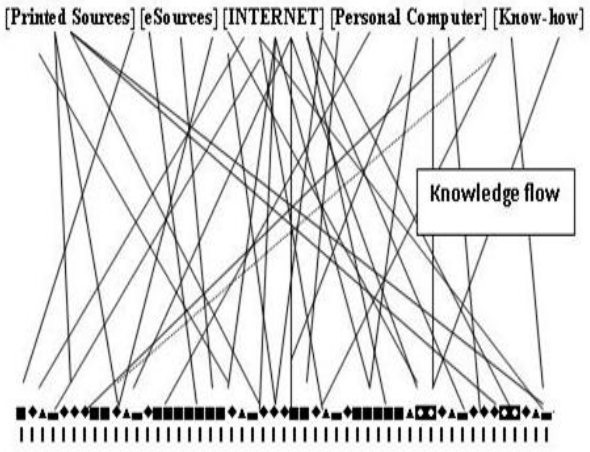

Fig. 1: Knowledge flow between the information sources and knowledge tables of the WPD

The "batch knowledge processing" is a *bottom up* concept. It takes into account that knowledge is a key element in education, and educators work with knowledge when performing daily educational and other activities. In addition, today's teacher must work on his computer with a huge amount of knowledge in conditions which are characterised by attributes such as *multipurpose*, *multilingual*, *multiformat*, *multiwindow*. This state-of-the-art automatically requires working with "knowledge packages" which are to be batch processed.

For this purpose, "knowledge" was defined as a set of structured and unstructured information with a specified content stored in one row of the database table with a default structure. Such a definition is acceptable from an informatics and pedagogical point of view. Knowledge is then concentrated by storing it in the "knowledge tables" which can be used for building larger knowledge clusters, and for the sophisticated systems rich on information respectively.

In terms of this, an actual ICT tools' level is too low, this includes software for personal computers. Thus, the *multipurpose pre-programmed desktop environment* has been developed at the FMST SUT. This desktop environment exploits knowledge tables for batch knowledge processing and enables browsable outputs, batch retrieving, generating study material offline or WEB pages, text processing, image processing within digitalisation (made by the teacher when preparing lectures), writing and launching programming codes (prg, php, html), and many other pre-programmed actions. Hence, the actual "work name" of the personalised environment is "BIKE"- Batch Information and Knowledge editor. In this case, the TEL approach should be understood as "the automation of all activities performed by teachers" related to any type of education, both in general and in a personalised way. With the BIKE and the use of existing software, the automation is being solved in the following order: *knowledge – knowledge tables – templates for automation – knowledge processing – outputs (products) and target activities.*

It should be noted that there are more than 200 thousand free software applications divided into twenty categories at the SourceForge.net portal [6], there are many other existing commercial products, but not all of them work in the same way as BIKE (they are mostly one-purpose applications).

This *multipurpose* desktop pre-programmed environment (system) has been programmed as the supporting tool for research and industrial projects or educational activities over the past 10 years. It is built on a conventional Relational Database Management System, however, the paradigm of the batch processing is different from the conventional relational database one and has not yet been described or published. Just as, e.g. MS Word – editor enables working with texts, the BIKE enables working with knowledge in the role of a basic element within engineering education. Fig. 2 illustrates an example from a php self – study made in the BIKE environment plus a query output into html.

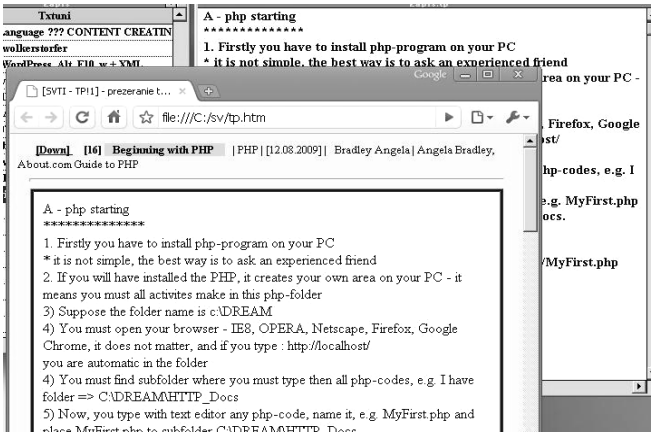

Fig. 2: The example of two screens from the php self-study using the BIKE plus the output query into html

III. THE AUTOMATION OF TEACHERS' ACTIVITIES

The experiences showed that the basic *educational* activities to be supported (automated) can be divided into *teaching, learning, publishing, research projects solving, self-study ,also including administrative and organisational activities*. For these activities various types of templates were designed - the pedagogical (with engineering content), informatics, combined (pedagogical plus informatics), navigation and administrative ones.

In general, for performing TEL there are many possible combinations when interlinking together: "*activities – templates – individual stages of the conceptualisation cycle*". Thus, various types of TEL outputs were prepared and tested on this account. For example, the learning and study materials

ISBN: 978-988-17012-0-6
ISSN: 2078-0958 (Print); ISSN: 2078-0966 (Online)

for courses of study, the internet "forums" (due to better feedback), the virtual libraries at the faculty's server (for each course of study), and the other personalised BIKE applications (internet batch retrieving, advanced search, multilingual support, digitalisation of the printed engineering content, data interlinking with the AIS).

From these outputs, language support is especially needed if English is not the native language of teachers and students. The examples from the multilingual support modelling are shown in Fig. 3 (using Wikipedia as the multilingual background for SWOT analysis) and in Fig. 4 (Left: French language table plus Text To Speech testing,
Right: English-German-Slovak template).

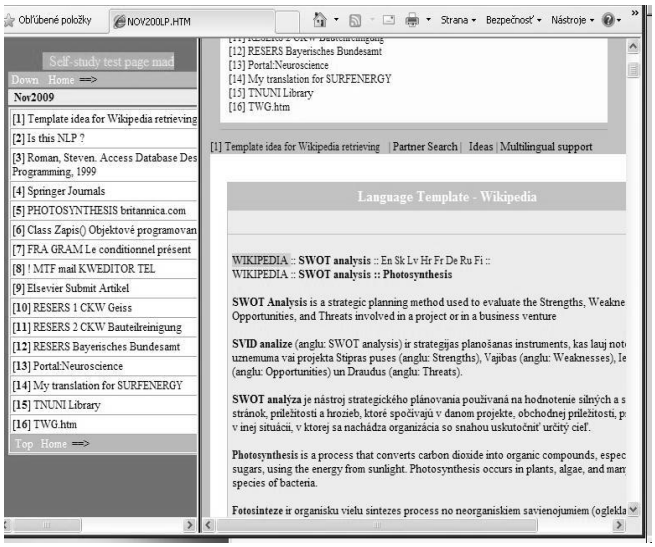

Fig. 3: The example from testing Wikipedia as the multilingual background (En, Sk, Lv, Hr, Fr, De,Ru, Fi)

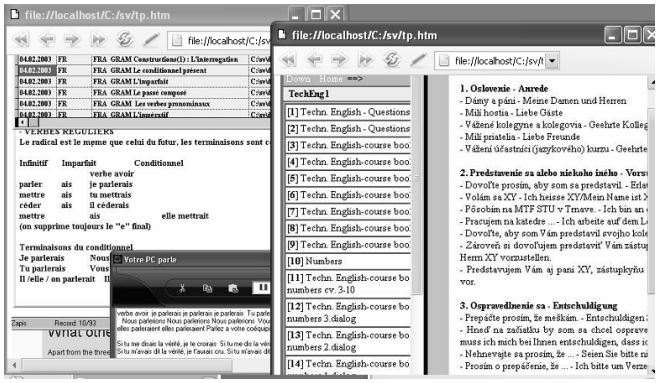

Fig. 4: The example of templates for the multilingual support

IV. CONCLUSION

The described TEL approach for engineering education based on the *batch knowledge processing* and *the automation of teachers' activities* represents another – personalised approach in comparison with the common TEL approaches which are mostly based on the *management of the educational and training materials* (e.g., Virtual Learning Environments, Learning and Course Management Systems).

The self-developed Batch Information and Knowledge editor (BIKE) enables a *teacher, as a key player,* in the development and performance of the "bottom up" concept from an informatics and pedagogical point of view simultaneously. It serves as a user-friendly "all in one" informatics tool which is convenient for supporting all types of the teachers' activities. The previous results at the FMST SUT showed that the developed TEL approach can be a good starting point for building other tailor made personalised applications or sophisticated educational systems which are rich on information.

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ISBN: 978-988-17012-0-6
ISSN: 2078-0958 (Print); ISSN: 2078-0966 (Online)