LEARNER-ORIENTED APPROACH FOR ENTERPRISE SYSTEMS IN HIGHER EDUCATION USING TEL-BASED CONCEPTS

Research Positioning Paper

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Abstract: Higher education institutes like universities or universities of applied science can not ignore the need to teach well know application and information systems, like Enterprise Systems, e.g. ERP-Systems. Case studies are the most chosen way to introduce stepwise the handling of these systems to fulfil the needs of the international employment market and to provide a practical focus within the education. Effective teaching concepts have to improve this situation by considering the pedagogical and didactical aspects, which supports the individual learning process of each student. Our research idea in this contribution considers actual needs of higher education, e.g. present learning in a lab as well as e-learning courses supported by new methods in Technology Enhanced Learning by recording student's behaviour to guide him through the system. Therefore we introduce an adaptive learning model which considers tracking and analyzing results deduced with methods of Application Usage Mining and built up a new idea to improve the learning progress. Within this adaptive learning model we propose an adaptive learning environment to bring learners and supervisors together to achieve positive influences on learner's behaviour and the learning progress.

1 NEED FOR CHANGE

Knowledge transfer is a key factor of our international oriented and globally connected education system in which universities and higher education institutions have to survive. Therefore these institutes have to collaborate with similar providers in different countries to compete in the learning market. This leads to a redefinition of their internal and teaching processes and an adaption of their curricula to the actual needs of the employment market. Higher education institutions have to support the individual learning lifecycle based on flexible learning services. Universities appear as "knowledge centers" for lifelong learning and have to be more flexible then in the past. The beginning of virtualization demands personalised and flexible learning services, whenever the learner needs and wants to access them. These services become an essential part of his lifelong learning.

Information and communication technologies (ICT) are often used as an enabler to support these processes. Technology Enhanced Learning (TEL) e.g. allows effective and cost-efficient learning environments based on individual needs and in a personalised way. TEL is focusing on the technological support of any pedagogical approach that utilizes technology and encompasses virtual and physical technology enhanced learning environments (incorporating physical learning spaces, institutional virtual learning environments, personalized learning environments and mobile and immersive learning environments). The aim of TEL is to explore and develop effective practice in the delivery of flexible, seamless and personalised services to learners, focussing on the technological interface between the learner and their learning environment. Therefore learning activity consists of learning resources, actions, context, roles and the learning objective to support the learner to his learning goals, respecting individual as well as organizational learning preferences.

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The technology plays an important role in supporting all these activities. That is surely one reason why the European Union (EU) support a number of project in this area, e.g. within in the 6th framework the Network of Excellences PROLEARN (www.prolearn-project.org) and Kaleidoscope (www.noe-kaleidoscope.org) which have the main objective to have shape the research area around TEL. In this research environment we want to introduce our new concept for teaching Enterprise Systems (ES) in higher education.

Due to the actual needs of the employment market, Enterprise Systems are getting more and more important for the educational environment. Though, the interferences and complexity of the different perspectives in computer science, business economics and the technology aspects make teaching and learning quite difficult in this field. Students need to be taught on practically approved systems to develop their own practical experience besides the theoretical lectures. Therefore ES offer the capability for future pedagogic innovation within higher education, which results from the possibilities in illustration, visualization and simulation of business and decision-making processes to students (Ask et al., 2008).

This contribution introduces an approach, which presents how technologies like Application Usage Mining (AUM) could improve the teaching of ES in higher education. Our research interests consider ERP-technologies and their usage in adaptive learning environments in higher education. Furthermore we focus besides actual standard software on new concepts resulting from up-to-date research, e.g. Federated ERP (FERP)-Systems (Brehm et al., 2009).

2 LEARNER ORIENTATION

Case studies are not the only a method for a successful learning process design; there are still problems occurring from missing background information as well as from differences in the domain knowledge of the learners. The actual teaching material does not reflect the different education and major studies of the students; it is the same for all, equal whether they are studying e.g. economics, computer science or pedagogic. Our research approach follows the idea to utilize new technologies from the wide range of TEL to reform these education methods and to guide the learner through his learning process: we call this Learner Orientation.

The main idea of our approach is to put the learner's behaviour in the focus of interest. This approach is not new (e.g. (Lenz, 1998)) and used in many parts of continuing education for adults. The orientation to the individual replaces the principle of orientation to the participants which concentrates on bringing participants into the institution of adult and continuing education. This development is resulting from the fact that traditional educational systems are not considering the learner's needs. By gearing to the learner and his behaviour the learning process deals with all aspects of the individual and leads to a higher individualization of learning. The result is a higher self-organized and independent learner. This is the main reason why it is mainly used on continuing and adult education. One result from this is for instance the well-known method of Tandem Learning, a method where two learners improve their learning progress in a team and through exchanging each other.

In the following section we reflect the problems which occur especially in the area of ES in higher education and present our technical oriented approach to improve the learning progress in the educational area. The aim is provide a technical solution to consider the personal learning process and progress to improve the teaching material and teaching methods. It is a new method to give the teacher a feedback about the individual problems of the learner within the material and the tasks itself to enhance the whole education in this field of ES in higher education.

3 ENTERPRISE SYSTEMS IN HIGHER EDUCATION

Higher education utilizes ES (e.g. Enterprise Resource Planning (ERP)-Systems) or Business Intelligence Systems to prepare students for the daily routine in their working life and to provide them a practical experience in the application of these technologies. This is often supported by software developing companies like SAP® or Microsoft®, which also have an interest in getting the user, developer and manager of tomorrow in an early touch with their software products.

A common method for teaching ES like ERP-systems is the usage of case studies. Leading software companies like SAP® or Microsoft® provide customized environments in form of customized companies (e.g. the International Demonstration and Education System (IDES) by

SAP® and the Cronus AG by Microsoft®). For supporting these activities the SAP AG build up an own higher education competence network in form of the University Competence Center (UCC) in Magdeburg and Munich based on the SAP University Alliance® programme. Besides, they offer teaching material in form of case studies, mostly based on material used for the origin software training courses. These courses give an overview and more or less detailed impressions of the system functionality, but often lacks in missing background information about company structures and processes.

Though, this concurrent interests have to be considered and the missing of pedagogic and didactic aspects need to be improved and implemented. For an effective usage of case studies it is necessary to give the learner the chance to find his own solution, to consider strategic aspects and to make reasonable decisions. Therefore the case study design is already a critical success factor (Hans et al., 2008).

Besides improving this case study material we want to provide a technical solution based on the user interaction within the system.

4 IMPROVEMENT OF THE LEARNING PROGRESS

As mentioned before, today's business application systems are mainly focusing on the integration of different enterprise sectors within one enterprise or across multiple enterprises. In the best case the solution is an all-round product which covers all the functionality a modern enterprise is dealing with. As a negative side-effect the user faces a rising complexity and an enormous amount of navigation and handling opportunities within these systems. This is one reason why it is becoming more and more difficult for users to handle such complex systems in an appropriate way (Haak et al., 2009).

Our superior aim for the identification of the learner's behaviour is the deduction of the current state of knowledge and the system-familiarity of the user from his executed tasks and steps he performs during the work within the system. A schema which illustrates our idea of the improvement of the learning progress is visualized in Figure 1.

On the basis of logging and tracing information, which is permanently recorded by the system, we are able to analyze the behaviour patterns which also includes specific deficits or general problems a user has in performing his ES-supported work. We can use this information to categorize different user types depending on their knowledge level. Finally, the learning material can be modified, according to the learner's knowledge category. In a dynamic monitoring, the results of the tracking and analyzing phase, which lead to a tailored course material, can be tracked again to close the circle. Future behaviour patterns will be tracked and analyzed in the same way once again, in order to improve the learning progress step by step.

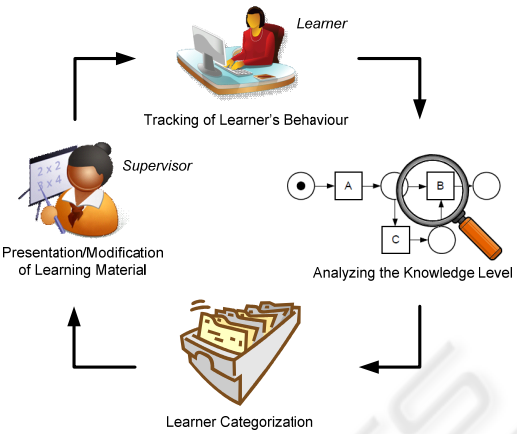

Figure 1: Improved Learning Process.

The schema itself will be described in detail in the following sections. The tracking and analyzing part, which is supported by existing approaches, is explained in Section 4.1. Recognizing these patterns, we can identify possible problem solutions or improvements in specific domains in a technology-enhanced way, in order to improve the knowledge and the performance of the individual user. The enhancement can be realized on top of the tracking and analyzing results. This improvement and its influence on the learning process is explained in Section 4.2.

4.1 Tracking and Analyzing with Application Usage Mining

Regarding the new technological possibilities to track the learner's behaviour in ES, such as ERP-Systems e.g., we can benefit in our work from the existing AUM approach (Kassem, 2007). The user leaves traces in the systems which are logged via trace files and protocols. This tracking information is a record of the performed steps or fulfilled tasks of the user in the system. According to Figure 2, the structure of such a User-Trace-File in the SAP R/3-system for example contains the name of the executing user, the code of the performed

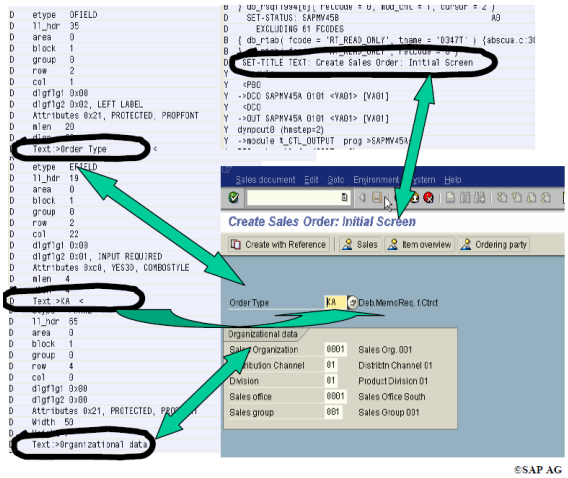

Figure 2: User-Trace-File in SAP R/3.

transaction (*VA01* for *Create Sales Order*), the input values to the specific input fields (*0001* for *Sales Organization*), the transaction time via time stamps and different other things.

The AUM idea is based on the well-established Web Usage Mining (WUM) which is dealing with the analyses of the user's behaviour in the field of web applications (Srivastava et al., 2000; Spiliopoulou, 2000). Defining AUM, Kassem pointed out several differences between web applications and business application systems in order to outline his approach. While browsing the Web, the user has an anonymous access to a web site, a user in a business application system has to identify oneself by using a log-in and his personal password. Another difference is that a visitor of a web site does typically not need an authorization in order the access the content, whereas the user of a business application system has a certain authorization, according to his function in the enterprise in order to perform his assigned tasks. Furthermore another difference is the user's behaviour and the objective, which is completely free or undefined during the visit of a web site, while a user of a business application system has to perform predefined tasks according to a business process, which have to be executed efficient and with an optimal performance (Kassem et al., 2003).

Data Mining, Process Mining and Workflow Mining, as other approaches in this field which also need to be taken into account, are also playing a role in this context. While Data Mining is the basis of all these approaches, it deals with the creation of knowledge out of large data amounts. Therefore Process Mining uses the knowledge of processes and extracts data, which describe the execution of processes in order to model, save and reuse the process knowledge (Schimm et al., 2003). Workflow Mining controls, improves, executes and monitors business processes and aims on the extraction of information about processes from transaction logs for the purpose of visualizing the current status of a workflow model (Zur Mühlen and Hansmann, 2005).

Another approach is the Education Data Mining (EDM), which is defined as the process of converting raw data from educational systems (such as interactive learning environments, computer-supported collaborative learning, or administrative data from schools and universities) to useful information that can be used by educational software developers, learners, teachers, parents and other educational researchers. EDM is also an emerging discipline, concerned with developing methods for exploring the unique types of data that come from educational settings, and with using those methods to better understand the learner (Baker et al., 2008). This information can also be used by the adaptive learning environment, which is introduced in the next section, in order to influence the learner's behaviour as well as on the learning progress itself.

4.2 Influences on Learners Behaviour and the Learning Progress

The results of the tracking and analyzing phase, supported by AUM, built the basis for our new approach of a learner-orientation. According to Figure 3, the adaptive learning model shows how supervisor and learner are connected to the adaptive learning environment.

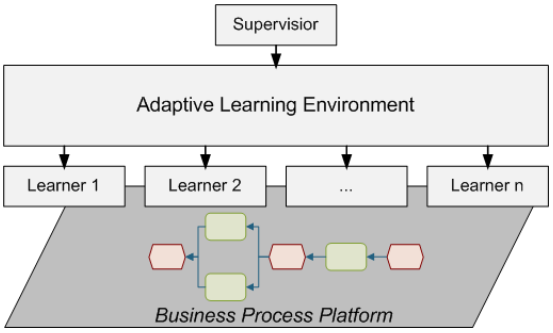

Figure 3: Adaptive Learning Model.

The adaptive learning environment is based on a Business Process Platform which represents processes within an enterprise. Exercises will be generated according to the underlying business processes. This helps the learner to understand the functions which are covered by the business application system. It is also visible that supervisor

and learner are interacting with the adaptive learning environment. This interaction is described in the following.

For example, a learner who wants to fulfil a specific task according to his exercises within the system leaves a mark which can be expressed in a graph or a path. Kassem is using Petri nets to visualize these paths for the analysis of the data. In our approach the adaptive learning environment possesses a predefined workflow structure which contains the "correct" path of fulfilling this task or exercise. These paths can also be visualized with other process description languages like Event-driven Process Chains (EPC) for example.

An imaginable exercise can be the creation of an order with more than one order item in the system. In Figure 4 a Petri net illustrates the SAP transaction *Create Order*. In the first state *A* the learner has to enter the first order item for the order. After entering an item number and the required amount, the learner can complete the order with a confirmation in state *B*. If he wants to add additional order items, the user reaches state *C*. He can enter more order items and then complete the order, which leads him in state *B* finally. In comparison with the transaction workflow of a learner, it is possible to find out, if the learner could complete the task in accordance to the task of the exercise. If the learner had problems in finding the right button to add additional items to the order, his path does not have a state *C*. In this way, the adaptive learning environment can propose a hint in order to help the learner in completing the task. Moreover it could be assumed that the user obviously needs help if he spends too much time in state *A*.

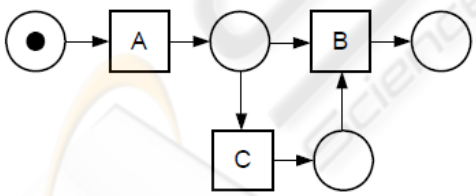

Figure 4: Petri Net of the SAP Transaction *Create Order*.

The way of assistance how the adaptive learning environment supports the learner, depends on the exercise itself and the knowledge level of the user which was captured by the system. Both parts can be influenced by the supervisor.

The proposed solution of the adaptive learning environment will improve the learning progress because of different reasons. The mentioned benefits from a didactical point of view have been introduced in the first chapters. Nevertheless, the technical realization offers more benefits for learners and lecturers, e.g. it is possible to deal with each single problem of an individual learner. The system could offer different ways to get to the solution or recommend related literature. In general, the proposed solution can bring a lot of advantages to the participating parties like the learners itself, but also to the associated lecturers. Each group of learners is associated to a supervising person, which is normally represented by a teacher or lecturer of an educational institution. In the traditional way, an often unequal knowledge level of the learners exists. The learners have different methods of learning and the supervisor needs to respond to each one individual. This is often very time consuming and can mostly not be realized in practice. As a result we can assume that the existing ways to identify the learner's behaviour are not appropriate to fulfil today's requirements in the field of handling ES.

It is also imaginable that different learners who are working on the same exercise can benefit from each other. Experienced learners can assist learners who do not have the same experience. This scenario is also supported by the adaptive learning environment. Via the comparison of the solution paths from different learners the system can identify similar problem groups or learners which can help each other in a successful way. If there is a learner who already completed the task after having the same issue, he might be the best contact person.

Furthermore the comparison of solution paths can be used to find out whether there is general problem concerning the content of the exercise. In this case, if the majority of the learners have the same issue which makes a positive completion of the task impossible, there might be a deficit in the way an exercise is putted. In this case the supervisor will be informed about the appearing problem. As a result it could be necessary to improve or rethink the teaching tasks and methods. When talking about the tracking and the further processing of the learner's progress, we need to take privacy issues into account, which are not analyzed at this early step of research.

5 CONCLUSIONS AND FUTURE WORK

In summarization, the teaching of ES in higher education is a young discipline, which has to be improved to fulfil the needs of today's students. The

learning process has to be more flexible and individually customized to the background of the student and to the needs of global employment market. Therefore we focus on the concept of Learner Orientation and design a concept to improve the teaching of ES in higher education supported by a technical solution which considers the knowledge level of each individual learner.

The introduced AUM delivers techniques to identify the behaviour of a user in an ES. Therefore it uses the transaction data which is tracked during the interaction of the user with the system and is stored in trace- and log-files for further analysis. Our proposed adaptive learning environment, as a major part in the adaptive learning model, can analyze the user's behaviour and draw conclusions to the knowledge level and possible problems during the work. Then, it can deduce problem solutions on the basis of the analyzed data and assist the learner in completing his task. Besides the learner, the adaptive learning environment can also assist the supervisor or lecturer of a group of learners. Thus, an improvement of the learning process including all participating parties can be assured.

In future the architectural design has to be formulated in much more detail. The different components of the adaptive learning model have to be more concrete and well defined. After this, a first technical implementation of a prototype will be focused. Therefore it is necessary to identify the specific requirements and distinguish the parts which definitely have to be realized. In the end, an evaluation of the success and the major improvements in comparison to existing approaches will be carried out.

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