Towards an Adaptive Enterprise Systems Learning Environment for Higher Education

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Abstract. The need of knowledge about well-known Enterprise Systems cannot be ignored by modern higher education institutes. Especially the practical handling and understanding of these systems is not imparted by today's universities in an appropriate way. Thus, we observe an increasing need for adequate teaching methods going along with the demand for a better technological support via adequate software systems. The main objective of this PhD project is to develop a concept for a technologically enriched, integrated, and adaptive environment which supports the individual learner in his learning process. The basis for this adaptive approach is the analysis of information which is stored in trace-files coming from the Enterprise System. Thereby, it is possible to deduce the knowledge level of each individual and optimise further exercises to build the needed competence.

Keywords: Adaptive Learning Cycle, Adaptive Learning Environment, Application Usage Mining, Enterprise Systems, Higher Education.

1 Introduction

In today's education system we are facing various new challenges. Especially the current situation for higher education institutes is affected by major changes coming from different perspectives. Universities and universities of applied sciences, as the major education institutes, complain about high drop-out rates, shoestring resources, and an increasing pressure of competition. From the students' perspective, we can observe a development towards an output-oriented perception, a higher attendance for continuing education, and a rising mobility. Besides the institutional and the students' perspective a third domain perspective is identifiable, which is affected by often changing requirements regarding the content of teaching. Furthermore, different demands coming from the industry and public authorities have to be brought in line with ongoing research topics. Especially in the domain of teaching Enterprise Systems (ES), like ERP systems e.g., this balancing act between industry and research has a very high significance. ES are a good example for the combination of industry and research topics and also allow a very good insight into the illustration, visualisation, and simulation of business and decision-making processes to students

[1]. Therefore knowledge in development and handling ES is highly recommended. This is also underlined by many studies, which show that graduates with experience in ERP systems have better chances on the job market [2], [3], [4]. The industry asks for an adequate knowledge level in handling the most popular ES in order to meet today's market requirements and stay competitive. In summary, ES can be seen as an important component of a modern academic education. Higher education institutes are facing an increasing demand for a sufficient practical education, which has to go along with the communication of the expertise in theoretical knowledge.

Starting from the problem definition in the next subsection (1.1), the objectives of the PhD project will be described. On the basis of these objectives, concrete research questions will be derived (section 1.2). Furthermore, the procedure on how these problems can be solved is explained and a link to the relevant and used research methods is given (section 1.3). In order to meet the requirements for a proposed Enterprise System Learning Environment (ESLE), a conceptual idea for an architecture is introduced in the next section (2). The impact of the PhD project contribution to the problem solution is described in the following section, including a discussion on how the suggested solution is different to existing approaches (section 3). The contribution will close with a summary and final conclusions (section 4).

1.1 Problems

Teaching the handling of software systems, particularly enterprise systems in a practical way, is a relatively new discipline. The development of new software systems is a very fast changing field in comparison to other domains. One occurring problem is the lack of appropriate learning material. The existing material is often realised through case studies (like e.g. the SAP® IDES[1]), which describe a real business scenario and consist of one or more occurring problems resulting in exercises. The students have to work on these practical exercises in order to solve the defined problems. Unfortunately, the success of the case studies lacks for different reasons: Often the students do not understand the underlying business processes with its integration aspects, because the exercises are formulated too specific in order to allow a wide-spread constructivist learning approach [5]. In most cases, the teaching concept does not consider pedagogical aspects in order to support the individual learning process. Furthermore, case studies are presented to a whole classroom, whereby the learning material does not care about individual strengthen and deficits of every single student. Another disadvantage is the lack of a technological support in solving the described problems. How can the learning material be connected to existing Learning Management Systems (LMS) or further supporting systems?

Other practical learning approaches, like ERP simulations (e.g. ERPsim by Léger et al. [6]), do neither cover the integration of a more detailed theoretical insight nor consider the individual state of a learner. In order to solve these problems, the main objectives of the PhD work are described in the next section.

[1] IDES = International Demonstration and Education System

1.2 Objectives

After giving a short insight in the current problem situation for teaching ES in higher education, the main objectives of the PhD project can be formulated. Generally spoken, the main objective of the PhD project is the development, conceptualisation, and prototypical implementation of an adaptive ESLE on the basis of trace-file information in order to improve the overall learning process of the individual learner. Therefore, the learning material, which is presented to the learner, is varying in its specification depending on the prior behaviour of the learner. This information can be deduced from trace-files, which are provided by the most common ERP systems and track nearly each step of the user. This information allows a real-time supervision of each user and gives information about the degree of fulfillment of given exercises. A very important aspect is the integration of the planned learning environment into the familiar working environment. More precisely, the learner will receive hints and exercises, adapted to his individual state, directly from an overlapping interface which corresponds with the regular interface from the ERP system. These objectives lead to the following research questions:

- To what extend can trace-file information allow assumptions about the students learning behaviour, learning styles, and the measurement of learning success?
- How can the learning process, regarding the domain of ES, be improved on the basis of a technology enriched, integrated, adaptive learning environment?

1.3 Scientific Approach

The scientific approach consists of an intensive literature research which also includes a comparison of the main existing solutions and research activities in this field. In parallel, a first conceptional design of the targeted architecture for an ESLE will be developed. The resulting ESLE architecture will build up the basis for a prototypical implementation in the university environment. With this prototype, the theoretical results of the PhD project can be evaluated. Emerging results from the whole PhD work will be summarised in other contributions, which will be submitted to relevant conferences in order to receive feedback from international experts for technology enhanced learning and ES education.

The current state of the doctoral work is the development of the ESLE architecture. More precisely, the actual topic is the comparison of different mining technologies in a technical way for tracking and analysing purposes. Until now, four contributions have been published and presented on international conferences [7], [8], [9], [10].

2 Idea

The main idea of the presented approach is to support the learning process on the basis of trace-file information. Introducing the developed Adaptive Learning Cycle

(ALC) [7] in the next subsection (2.1), the main characteristics of the considered architecture (section 2.2) will be presented.

2.1 Adaptive Learning Cycle

The focus of the idea is primarily on the learner itself. This learner-oriented view assumes that an ESLE is based on the individual and his specific qualification [7]. In order to describe the main idea more general, the ALC is visualised in figure 1. Within the ALC, exercises and tasks are adapted to the individual state of the learner.

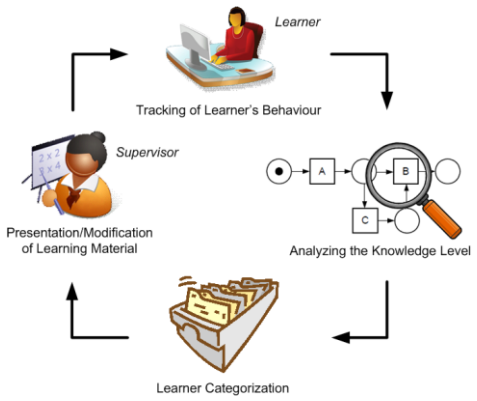

Fig. 1. Adaptive Learning Cycle.

The ALC is subdivided into four areas: Initially, it starts with the tracking of the learner's behaviour, while he is performing a specific task directly in the system. On the basis of this information, it is possible to analyse the learner's behaviour and derive some detailed information about the knowledge level, strengths and weaknesses or general information about the learner and his familiarity with the system. This leads to a categorisation of the learner as a result of the analysing phase. Depending on the assigned category, the learning material can be modified by an advising entity (a lecturer e.g.) and presented to the learner. The effectiveness of this new advisement can also be measured in later cycles. For this case, the success of the new modified learning material, which was presented to the learner, can be analysed via a second run through the ALC. If applicable, are new categorisation of the learner can be made. The concrete functionality will be described within the component description of the architecture of the ELSE in the following section.

2.2 Enterprise System Learning Environment Architecture Approach

At the current state, the development of the ESLE architecture is main task of the PhD work. Therefore the main characteristics of the already defined components will be described. The overall architecture approach is build up on the basis of the ALC.

Later, the resulting architecture will provide a definition for the necessary components and their connections between each other. The architecture will also provide the basis for a later prototypical implementation for evaluation purposes.

Tracking. The ESLE architecture has to include a tracking component, which is responsible for a real-time extraction of trace-file information from the underlying ERP system. The tracking can be carried out during the daily work integrated into a workplace, during a training course, or in a curricular environment. The most ES are logging transaction data via trace-files and protocols. In a SAP® ERP system for example, a huge amount of data is collected during daily operation. In so called user-trace-files detailed information (e.g. name of the performing user, transaction codes, input values, time duration, etc.) about the performed interaction between the user and the system is stored, which can be used for further analysis.

Analysing. The analysing component of the ESLE architecture has to interpret the tracking information in order to find out patterns, which are relevant for the learning aspects like the performed transactions, in- and output data, or the required time. In this component, different existing mining technologies such as Application Usage Mining (AUM) [11] or Educational Data Mining (EDM) [12] come into operation. The derived patterns can be used in order to categorise the learner including a consideration of the current exercise he performs.

Categorisation. The challenge of the learner categorisation is, to evaluate the degree of task fulfillment. Therefore the categorisation component has to compare the intended learning target of the exercise with the concrete transaction, the learner has performed at the system (coming from the analysing phase). On the basis of this result, the new individual learning material can be presented to the learner. Thus, the learner receives an ad hoc response to his performed task, whereby strengths and weaknesses can be handled in an optimal way.

3 Impact

The suggested idea is different in comparison to existing approaches to the problem. It combines the adaptivity and personalisation, which is introduced by Graf and Kinshuk [13] especially for LMS with the practical use of ES realised by case studies (e.g. SAP® IDES). Existing approaches regarding practical exercises such as ERP simulations (e.g. ERPsim by Léger et al. [6]) do not cover this individual support of the learner. Another aspect for practical introductions to ES is the lack of pedagogical issues. The suggested idea will cover methods of competence-building according to the constructivist learning paradigm [5]. Furthermore the involvement of new technologies will be taken into consideration as well. It is possible to connect or integrate the described ESLE into existing learning platforms like LMS or Learning Content Management Systems (LCMS) to provide further adapted learning material to the students.

4 Conclusions

In summary, this contribution introduces a new approach for a technology supported learning environment for the competence-building in the domain of ES. Starting from today's problems in teaching of ES for higher education, this PhD project aims on the improvement of the individual learning process on the basis of historical traces a user leaves in the system. After introducing the ALC, the first components of the planned ESLE architecture are described. In future, the single components will be developed more in detail in order to provide a general architecture. In the end of the PhD work a prototypical implementation will be realised. The results will be evaluated in a university environment in order to measure the success of the suggested approach.

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