CUSTOMISING E-LEARNING-PROCESSES

Towards a Decision Support System for the Individual Selection of E-Learning Services in Academic Teaching Processes

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Abstract: This paper presents a method supporting decisions for the selection of information systems in the context of electronically supported teaching and learning. Existing approaches are supplemented by considering individual context factors and teachers' configuration desires. The supported selection process ranges from the specification of situational characteristics of the teaching process to an individual selection of required e learning services. Thanks to a process-oriented approach, functionalities of e-learning systems as well as non-automated activities are identified. This comprehensive approach enables teachers to select an information system appropriate for an individually planned learning scenario, which further consists of both automated and non-automated parts.

1 E-LEARNING-SERVICES FOR ACACEMIC TEACHING PROCESSES

With e-learning, the design and application of information systems is subject to research aiming at the increase of both the effectiveness and efficiency of learning processes (Curran 2004 p. 1; vom Brocke 2005). Recent learning products for example can increase effectiveness, whereas efficiency can be enhanced by special and temporal flexibility (Wentling et al. 2000; Arnold et al 2004 p. 37). The realization of these potentials can be achieved by a large number of e-learning systems. (Lai-kuen/Eastham 2002) Therefore users are confronted with the necessity to choose a single or a combination of systems that support their individual teaching and learning scenario best (vom Brocke 2005; Westerkamp 2004).

Recent papers emphasize the impact of non-technical aspects on the arrangement of teaching scenarios (Dittler 2003 p. 14; Euler 2004; Albrecht 2003). The need for personnel giving technical support, such as helping with setting up notebook and beamer or handling the backing-up of online learning material are examples for these aspects.

In order to ensure consideration of both technical and non-technical aspects for the configuration of teaching and learning scenarios, this paper utilizes the term e-learning services. An e learning service refers to an independent part of an information system fulfilling a specific task in the context of e learning. In general, information systems are constituted of purposive socio-technical systems dealing with the dissemination and the exchange of information (Ferstl/Sinz 1998; Scheer 1994). The systems are described socio-technical for the reason that people as well as technical equipment are involved in the dissemination and exchange processes. In contrast, information systems with entirely automatic execution are referred to as application systems. Information systems are purposive as they serve the accomplishment of a specific task. E-learning services include services of applications (e.g. chat or newsgroup) as well as organizational services (e.g. the didactic concept).

The arrangement of computer-supported teaching and learning processes demands determining which which e-learning service is relevant in the specific scenario (Adelsberger/Pawlowski 2002). From the teachers' perspective, this includes the choice of services required for the realization of their individual teaching scenario. From the university's point of view, the decision relates to the teacher-supporting service to be provided. Due to the definition of service in this paper, both applications and organizational services are concerned, each of

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them regarding specific context factors (Lasonen/Finch 1995).

2 INTRODUCTION OF A METHOD FOR THE CHOICE OF E-LEARNING SERVICES

2.1 Preliminary Work

Preliminary papers concerning the choice of e learning services focus on either the analysis of application systems (Schulmeister 2001 p. 165ff.; Baumgartner/Häfele/Maier-Häfele 2004 p. 153) or the evaluation of software products using a list of required features (Schulmeister 2000; Baumgartner/ Häfele/Maier-Häfele 2002 p. 65ff.). These papers are constricted to the technical part of teaching and learning processes, whereas non-technical parts of information systems are largely missing. Additionally, the principle of service-oriented design of application systems is left unconsidered. In this paper, a method based on a regulatory framework is introduced, enabling teachers to identify individually necessary e-learning services. Finally, the benefits of this method are illustrated by means of a short example.

2.2 General Framework

The method presented in this paper comprises three levels: the context, the process and the service level. The regulatory framework shown in figure 1 illustrates the composition of the method.
In the following, these three levels are described in detail.

Context level

The first level facilitates teachers describing their individual teaching scenario with regards to their context factors. These factors are based on papers by Schulmeister and Arnold et al. (Schulmeister 2003 p. 175ff; Arnold et al. 2004 p. 9) enabling the description of individual preferences and restrictions (Baumgartner 2002 p. 9). Criteria for the selection of the factors are independency and completeness.

Process level

Based on the teaching and learning scenario described in the prior level, the processes required for the preparation, accomplishment and post processing of courses are considered.

The teaching processes identified by Arentsen/Wieland as well as Gervedink Nijhuis (Arentsen/Wieland 2001 p. 6; Gervedink Nijhuis 2005 p. 68) provided a basis for the processes regarded in the method introduced in this paper.

Further activities (i.e. parts of a single service) can be added easily in order to ensure the

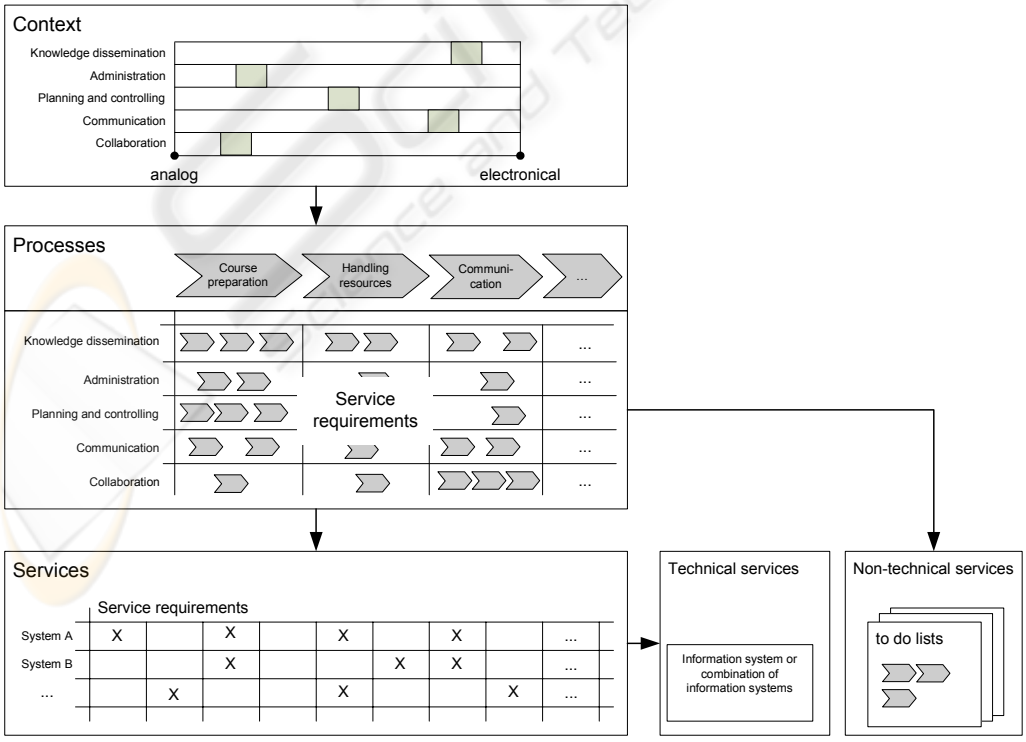


Figure 1: Regulatory framework for the choice of e-learning services.

upgradeability and adaptability of the method.

For each activity, the service requests required for the accomplishment need to be identified.

Service level

Finally, adequate e-learning services are identified on the basis of requirements derived from the prior levels. Services concerning technical parts of the information system can be utilized for the choice of an application systems. Other services, mainly consisting of organizational activities needed for the accomplishment of a course, are merged in a to do list.

The following chapter describes the proceeding within the method and elaborates on the levels in detail.

2.3 Levels of Configuration

2.3.1 Context Level

The first level enables the specification of context factors for teaching and learning processes. Technically, they can be described by the vector K:

$$K \in \{K_1, K_2, ...K_n\}$$

The motive of this selection is the bundling of expectations towards the support of information systems for teaching and learning processes on a pragmatic level. The required services – technical as well as non-technical – are not pre-specified, but are selected by the method on a subsequent level.

For the standardized description of context factors according to the vector K, a catalogue of factors has been developed. In order to structure these factors, they have been subdivided into categories, created according to the proposed description of teaching scenarios by Baumgartner/Häfele/Maier-Häfele and Schulmeister. (Baumgartner/Häfele/Maier-Häfele 2003 p. 8f.; Schulmeister 2003 p. 175; Arnold et al. 2004 p. 91). Figure 2 illustrates the categories and provides examples of context factors for each of them.

Category	Examples for context factors
Knowledge dissemination	Presence lecture with presentation software; synchronous lecture with spatially separated participants communicating by video; interactive elements within self-study
Administration	Provision of paper documents, Transmission of electronic materials by e-mail; Provision of electronic materials on the web.
Planning and controlling	Presence examination; paper-based evaluation; multiple-choice evaluation on the web.
Communication	Newsletter; information on a website; discussion forum.
Collaboration	Computer-based presence seminar; synchronous editing of documents by learners; asynchronous editing of documents by teachers.

Figure 2: Categories and examples of context factors.

For every context factor, the teachers can decide whether and to what extent it should be supported by technical systems. Thus, the teachers' preferences and possible restrictions can be specified for each individual e-learning scenario. Within each category, multiple context factors can be chosen. The descriptions of the context factors are based on the needs of teachers intending to keep usage barriers as low as possible. In order to increase usability, pre-defined combinations of context factors are provided, enabling the selection of required application systems and organizational services, even without profound technical knowledge.

2.3.2 Process Level

Based on the context factors describing individual preferences and restrictions, the required processes are identified within the next level. These can be described technically by the vector P:

$$P \in \{P_{1,}, P_2, ...P_n\}$$

The processes and activities proposed by Arentsen/Wieland and Gervedink Nijhuis serve as a basis for the processes used in the method described in this paper. (Arentsen/Wieland 2001 p. 6; Gervedink Nijhuis 2005 p. 68). Within the method, 11 processes containing 40 activities relevant for e learning are pre-defined. A connection of the vectors K and P produces a matrix, in which the cells

contain specific requirements for services in the form of a vector S. This vector can be described technically as follows:

$$S \in \{S_1, S_2, ...S_n\}$$

The vector includes the technical and non-technical services required for a specific combination of a context factor and an activity. Figure 3 shows the matrix and the existing service requirements in an extract.

In order to match all requirements of services, a subsequent function of the method analyzes all relevant cells. Cells not containing any data are not considered.. The function determines the vector of required services $B_{n,m}$ which can be described as follows:

$$f(K_n, P_m) = B_{n,m}[S_1, S_2, ..., S_n]$$

The vector of required services comprises all relevant services required for the realization of an individual scenario. Within this vector, technical as well as non-technical service requirements are being considered. Technical requirements form the basis on which application systems are chosen. Non-technical requirements serve the identification of additional services required for the support of a teaching scenario.

Further differentiation of the processes and activities as well as the possibility of additional activities being supplemented are offered within the method by means of specific interfaces. Thus, the capability of development and the future usability of the method are ensured.

2.3.3 Service Level

The identified required services which can be realized by application systems provide the input parameters for the choice of a suitable information system. (The papers of Baumgartner/Häfele/Maier-Häfele and Schulmeister serve as a basis for the identification of computer-supported services. Baumgartner/Häfele/Maier-Häfele 2002; Schulmeister 2000). Available information systems require an analysis regarding their support of e learning services in order to ensure an adequate choice for teachers (refer to figure 4). For every information system

$$IS \in \{IS_1, IS_2, ..., IS_n\}$$

a vector

$$S \in \{[S_1, S_2, ..., S_n], [S_1, S_2, ..., S_n], ...\}$$

needs to be defined, which includes all services supported by the system. Therefore either a single or a combination of information systems is proposed to teachers − according to their individual scenario. This proposition is the result of a best possible overlapping of the vector

$$B = [B_{1,1}, B_{1,2}, ..., B_{n.m}]$$

where a vector S represents a single information system or a combination of several.

The service-oriented approach of information systems is advantageous since the information systems do not require categorization in advance. Consequently teachers generally do not need to take into consideration which application fits their requirements best. Instead they determine the best fitting system regarding their individual requirements by means of the described decision support process.

Processes / Context factors	Course preparation			Communication with colleagues	...
	Research lecture materials	Develop lecture materials	Create excercises and tasks		
Knowledge dissemination ... Use of presentation software ...	Search former presentations	Develop presentations	---	...	...
Administration Sub-factors [1, ...n]	S.4 S.5	S.1 S.2	S.7 S.6	S.8 S.9 S.3	...
...	...	...	...	...	...

Figure 3: Contex-process-matrix.

Services / Application system	Development and administration of materials					Communication			...
	Search feature	Create material	Administer materials	Up- and down - load of material	...	Chat	Newsgroup	...	
Clix Campus	☑		☑	☑		☑	☑		...
WebCT	☑	☑	☑	☑		☑	☑		...
...			...						

Figure 4: Matrix of services and application systems.

3 APPLICATION OF THE METHOD BY MEANS OF AN EXAMPLE

This chapter presents a concrete example illustrating the possibilities offered by the method discussed in this paper: a university teacher for business administration wants to conduct a presence lecture in accounting. Important news such as room or schedule changes should be transmitted to the students by e-mail newsletter. In addition, documents utilized in the lecture should be provided electronically. It is assumed that the teacher has already used presentation software and a beamer for other lectures, wherefore lecture materials have already been collected and transformed into the format required for presentation and dissemination. Finally, the teacher does not intend to spend monetary resources for the purchase of software. Thus, commercial software is excluded from the consideration.

Initially, the teacher can chose the categories of context factors required for the realization of a specific course. For the purpose of this example, the teacher selects Knowledge dissemination, Administration and Communication. Presence lecture with the use of presentation software, provision of electronic data on the web and newsletter are the relevant context factors for this example.

Based on the inputs of the user, the system generates a list of processes the teacher has to accomplish. In the scenario described, a software system has to ensure the processes Transmission of lecture notes to learners and Provision of electronic materials on the web. Further, the teacher wants to make use of asynchronous and unidirectional communication, wherefore only accordant systems are eligible. The provision of material should be web-based as well. In contrast to a transmission per e-mail, this procedure enables the learners to access the materials independent of access to their own computer. Moreover, the teacher wants to use the advantages of a document-management-software, noticeably facilitating the administration compared to editing an html-page.

The technical services form the basis of a requirement catalogue based on which an application system is chosen that fits the teacher's individual needs. Considering the scenario described, for example, a software system is sought combining functions for providing and updating materials on the web on the one hand and administration of e mail groups on the other hand. The learning-management-platform OpenUSS is an exemplary software fulfilling these criteria.

Additionally, the system provides a list of processes requiring manual arrangement, such as collecting the learners' e-mail addresses. This sorted list of non-technical services facilitates the preparation and accomplishment of courses for teachers. Moreover, an analysis of several of these lists enhances the transparency of the demand for e-learning services. Thus, university management is assisted in the decision on providing manual or semi-technical services for teachers.

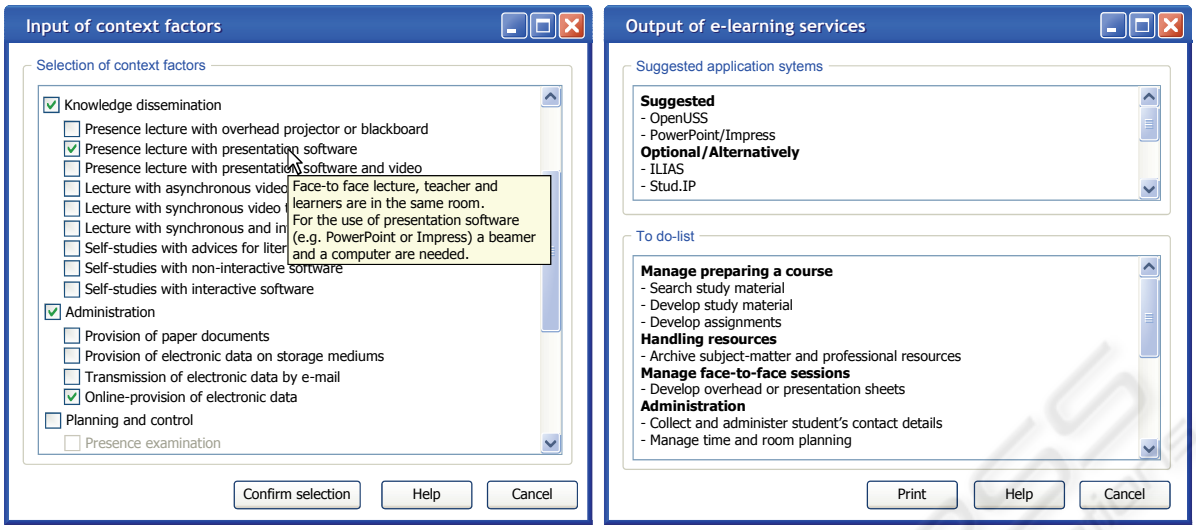
Figure 5 shows a possible implementation of the method. The user can select the relevant context factors in the input window on the left. Upon clicking the "Confirm selection" button, the right window is displayed, showing the suggested application systems and non-technical services.

Based on a J2EE framework, the implementation of the method will be designed as a web-based open source application. The context-process-matrix and the matrix of services and application systems are both stored by use of a relational database.

4 CONCLUSION

The heterogeneity of teaching at universities requires individually designed e-learning services. These services result from both specific restrictions as well as demands of the teacher. In the course of this paper, a method to tackle this problem has been presented.

The method enables teachers to compose an individual mix of services according to their situation. Additionally, a basis for the identification and comparison of the demands of several teachers is provided. Thus, the university's demand to identify reasonable software systems requested by several teachers is satisfied. Decisions regarding which application systems (e.g. learning-management software) to acquire or which



organizational departments (e.g. helpdesks) to set up and change respectively can be facilitated.

The participation of teachers in the selection of services seems promising in order to utilize the teachers' decentralised and detailed knowledge. On the other hand, the acceptance of selection decisions is enhanced. In order to increase efficiency of coordination processes, pre-configured combinations of context factors can be chosen and adapted in accordance with individual needs. The simple and transparent operation of the model reduce usage barriers.

However, in this early stage of the method conclusions are limited due to the lack of an implemented application. Upon accomplishment of the implementation, the tool will be deployed at the University of Muenster. A subsequent evaluation by both teachers and university management regarding the usability and the extent of facilitation will be initiated once the first usage data is available. In order to apply this service-oriented procedure, future e learning services have to be evaluated regarding their requirements on the process level. Maintaining and updating a pool of services seems to bear promising possibilities, following the aim to share good practices in e-learning.

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