DOES ANYBODY NEED HELP? PUPILS AND TEACHERS IN HARMONY

Creating an Adaptive Visualisation-module for Teachers to Support their Scheduling and Teaching Processes

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Abstract: In this paper a concept for an adaptive visualisation-module (short: AViMo) for teachers is introduced. An overview on existing European software tools used in schools is given and discussed. Out of this discussion the additional needs for teachers and scholars are outlined and transformed into criteria for the planned project of AViMo. New technologies, like subjunctive interfaces, together with the knowledge out of two internal projects are introduced to meet the specific requirements. Software Tools used in schools e.g. school-management software or learning management systems provide a wide range of data. The authors describe ways to integrate and combine this data by the use of interoperability standards. A framework is introduced to illustrate the system components that are involved in the adaptive determination process. For visual preparation of the data and their combination an approach based on subjunctive interfaces is presented. The proposed adaptive visualisation-module is a first approach to support teachers to implement an individualised teaching, including the identification of the individual support for every scholar in his class. Besides open issues mentioned in this paper, the work shall offer a basis for further discussions.

1 INTRODUCTION

A good school lesson requires that defined content is taught in a way that every pupil can follow. Therefore it would be good to prepare the lessons in harmony with the teachers needs and with the pupils gratifications. Many projects tried to find solutions for these requirements, often they ended according to W. SHAKESPEARE "The wish was father to the thought".

Working on projects in the field of knowledge management and e-learning, the authors found similarities in the problems they worked on, to the requirements for an adaptive visualisation-module used in schools. In this paper we introduce a planned project, where a software-tool is to be build that supports the teachers in planning and organising their teaching process. From the beginning we would integrate schools, school authorities, teachers and pupils in the research, for a better interaction between research and application. Bringing the users into the project will help that certain situations in teaching and learning will be highlighted and problems will be identified. Schools already use well-structured and easily approachable software especially for administrative purposes. A lot of data is stored and processed, concerning information about pupils, teachers and administrative data. This is exactly where the authors see problems and gaps in relation to support the schools, but especially the teachers and pupils.

The starting point of the present paper is the so-called school management software. Right now this kind of software serves as a basis to handle the whole school administrative processes. Quickly available information is important for schools. Primarily European software products are regarded in this paper (e.g. *WinSCHOOL* (Ramcke, 2009), *CAS Platon* (CAS, 2009), etc.). The various systems differ primarily in the technical design, the kind of access and the graphical appearance. Basically all the systems provide almost the same features: The administration of pupils, classes and teachers, schedules, registers, reports, statistical surveys, inventories and books.

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1.1 Problems and Lacks

The aforementioned systems unambiguously serve almost the perfect support for the management of the schools. There are many approaches within these systems, which serve the support of teachers, students and parents. The focus of these systems is mostly on statistical evaluation, for example classes average, grade point average, attendance messages, etc.

The problem is, that it is therefore not possible to allow an intuitive assemble of the different data within abridgements or evaluation diagrams. There are few customised analyses, charts or tables for the users subjected to the individual non-administrative needs - the teachers and the pupils. Another gap to support the teachers maybe, that mostly only administrative data is recorded. This means that the teachers get the level of knowledge of the class or of individual pupils only on this basis. This is not enough information for the teachers and often it is to late for them to react on bad marks.

But it would be wrong to say that the teachers fall by the wayside. The existing systems are helpful but not flexible enough to give support in all individual situations.

1.2 Motivation

Individualisation, personalisation, adaptivity and user-modelling are in the current software and computer applications development inevitable criteria. With the aid of these approaches pupils could learn better. Additionally the emphasis thereby is the support of the teachers in their daily work. To address individual problems, these must first be detected and analysed. Exactly this is the starting point of the described project: Giving teachers and scholars support to increase, optimise and better control their teaching and learning quality.

A teacher has to schedule the study sessions in accordance to the curriculum. Mostly the tough schedule remains little room to additional maneuvers, e.g. to extend certain topics or even to repeat certain learning matters. Could an appropriate software tool possibly help the teacher in his work, that would not only record the progress of the students, but would process the data and would give the teacher a consistent recommendation on the content for his next session? Additionally the planning tool would adapt on the relevant individuals and therefore could be more and more concrete in its recommendations. In the following chapter the mentioned features will be differentiated.

1.3 Purpose

For the best purpose of the system, firstly data about the specific strengths and weaknesses of pupils, classes and subjects can be determined. This allows the teachers to implement an individualised teaching, including the identification of the individual support for every scholar in his class. Due to the connection of different information the proposed visualisation-module allows a dynamic adjustment (i) of the training of special events (sickness, cancellation of lessons, etc.), (ii) of the level of knowledge as well as (iii) the individual learning progress of the pupils or the entire class.

For the teacher the reflection of his own educational work will be better possible. His teaching will be assessed by reviews from the scholars, who can comment on the content and on the teaching. By the visual connection of this assessed data with subject matters or analog curricula-elements certain weaknesses can be quickly determined in the teaching. Simultaneously varied custom visualisations of the subjunctive interfaces (see section 2.3) can be prepared and presented to the teachers. With these visualisations each teacher can draw individually conclusions and if necessary subsequently reorganise his sessions.

2 APPROACH

How can the identified shortcomings be remedied? Below, the authors lead to different solutions to the problems identified in section 1.1. A universal integrable adaptive visualisation-module (short: AViMo) forms the basis of the approach. The main questions to answer are: (i) What systems provide what data and how this can be accessed? (Input), (ii) In what way adaptive determinations are made and what is needed for this? (Process) and (iii) How does the visual preparation and presentation work? (Output).

2.1 Interfaces and Data Access

School management software, learning management systems (LMS), educational platforms and similar tools generate a large amount of data. Building on the use of established standards and specifications, allows the re-use of these data. Prerequisite is, of course, these systems offer the exchange of these formats.

The central approach is based on the exchange of standardised data. The IMS LIP can be used to get pupil-data. For the evaluation of the learning progress, data based on IMS SS can be interpreted

and the individual results of IMS QTI compliant assessments can be used (see IMS GLC). Basically, the SCORM (ADL, 2006) approach provides a good basis for the use of data access. Besides information on content even curricular data can be used. The information stored in specific metadata-formats like IEEE LOM (IEEE, 2002) can be used to link the data-elements according to the properties. But the account of standard based exchange formats is in the discussion about access to data not enough. There should also be standardised components to provide data. AViMo also needs components to provide the transmitted information to the other system-internals.

2.2 Adaptive Determination Process

The aforementioned information will be required in order to achieve adaptive decision-making processes. For this reason the authors propose a specific framework as shown in Figure 1. In the following the main elements of the framework are briefly described.

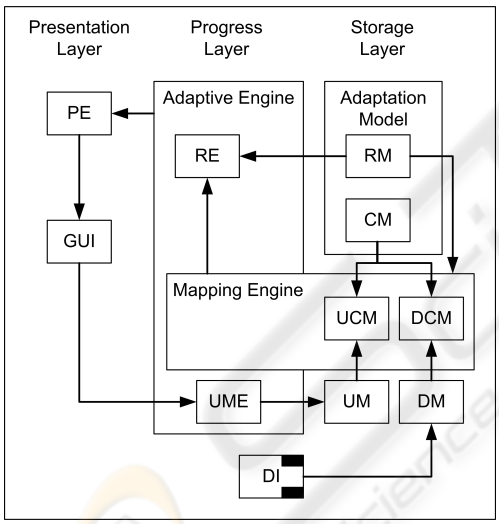

Figure 1: Framework for adaptive Processes.

The Adaptation-Model contains attributes that essentially needed for the process of adaptation. Rules for the adaptation are stored in the Rules-Model [RM], while the Component-Model [CM] stores descriptions about the system components and its functionalities. The User-Model [UM] contains "[...] collections of information and assumptions about individual users (as well as user groups) which are needed in the adaptation process" (Kobsa, 1995). Meta-data and other information are normally stored in a Data-Model [DM]. The system itself does not include any data that is relevant for visualisation. Therefore the data-model will be dynamically built on data that is available through the Data-Interface [DI] which realizes the above mentioned topics of data-access (see section 2.1). The Mapping Engine combines data-elements with specific system-components by creating relations between them on the basis of predefined rules from the Rules-Model. The information of this mapping-process are stored in the User-Component-Model [UCM] and the Data-Component-Models [DCM].

The Adaptive Engine represents the central processing unit of the proposed framework. Specific adaptation rules will be used to process the mapped data in order to serve the Presentation Engine [PE] with specific determinations. This is where the visualisation and subjunctive interface approach comes in.

2.3 Visualisations and Subjunctive Interfaces

Complex problems, are sometimes easier to solve with visualisation, e.g. the spatial representation. For the solution of such problems we use the visualisation, that means, we generate a mental picture of the relevant spatial situation (Schlieder, 1996), by giving the scholars visual information about the relevant learning matter. For the support of such mental images superficially, context-sensitive visualisation objects must be applied. On the technological level this means, find appropriate technologies for transmitting such visualisations. At this point, the technology of *subjunctive interfaces* must be mentioned.

Subjunctive interfaces are a motivated concept from the cognitive psychology to evaluate different variants of complex issues and solutions. It is based on Hofstadter's (Hofstadter, 1979) playful notion of a subjunc-TV. In Jantke and Lunzer (2005) it is explained that subjunctive interfaces are a concept for interface design. This approach has the potential that people in the working process acquire solutions that they otherwise would not find. This profit in the processing of knowledge is to be found in the simultaneous and visually intuitive determinable representation of variants. Subjunctive interfaces provide mechanisms for the parallel setup, viewing and control of scenarios, aiming to support users' thinking about and interaction with their choices. Additionally they are a way to provide such mechanisms by extending applications to support parallel setup, viewing and control of alternative scenarios (Lunzer and Hornbæk, 2008).

In Lunzer and Hornbæk (2008) are illustrated three key design principles for subjunctive interfaces: the interface should give support by (i) setting up multiple independent scenarios that exist at the same time;

(ii) viewing those scenarios side by side; and (iii) making changes to many scenarios in parallel.

Below the authors will show an example based on the first aforementioned design principle "i" (setting up multiple independent scenarios that exist at the same time). Figure 2 illustrates an interface for getting different information about a pupil.

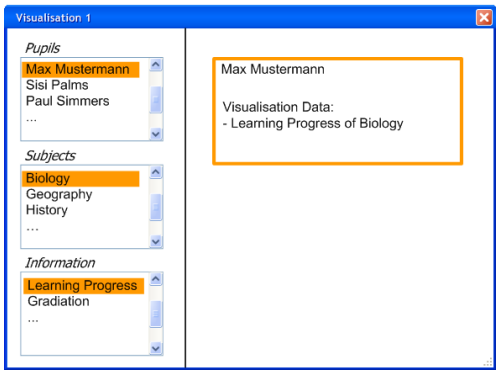

Figure 2: Interface for one data record.

Once the user has selected an item in each menu, the system displays the corresponding records for the learning progress in one subject. The selection in a menu can be changed simply by clicking on a different item, thereby accessing a different record. This kind of interface provides good support for requesting any individual record, but not for tasks that involve accessing a large number of records.

Figure 3 shows a subjunctive interface for this application. This interface can support multiple scenarios, where a scenario in this application comprises a selection in each menu, and the corresponding results. The layout of the browsers elements is unchanged, but each menu can support distinct selections in the various scenarios, and each result displayed shows a separate value for each scenario. Especially for the example in Figure 3 the user can get a comparison of the learning progress for different pupils at the same time, additionally the user can get a combination of certain results.

3 RELATED WORK

The two projects *Knowledge Media Aspects* and *Adaptive Schoolbook* serve as previous work. In one of these projects the goal is to provide adaptive supply of learning material in digital media. Here the areas adaptivity and user-modelling play a major role. The second project deals with the issue of visualisation. Concepts and techniques for better representation of planning processes for a faster decision-making will

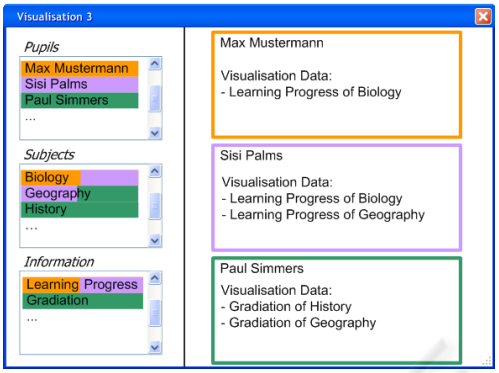

Figure 3: Parallel View and Data Combining.

be created for special applications, e.g. the planning and scheduling of the production in a manufacturing enterprise. From these two projects the priorities of adaptation and visualisation are highlighted.

An effective and efficient system is characterised by a good balance between adaptivity and adaptability. "To increase the quality of technology enhanced learning it is important to distinguish what should be adapted, to what features should it be adapted and how should it be adapted" (Specht, 1998).

Interactive systems that adapt to individual users are used to increase usability and accessibility on the one hand and to increase effectiveness and efficiency on the other hand. The adaptation process of such so-called user-adaptive systems are based on "[...] processes of user-model acquisition and application that involve some form of learning, inference, or decision making" (Jameson, 1999).

Our actual projects (e.g. Adaptive Schoolbook) not only ask for methods of adaptation. Debates about potentials and hazards of adaptivity and the required process of user-modelling are central issues, too. Our goal is to find ways out of problems of adaptation as a self-fulfilling prophecy (Kobsa, 1990). A differentiated and interdisciplinary view on the methods and approaches is important for creating useful solutions.

The basis of user-adaptive systems are user-models. In order to build user-models the system must collect information about its users. A so called user-modelling-component incrementally construct a user-model. It stores, updates and deletes entries, draws inferences from initial assumptions and maintains the consistency of the model.

Basic user-modelling approaches like the Overlay-Model, the Deviation-Model or the Stereotype-Model (Rich, 1979) are mainly based on knowledge-modelling. Our current studies are investigating new ways of user-modelling. The goal is to integrate motivational factors and individual interests to build up an user-model based on the

approaches of Stereotype-Models.

How to bridge the gap between digital and traditional (non-digital) learning material? The Adaptive Schoolbook project will answer this question by combining digital media with common schoolbooks. Measuring the level of a useful integration of digital media in the everyday school life: When is it creating an additional value, when is it a distraction?

The objectives of the project mentioned above are to define needs and to create an application that retrieves digital media by special identificators. The middle-ware approach implies the need of certain interface specifications. Besides the adaptation of the selected media for the used technology, a learner-adapted representation of the digital content will be implemented. The arisen knowledge about adaptive methods and user-modelling techniques will be basically for the discussion of AviMo.

4 CONCLUSIONS

Since years management tools are used on the macro-level, the ministries and school administrations. On this level, the acceptance of the systems and its values are highly proven. On a meso-level, planning systems for schools find their ways in the schools but seem to go through a process of usability and acceptance. In this paper we discussed the micro-level -the teachers and the pupils- and criteria for such a system.

It seems that data for the micro-level already exists. However the statistical data, originally collected for the school administration often is misused to get information about the micro-level. As an example, the data of marks do not give sufficient view on the performance of the relevant pupil. Information on the time needed for the exercise, on replications and on user characteristics additionally should be taken into account. Then individual representations could give the people on charge a differentiated overview on pupils, their needs and their potentials.

The primary technical discussion about this topic raises many open issues to the authors. Considerations to the basic GUI-Design in the light of best possible usability arise questions about the appropriate choice of given Principals of Subjunctive Interfaces. Needless to say, the visualisation style and upcoming questions about their field of application must be answered. Precisely for the practical use, it is necessary to discuss the degree of adaptability and adaptivity. The proposed adaptive visualisation-module is a first approach to this and offer a basis for discussion.

When getting to work on this tool the future users should be involved into the projects from the beginning. They must be able to use it, they should accept it and only they can optimise the benefit of the adaptive visualisation-module.

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