OLD SCHOOL MEETS NEW SCHOOL: THE ADAPTIVE SCHOOL BOOK APPROACH

Adaptivity Extends Conventional School Books with Digital Media

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Abstract: The school book as the traditional learning medium is still going strong. The mere use of digital media is no guarantee for the improvement of learning. In this paper, the project "Adaptive School Book" (ASB, for short) is presented. The focus is on the combination of printed school books with digital media (media mix). This approach is extended to the adaptive deployment of digital media. The overall objective is the optimal support of the processes of teaching and learning. Therefore the authors developed an approach based on the analysis of adaptivity and the detailed discussion of the conditions of the application domain (focussing learning in school). The variety of the influencing factors, the open issues and the risks of uncertain decisions in the adaptation process show the need of a well-considered procedure of development. Therefore, four major steps of development have been proposed. The implementation of the first step of development is shown in a demonstrator. The evaluation of the demonstrator in the context of expert interviews and qualitative studies in school lessons provides important criteria and requirements for the future development of the approach.

1 INTRODUCTION

Since decades the printed school book is the dominating media in school lessons. But, considering the fact that digital media has a lot of advantages, is that still contemporary?

Nearly all schools have access to the internet, are equipped with computers for the lessons, or offer even lessons in so-called notebook classes. Nevertheless, it has shown itself that the introduction of digital teaching media and learning media in the school lessons is a very sensitive field. The initial hype seems to fail because of the real circumstances. A result from the attempts to the mediasation of the schools is, that only digital media does not guarantee an improvement of the teaching and learning. Rather a mix of different media and its meaningful didactic usage is looked as successful-promissory.

1.1 State of the Art

For quite some time school book publishers offer various contents in digitally processed form.

These complementary or additional digital materials can be accessed by data carriers attached to the school books or via internet (Wicke and Baumann, 2007; Brameier and Kreus, 2009; Diehl, 2008). Striking in these approaches is that they are tailored to only one book, at best, to the offer of a publishing house.

In spite of the high relevance for pupils, teachers and parents the scientific debate about the subject "school book" is strongly neglected. General and actual considerations to school books as media and the influence of the digital educational media appear extremely seldom. There is a clear need for research.

It is indisputable that the potential of digital or computer-based media goes far beyond the potential of traditional media. However, the numerous empiric studies on learning with digital or computer-based media (Wiggenhorn and Vorndran, 2003; Herzig and Grafe, 2006; Schaumburg et al., 2007; Hoppe et al., 2011) partly come to very contradictory results. According to Gerhard Tulodziecki (2004) the consideration of learning-relevant conditions as well as the choice of suitable teaching concepts are essential for the use of digital media.

To sum up, is to be found out that the print media (printed school book) and the digital media (digital school book) shows in each case specific advantages and disadvantages. This is reflected, inter alia,

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in studies on the comparison of traditional print media and digital media (Eveland and Dunwoody, 2001). The combination of both types of media, as in the above introduced approaches, therefore has a high potential.

1.2 Problems and Lacks

However, the usage in schools and the expected high economic success of the media mix products is missing, at least in Germany. From the perspective of the authors the essential problems lie in the fact that the approaches are mostly only insular solutions. The complementary digital media are offered just at book level or publishing company level using a uniform platform. These are often merely media collections which are not tailored to specific learning-related conditions such as exist for example in school lessons. Besides, individual needs of teachers and learners often remain disregarded.

1.3 Motivation

The potential which lies in the combination of different types of media should be used. Besides, an universally applicable solution to the connection of the advantages of print media and digital media offers many farther fields of application.

Learning processes and learning strategies are individually and will usually be caused by a huge number of factors. The adaptation of teaching methods and teaching contents to learning-relevant conditions can indeed be regarded as a central component of successful teaching and learning. The supply of digital school book lessons by taking into account such adaptive methods would show not only an added value, but could increase the efficiency and the effectiveness of the learning as well as the practical suitability of the digital media.

1.4 Purpose

The increase of the efficiency and effectiveness of learning is regarded as a fundamental objective of the proposed project. Besides, the investigation and development of processes for the adaptive supply of digital school book contents as an extension of the media mix approach forms the central purpose.

Within the scope of a generic process of development a universal system which combines the advantages of print media and digital media is realised. The objective of the system development is the adapted supply of digital media by taking into account individual needs. Besides, the arrangement of methods with the focus on the school environment stands in the foreground of the considerations.

Beside the connection of printed school books and digital media the essential objective of this work is the development and implementation of models and methods to support the decision-making ability of a computer system - an adaptive system. But the authors want to go beyond the common approaches of adaptivity. The overall objective (considering the adaptivity) is to implement reflective adaptivity which was introduced by Klaus P. Jantke (2010).

2 THE UNDERSTANDING OF ADAPTATION

In order to achieve increased efficiency and effectiveness of learning, it is considered an art of the teacher to adapt itself to the individual needs of its pupils. Already Burrhus F. Skinner (1954) emphasised the importance of adaptation of the support offering provided by the teacher. In a narrower sense, the excessive demand or unterdemand of learners can be counteracted by measures of individualisation (Heckhausen and Heckhausen, 2006; Heckhausen, 1968). The associated extreme workload for teachers predestines the use of software systems.

In the present paper the very different understanding of the term “Adaptation” is considered as a functional property of a software system. Basically it is distinguished between adaptivity and adaptability. While *adaptability* means the customisation of system-parameters by the user itself, *adaptivity* stands for an automatic, system-controlled adaptation to users according to changing conditions. An adaptive computer system uses information about its users, their tasks and their goals to adapt itself to the user (Leutner, 1995; Blank, 1996).

2.1 Adaptive Systems

The basic functionality of adaptive software systems follows a uniform structure. Figure 1 illustrates the essential elements and relationships of adaptive systems. There are essentially three phases of the adaptation process to highlight: diagnosis, modeling and adaptation. An adaptive system automatically initiates an adaptation due to the diagnosed and modeled data. Accordingly, the content or the User Interface is ajusted.

Basically all dimensions of adaptive methods must be considered. “To increase the quality of technology enhanced learning it is important to distinguish what should be adapted, to what features should

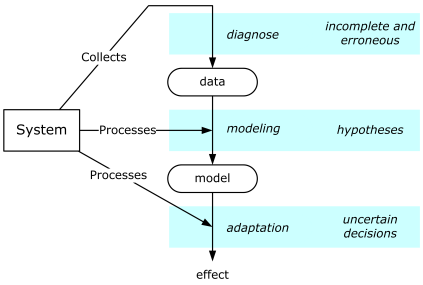

Figure 1: The Basic functionality of adaptive software systems modified according to (Brusilovsky, 1996).

it be adapted and how should it be adapted" (Specht, 1998). Besides, the diagnosis and the modeling earns a central position in the functionality of adaptive systems. They put the points for the actual adaptation process.

2.2 An Examination of Adaptivity

In practice, the illustrated theoretical aspects are associated with many open questions, problems and even dangers (Jameson and Schwarzkopf, 2002; Kobsa, 1990). The biggest difficulty arise in the necessary diagnosis of valid data as well as the adequate modeling. The inconsistent learning behaviour[1], the permanently changing contexts and tasks are only some of the effective interference. An incomplete and erroneous diagnosis of data is the result. The hypotheses based on these data (modeling process) finally admits merly uncertain decisions. This may be one reason why there are considerable disagreements about the methods for diagnosis and modeling, in the research (Jameson, 1996; Brusilovsky and Millán, 2007; Greer, 1994).

Especially the user-adaptive systems, where the adaptation process is based on interests and preferences, are at risk to succumb the problem of "self-fulfilling prophecy" named by Robert King Merton (1948). The systems providing content adaptive alone with the help of the history of the use, influence the choice of the user. This creates a circuit of limited provision, limited choice and therefore limited diagnosis of the contents chosen by the user.

Another problem arises by the reduction of the control over the system. As long as the decisions of the adaptive system are understandable for or hit requirements of the user this is absolutely unproblematic. But if the adaptations do not correspond to the requirements this leads to problems, mistakes or irritations with the user. These problems correlate with the question of the balance between adaptivity and adaptibility of a system which is often discussed the literature (Lohman, 1986; Clark, 1987).

But why adaptivity in other systems has been so successful? The answer to this question is relatively simple: As much factors of influence as possible need to be excluded. Specifically, this is expressed by the very exact definition of the application domain.

However, the objective of the system development treated here is not just aimed at a certain application domain. The system should be universally applicable. It must be clarified, what factors are critical for the optimal use of digital media at school.

2.3 Conditions of the Application Domain

As mentioned (see chapter 1.1), the optimal use of digital media is characterised by partially very different approaches and results of the research. In general, the situation and the task determine their suitability, or how Gerhard Tulodziecki (2004) formulates it, the consideration of learning-relevant conditions .

On account of the lack knowledge about the use of software systems for the realisation of the combination of print media and digital media (media mix) the basic factors of influence of learning at school are to be considered. This opens an almost unmanageable number of issues.

The school system of Germany is characterised by a high degree of heterogeneity. This shows itself in the varied country-specific arrangement in the numerous types of schools and in the different possibilities of courses of education. Besides, no teaching and learning materials are prescribed in Germany. As a result, a wide variety of different teaching and learning materials (including school books) are used. Consequently, software systems for educational use (especially at school) should have a correspondingly high degree of flexibility and universality.

The design of the school curriculum and lesson is customised depending on the school and the teacher. A consideration of the respective situation becomes clear once more. Considering a school lesson, the following key dimensions can be identified: class level, duration, content, teaching method and location.

While the content is given by the appropriate subject of a lesson, the lesson goes through different phases of education, which in turn are influenced by the use of different teaching methods, social forms, instructional materials and so on. It is again clear, that software systems must have a high degree of flexibility and universal applicability.

[1]Due to loss of concentration, tiredness, dynamic and non-monotonic nature of human learning, ambiguity and vagueness of answers.

Besides, the very differently distinctive media literacy of pupils and teachers plays an essential role for the use of software. In the consequence the usability should be marked by simplicity, faithful to the principle “Less is more”.

To sum up, digital media must show a high degree of universality, flexibility and simplicity of use. These three key aspects are essential to guarantee the practical suitability of digital media for educational use (especially at school).

2.4 Development Steps of the Adaptivity

The huge number of external factors of influence, the high relevance of the applicability or practical suitability and, finally, the lack of valid requirements for the application domains considered here complicates the priorisation of suitable adaptive methods. To counteract against the raised risk of wrong decisions of the adaptive system, the development of the system should, according to the authors point of view, run through the following four stages of development:

1. Implementation of the base system and ensure the practicality of access to the digital media and their deployment.
2. Implementation of models and methods of situational adaptive supply of digital media.
3. Implementation of models and methods for the task-based adaptive supply of digital media.
4. Implementation of models and methods for the user-adaptive supply of digital media.

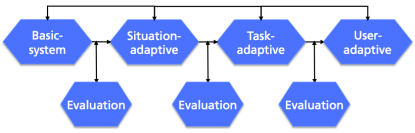

Figure 2: Development steps of the adaptivity.

In other words a gradual realisation of the adaptivity is proposed (see figure 2). In addition, suitable decisions are to be made in each of the phases to the possible or necessary implementation of adaptable elements. Besides, an accompanying evaluation of the results of the developments serves the iterative adaptation and optimisation of the system.

3 THE CONCEPT

Based on the results of the previous chapters, and by taking into account the approaches from (Vogler et al., 2010) the concept for the first stage of development, is presented in the following. The scenario (Figure 3) illustrates the underlying idea.

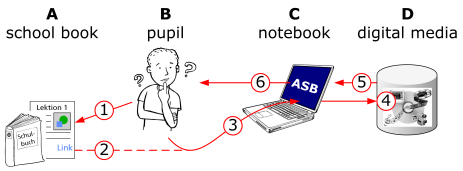

Figure 3: The Concept of the ASB-Approach.

The school book (A) serves the pupil (B) as a guideline through the lesson (1). Under use of a suitable terminal equipment, for example, a notebook (C), the complementary digital media (D) are available. Defined references allow the unequivocal access (2) on the school book lessons.

A software system, in the following designated as “ASB-System”, serves as a interface between the printed school book (A) and the digital media (D). By input the references using the integrated user interface (3), the ASB-System can provide the information that is requested.

This requires a system-understandable representation (4) of the digital media and (the structure) of the printed school book in digital form.

The ASB-System selects the digital media with the help of defined criteria (situation, duties, user’s signs, etc.), ensures an accordingly adapted adaptive provision (5) and displays this to the pupils in the form of a suitable presentation (6).

The proposed approach is based on a software tool to support the learning process. The combination of the printed school book and digital media should produce a balance between the solid structure of the printed school book and the free, flexible, adaptable and adaptive information variety of digital media.

The outlined concept raises many questions. In the following chapters approaches to access, user interface, representation, delivery and presentation are discussed.

3.1 Access

The combination of print media with digital media requires interfaces defined in terms of unequivocal references. The possible detail of a reference is determined by the granularity of the book to be described.

A present key aspect is that the book content can not be considered or referenced without the book itself. Therefore the reference of a book element, in the following designated as *MediaID*, consists of at least two components: a book identificator (BookID) and a identificator for the suitable element (ObjectID).

The objective is to create a referencing that is suit-

able for practical use (short, intuitive, easy to remember, etc.) and universally usable (also books without specially printed identification). Figure 4 illustrates the structure used in the present work. As *BookID* a combination of initials for the suitable school subject (e.g. PH for physics) and class layer (e.g. 08 for class layer 8) is used. The *ObjectID* consists of a marking for the respective chapter (e.g. K01 for chapter 1) and a page number (e.g. S08 for page 8).

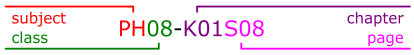

Figure 4: An exemplary MediaID.

The use of unambiguous identifiers such as the International Standard Book Number (ISBN) or the Digital Object Identifier (DOI) are not suitable for the input. Alternatively, the input of textual issues is conceivable to access Media. However, on this occasion, the relation to the book structure would get lost.

The suitability, universality and practical suitability of the proposed MediaID should be checked in an evaluation accompanying the process of development. There may be other options prove to be suitable in everyday use.

3.2 User-interface

The graphical user interface (GUI) is the interface between the user and the system. The design of dialog orientates itself by ergonomic points of view and the principle “Less is more”.

Figure 5: The Basic Design of the Graphical User Interface.

Figure 5 shows the basic design of the graphical user interface of the ASB system. This GUI forms the primary dialog to the access to digital school book elements. The minimalistic design ensures a function-oriented, easy and intuitive usability.

In addition to design aspects the GUI includes three dialog elements. An input field (2) allows the entry of MediaID. By triggering the ok-button (3) the request is executed. In addition, window controls and help functions (1) are available.

3.3 Digital Representation

There is a need for a system-understandable (digital) representation of the book structure. This allows the allocation of digital media to the content structure of the printed school book.

The IMS Content Packaging Specification is well established in the field of e-Learning and offers a very good basis. This specification enables the interoperable exchange of multimedia (learning) content, by providing standardised data structures. As it is shown in figure 6 it consists of a special XML file, called IMS manifest file (imsmanifest.xml), and the corresponding learning object files (resources). The manifest file consists in the essentials of four XML elements: Meta-Data, Organizations, Resources and (sub)Manifest(s). At this point the Organizations- and the Resources-container are particularly interesting.

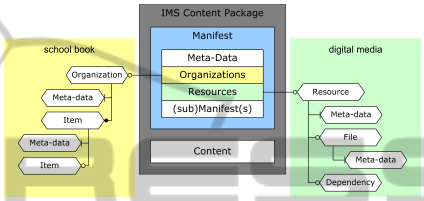

Figure 6: The general structure of the IMS CP.

The *Organizations-container* is suitable for representing the content structure (chapter, subchapter, et cetera) of the printed school book. The `<item>`-elements can be used to build a tree-like structure of the printed book (see Figure 6). Each element can be extended with metadata and references to resources.

The *Resources-container* contains references to all resources and media elements required for the manifesto. This encloses their description by means of meta-data and references to other external files. Therefore the complementary digital media can be described in an adequate data structure.

The *Meta-Data* set is based on the IMS Meta-Data (IMS MD) specification, which is in turn based on the IEEE standard 1484.12.1 - 2002 IEEE Standard for Learning Object Metadata (LOM). So described data offer a high potential for the automated analysis and processing. Especially for adaptive processes they provide a determining basis.

The IMS CP serves as the basis of numerous other specifications, such as the Content Aggregation Model of the ADL Sharable Content Object Reference Model (ADL SCORM), which is considered by a huge number of actual e-Learning systems. The IMS CP provides therefore an excellent basis for the cooperation with LMS/LCMS as for example Moodle[2].

3.4 LCMS Cooperation

The ASB system was designed to act as an interface between users and existing e-learning platforms. The

[2]See http://www.moodle.org.

user can login the LCMS by using the ASB-System and interact with it. Thus, for example, a LCMS like Moodle can serve as a digital repository.

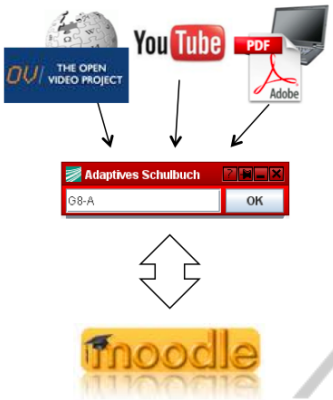

Figure 7: The ASB system to interface with the LCMS Moodle.

3.5 Provision and Presentation

The process of the *provision* can be initialised, for example, by selecting a certain page of a school book (e.g. entering a MediaID). In the simplest case a suitable search algorithm determines the manifest file belonging to the contained BookID and the suitable `<organization>`-Container. Using the Object ID, the concerning `<item>`-element can be determined, its (meta-) data can be read and referenced resources can be identified.

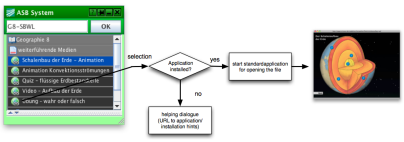

Figure 8: Advanced user interface for selection and presentation of digital media.

The *presentation* of the provided digital media needs the extension of a secondary GUI dialog. In general, more than one digital asset is provided. This requires a specific (user-controlled) choice. Therefore a Media list (secondary dialog) as is shown in figure 8 is proposed.

To promote the pupils media literacy and involving the individual work environment the standard application of the student will be used for the representation.

4 THE IMPLEMENTATION

A first demonstrator of the ASB System was developed for illustration and evaluation purposes.

To guarantee platform independency and maximum flexibility during the development process, the system was written in the Java programming language. The access and processing of the XML structure was implemented using the Document Object Model (DOM) techniques.

4.1 Simple Use Case

From a user's point of view, the demonstrator offers access to and representation of digital school book lessons. Besides, teachers can extend the already deposited contents by own, individual content.

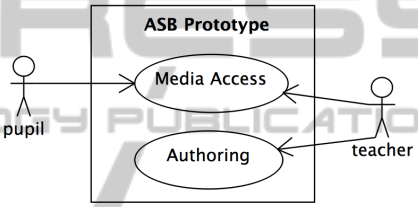

Figure 9: Simple Use Case for the ASB demonstrator.

4.2 Specification

In the first version, the demonstrator is limited to the following basic functionalities:

1. Access to digital media (for example, as a supplement to a textbook) by entering the MediaID or by navigating through a structured list.
2. Presentation of selected digital media assets with applications that are already installed on the system of the user.
3. Drag&Drop Authoring functionalities for the easy extension of existing content with individual digital materials.
4. Adjustment of system parameters, such as the individualization of the user interface.
5. Tracking the usage, so that the system store inputs (such as the MediaID) and system settings, to be quickly available again after a restart.
6. Support the usage by, for example, autocompletion, feedback dialogues and offline help.

4.3 Architecture

Due to the fact that the demonstrator is the basis for further development, the architecture of the system

was strictly designed with the help of the Model-View-Controller Pattern.

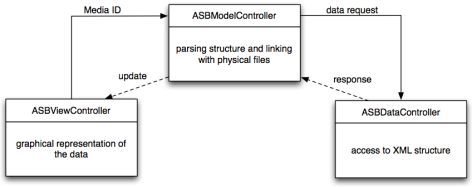

Figure 10: Class diagram of the demonstrator.

This may appear overdimensioned for the described use case, but it offers the essentiel flexibility and extensibility for future functionalities.

Because of the modularisation and the strict separation of the components (user interface, data access and data processing) future requirements like LCMS connection and providing the ASB System as offline and webbased application can be realised subsequently.

With regard to the implementation of adaptive methods and taking into account a maximum interoperability, make appropriate frameworks and reference models a good basis. According to the authors of the present paper, the Adaptive Hypermedia Application Model (AHAM) by Paul de Bra et al. (1999) and the Munich Reference Model (MRM) developed by Nora Parcus Koch (2000) form an appropriate basis for the presented approach.

4.4 Interim Conclusion

To achieve the global objectives, the feasibility and functionality of the first stage of development of the concept, raised in a demonstrator to prove. It is characterised by a high degree of universality and flexibility. For example, it is not bound to a specific school book and can be linked with different books. Besides, it was taken care of platform independence, as well as adaptable changeability and extensibility of the contents. The simplicity of the user interface guarantees an intuitive use and requires a minimum of media literacy.

To sum up, this Demonstrator is able to clear the open questions. It can be used as a basis for evaluations, to gather empiric results.

5 EVALUATION

As a matter of fact, practical suitability of a system is highly important in an enviroment of learning and teaching in school. For that purpose, feedback given by experts and users was included quite early in the concept phase and development stage of the ASB System. The tool and his respective level of development was introduced and discussed in numerous expert's rounds. In addition, the described demonstrator was used and evaluated in two lessons by pupils and teachers of a ninth grade in college. The results of the evaluation can be used to shape clearly defined technical situations and requirements, which are all-important for the further development of the system.

5.1 Evaluation Setup

It was extremely important to get a first impression of realistic and sensible application scenarios while developing the system. For that purpose the draught of the adaptive school book and the existing demonstrator was introduced to experts of a thuringian institution for teacher advanced training and new media.

In four successive meetings the system was presented and discussed in different focus groups. These groups consisted in each case of up to ten teachers, who besides, act as multipliers for new technologies in politics and their own schools. Because of the different technical alignment of the experts (content development, digital whiteboards, eLearning and Moodle integration at schools) a huge number of requirements were determined for a system to fit into a real teaching and learning environment. These requirements reach from aspects of privacy, copyright and security issues, to the authoring of content and finally to the direct application in lessons.

To get a detailed impression of practical use cases in lessons, the system was tested in cooperation with a Thuringian media school. Therefore, a ninth grade was chosen consisting of 25 pupils. Each of them was equipped with a notebook on which they started the ASB system from an USB stick. The teacher demonstrated media access on a digital whiteboard, where the system was also running.

During the lessons, the teacher used the ASB system as a media container to show short movies and illustrations. Later, the pupils retrieved media from ASB with which they completed given tasks. They worked with the system in two lessons on a single day. The lessons were geography (topic: continental drift) and history (french revolution). The contents were taken over in cooperation with the teacher from an already available course in moodle.

5.2 Technical Parameters

Embedding the ASB System into the already existing technical infrastructure of school is mandatory for

ensuring practical suitability. During the discussion with experts the following technical parameters were determined:

1. Already available e-learning systems still require a very high training and administration expenditure which stands in no relation to the benefit of the use of digital media.
2. Missing education and experience in newer technologies deter many teachers from using digital media. The introduction and use of an LCMS proceeds mostly slowly and is dependent from the motivation of the teacher.
3. Digital content, as it is offered at the moment by publishing companies for teaching, is mostly packed into isolated applications and can only heavily be integrated in a school course.
4. Although most schools are equipped with a good connection to the Internet, mostly administrative security issues prevent the unlimited access to all functionalities which the network can offer.
5. It can not always be ensured that pupils and teachers fit the nessessary technical requirements when they want to work with digital material at home.

The experts see the main advantage of the ASB System in its simplicity and clarity. From their point of view the system could serve as an interface between users and a complicated LCMS. It can simply be integrated into the school courses and also can take care of technical processes running in the background, hidden from the pupils and teachers.

As a result of the discussions and the evaluation, several application scenarios were defined. They will be briefly described in the following.

5.3 Use Cases

The system's ability to let the user extend the existing content with own, new digital content via drag&drop authoring seems to be an optimal solution for teachers in the eyes of the experts. So they are able to easily deposit content for pupils and to prepare and give the lessons. Connected to a LCMS, which contains a rights management for every user, the teacher can systematical provide content, which he would like to show to the pupils in the respective phase of a lesson. The compact and simple graphical user interface can be used as a container for media to present it on a digital whiteboard.

Structuring the content with the help of specific Media Ids allows the teacher to granulary organize digital material. The ASB System can also be used to divide the class into workgroups or to assign individual content to specific pupils.

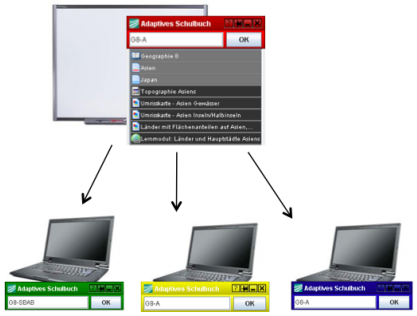

Figure 11: Usage of the ASB System during a lesson.

Because of the permanent synchronsiation of every instance of the ASB system with the LCMS, the teacher can toggle the visibility of every single media for the pupils.

The platform independency of the java-based application makes the ASB System suitable as a portable application, which can be stored on an USB sticks for the use at home or on private laptops. The experts see here the imbedding in a so-called "digital schoolbag", a collection of portable applications which can perform the most common tasks on a USB stick as very sensible.

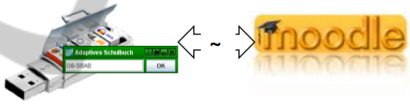

Figure 12: ASB System as a portable application.

The functionality of the system to hold data in a temporary local repository enable the offline usage of the application. A synchronisation with the LCMS can then be done, whenever a connection to the network is re-established.

5.4 Interim Conclusion

The results of the discussions in the expert's rounds, as well as the evaluation of the demonstrator in the lessons permit the formulation of a requirement catalogue for the integration of the ASB Sytems in the environment of school. Additionally, technical parameters were defined, which can describe the different situations where the system is used in. These input parameters can now be used to design a model for the implementation of situation adaptiveness.

6 FUTURE WORK

The results from the expert's discussions and the evaluations justify the suggested iterative realisation of adaptivity as described in 2.4. It is mandatory to embed the system into an existing situation in the environment of school in order to ensure practical suitability and a real benefit in the use. This realisation can only be achieved with appropriate adaptive methods.

6.1 Modeling and Implementation of Situational Adaptivity

The next work package in the ASB project is about implementing the defined use cases, as well as modeling and realising methods for situation adaptivity. Realising the Use Cases implements the technical connection and communication with the LCMS Moodle and the realisation of a suitable synchronisation strategy for the off-line use of the ASB System.

Furthermore, the defined input parameters can be used to model technical situations, to which the system has to adapt automatically. An adaptation controler module will be developed for the ASB System. It will be embedded between the modules *data access* and *processing data*, to control the data transfer between the repository and the user interface.

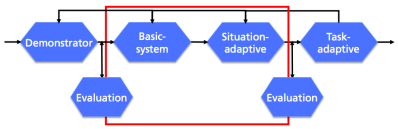

Figure 13: Roadmap for future development.

The goal is to realise a demonstrator, which ensures practical suitability and can directly be used in school lessons. Then this demonstrator can be used in further evaluations to determine results, which can define requirements for modeling and implementing of further adaptive methods.

7 RELATED WORK

The fundamental concept and the theoretical basis of the present contribution was developed in the diploma thesis of André Schulz (2010). The thorough development based on the results and experiences of the research project of our colleagues Hoppe et al. (2011). Their research focused, among other priorities, the impact of the processes of digitisation on the example of a laptop class. This was essential to get important requirements and conditions of the application domain.

Previous work like (Vogler et al., 2010) stated main approaches to the use and combination of existing software systems in the school environment. Focussing the development and implementation of the adaptivity in the presented project, the contribution about reflective adaptivity of our colleague and friend Klaus P. Jantke (2010) provides the mainly forward-looking goal. The developments of adaptivity in LCMS, as presented in (Jantke and Schulz, 2011) offer important insights for the implementation.

The entire related work, however, combines the importance of a differentiated and interdisciplinary perspective on the methods and approaches to make a truly useful solution possible.

8 CONCLUSIONS

The conventional school book is not lost. In this paper it was shown that there is still big potential in printed media when it is mixed with the new opportunities that digital media can bring into the classrooms. In bringing these worlds together teachers and pupils can benefit from the advantages of both kinds of media.

The adaptive provision of digital media guarantees an optimal support of the teaching trials and learning processes. To be able to realize the necessary limitations in the application domain specific requirements must be defined. The huge number of influence factors, the high importance of practical suitability and the lack of valid requirements are complicating the definition of adequate choice of adaptive methods.

For that purpose a gradual development of adaptive methods and definition of influence-taking criteria was developed . Accordingly a concept for the first stage of development was designed. The basis system described in it was implemented in a demonstrator.

The approach introduced in this paper was approved with positive feedback in several evaluations, interviews and discussions with experts. As an essential result well defined Use Cases could be developed. Besides, the high relevance of the practical suitability of digital media was confirmed.

A system used by teachers and pupils can only be a benefit, if it is embedded into the existing technical and social situation of the environment of school. This goal can only be achieved if the system fits exactly the requirements teachers and pupils have in their daily work. The system is confronted with different technical situations when fulfilling the desired tasks. So it is mandatory that this system is able to adapt these situations. The further development of the ASB System designates the consecutive implementation of these adaptive mechanisms.

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