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ABSTRACT

Within an electronic education market, an electronic education mall is defined as a virtual service center to support various transaction processes by providing a technological platform with appropriate value-added services and interfaces for suppliers and customers. In this context, an education broker service is of central importance, because the quality of the learning process is strongly determined by the quality of the available materials and their configuration to an integrated course according to a pedagogical concept and the respective customers' needs. To support these tasks, an Education Broker Toolset is introduced which is designed to: select the "right" elements out of a set of generally suitable learning models; adjust and structure the chosen learning modules to an integrated course in a pedagogically and didactically useful way; add navigational guides; provide added values; and deliver the integrated course to allow an intuitive application by the student. The Education Broker Toolset includes the PreSelector, which provides a questionnaire for determining students' individual needs, preferences, and qualifications, and the CourseComposer, designed to support integration of pre-selected learning modules. A CourseNavigator program enables students to access courses composed by the broker, supports navigational guidance, and provides added values. Three figures present the transaction process of World Wide Web course customization and CourseComposer and CourseNavigator screens. (Author/AEF)

An Education Broker Toolset for Web Course Customization

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Abstract: Within an Electronic Education Market an Electronic Education Mall is defined as a virtual service center to support various transaction processes by providing a technological platform with appropriate value-added services and interfaces for suppliers and customers. In this context, an Education Broker service is of central importance because the quality of the learning process is strongly determined by the quality of the available materials and their configuration to an integrated course according to a pedagogical concept and the respective customers' needs. To support these tasks an Education Broker toolset is introduced which allows to select the 'right' elements out of a set of generally suitable learning modules, to adjust and structure the chosen learning modules to an integrated course in a pedagogically and didactically useful way, to add navigational guides, to provide added values and to deliver the integrated course to allow an intuitive application by the student.

1 A Market-Oriented View on Media-Based Education

Parallel to the technological development an increasing commercialization of education and training can be observed. More and more companies, organizations, and institutions are trying to get their share in the promising media-based education and training market. Supporting the convergence of supply and demand electronically in this context is a true challenge. According to a general definition of the term 'electronic market' [Schmid 1993, 468] the emergence of an electronic market for education and training can be interpreted as a telematic-based marketplace which supports the exchange of goods and services by applying market oriented mechanisms. This market should not only be considered a physical place where supply and demand converge but in particular as a coordination instrument. "The market is not a place, a thing or a collective entity. The market is a process, actuated by the interplay of the actions of the various individuals." [Mises 1949, 258] One can expect that flanking developments in electronic commerce (cf. [Kalakota & Whinston 1996], [Kalakota & Whinston 1997]) will force and shape the establishment of an Electronic Education Market [Hämäläinen, Whinston & Vishik 1996]. Systems supporting the coordination and cooperation tasks within an electronic market have to provide a multitude of services. In addition, standardized interfaces for suppliers and customers are needed.

Internet-based electronic malls are a well-known approach for fulfilling these demands. This leads to the derivative concept of Electronic Education Malls (EEM) [Langenbach & Bodendorf 1998] for educational contents and services, which provide a technological platform with appropriate value-added services and interfaces for suppliers and customers. Some examples are:

- An *education broker* provides specific search mechanisms for the retrieval of learning resources. In addition, he is responsible for the customization of media-based learning material according to individual preferences.
- An *advisory board* offers a didactically sound educational consultation.
- A *certification and quality assurance authority* is responsible for the certification of new courses as well as for quality assurance.
- A *marketing unit* develops individual marketing strategies in cooperation with the suppliers.
- An *accreditation authority* is responsible for the accreditation and registration of customers as well as for various other administrative tasks (e. g., issue and delivery of certificates).

- A *technology provider* supports suppliers during the production and delivery phase helping customers to use media-based resources efficiently.
- A *financial clearing authority* develops individual payment systems, negotiates selling prices, special conditions, discounts, etc. and handles the clearing between supplier and customer.

From an educational point of view, the broker service is of central importance because the quality of the learning process is strongly determined by the quality of the available materials and their configuration to an integrated course according to a pedagogical concept and the respective customers' needs. On the other hand, the quality of the broker service depends on the quality of the tools used for the support of retrieval and customizing tasks and which are at the broker's disposal.

2 Web Course Customization as an Education Broker Task

In the current stage of our EEM research activities, dealing with the modeling of the various mall services outlined above, the education broker is seen as a human actor supported by a set of appropriate electronic tools. Against this background the transaction process of customizing a Web course according to the individual students' needs can be identified in an abstract way as shown in [Fig. 1].

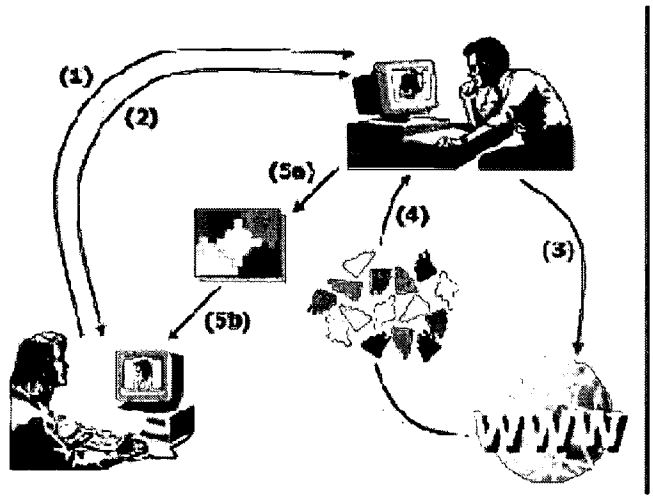

Figure 1: Transaction Process of Web Course Customization

In the first step (1) the customer (student) contacts the broker either asynchronously (e. g., via email) or synchronously (e. g., via videoconferencing) to ask for a course offer on a specific topic. In the course of the following communication process (2) the broker's task is to determine and operationalize the students' individual needs, preferences and specific qualification levels. An individual profile is generated based on the information gained. In the next step (3) this profile is matched with corresponding descriptions of educational Web pages (in the following referred to as 'learning modules'). As a result, a set of suitable learning modules is returned to the broker (4), ranked according to their 'fit' (= the relative quality of how well the respective criteria meet the requirements specified in the students' profile). The fine tuning task of customizing the course - crucial for its final quality - is now up to the broker. It includes the following sub-tasks (5a):

- selecting the 'right' elements out of the set of generally suitable learning modules
- adjusting and structuring the chosen learning modules to an integrated course in a pedagogically and didactically useful way
- adding navigational guides (e. g., guided tours)
- providing added values (e. g., means for student-tutor and student-student communication)
- delivering the integrated course and allowing an intuitive application by the student (5b)

To fulfil these tasks efficiently the broker has to bring in his pedagogical and didactical know-how as well as his specific experiences. In addition, powerful and flexible instruments should be at hand to support the respective steps.

With these demands in mind a set of tools is introduced in the following sections which are suitable for supporting stages (2) to (5b) of the customization process sketched above.

3 The Education Broker Toolset

3.1 The *PreSelector*

The *PreSelector* tool addresses stages (2) to (4). The user interface provides a questionnaire-oriented form which serves as a basis for determining and operationalizing the students' individual needs, preferences and specific qualification levels in the course of the broker-student communication.
Due to the fact that the determined criteria are crucial for the matching with the corresponding descriptions of the learning modules, two critical success factors for the whole customization process can be identified in this context: the items of the *PreSelector* form have to be well specified and the broker has to work very precisely to operationalize the students' answers according to the given items as exact as possible.
The problem is quite similar to the problem of specifying the 'right' keywords for a search engine inquiry. To support this crucial broker task, the *PreSelector* form basically provides two approaches: Firstly, an individual value can be assigned to each answer category of an item. By doing this, the importance of an answer category relative to the other ones of the same item can be determined. Second, a relative weight for each item can be set using a corresponding slider. The weight of an item reflects its relative importance. Furthermore, K.O. criteria for each item can be defined. These are answer categories which indicate that the respective requirements have to be fulfilled by the student in order to get the opportunity to apply a certain learning module. For instance, a student cannot handle a text written in Spanish if he does not have sufficient knowledge of the language.
After completing the *PreSelector* form all relevant data (the determined criteria as well as the assigned values and weights) is bundled into an individual inquiry profile which is used as input for the matching task with the corresponding descriptions of the learning modules. In this context, a corresponding item in the learning modules' descriptions must exist for each data set of the inquiry profile. The descriptions are stored together with the learning modules' URLs as meta information in a separate database.
This provides the means for a score-based comparison of all learning modules described in the meta information database. As a result a list of URLs of the most suitable learning modules ranked according to their respective aggregated scores relative to the maximum score attainable is returned to the broker for further processing. Basically, this list can be interpreted as an ordered pre-selection of learning modules from which the broker can draw to finally customize an integrated course.

3.2 The *CourseComposer*

The *CourseComposer* is designed to support the integration of the pre-selected learning modules which especially includes the adjustment and structuring of the materials in a pedagogically and didactically useful way. In our opinion, a full automation of this task - e. g., by using pre-defined course templates (cf. [Hämäläinen 1997]) – doesn't seem to be flexible enough for this specific purpose. In contrast, the broker should always be able to bring in his pedagogical and didactical know-how as well as his specific experiences during the fine tuning and customization phases. To support this approach, the *CourseComposer* provides its core functionalities and a set of added values via the user interface shown in [Fig. 2].
The *CourseComposer* frontend is subdivided into three parts: the *PreSelectionWindow* (1), the *PreViewWindow* (2), and the *CourseWindow* (3). The *PreSelector* output (the URL list of pre-selected learning modules) can be imported and visualized in the *PreSelectionWindow*. In this context the broker can decide how many of the pre-selected learning modules should be listed (e. g., only the 'best' 30% according to the score-ranking outlined in chapter 3.1). Learning modules which are basically well-rated by the *PreSelector* but which on the other hand are marked because of one or more K.O. criteria, are optionally listed below a separator.
By clicking on an URL in the *PreSelectionWindow*, the content of the corresponding learning module is visualized in the *PreViewWindow*. Now, the broker can 'manually' decide, whether the respective learning module is really suitable to be part of the demanded course or not. This decision is very sound because it takes the individual students' needs, preferences and qualification levels into consideration again and it is influenced

by the broker's pedagogical and didactical know-how, his specific experiences, and his personal impression of the respective learning module. If the broker finally decides to include the respective learning module into the course, he shifts the corresponding URL to the *CourseWindow* by simply clicking a button.

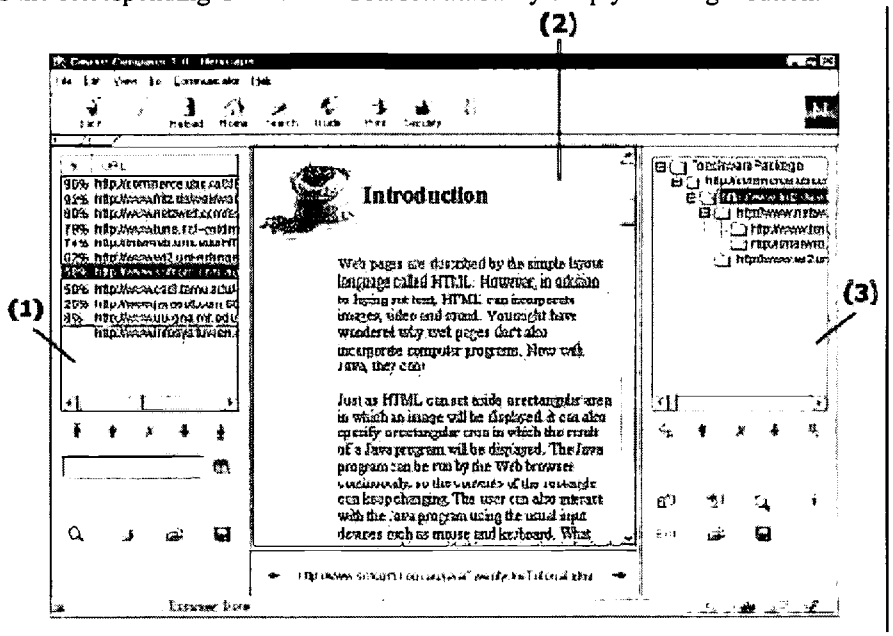

Figure 2: The *CourseComposer*

After finishing the decision process, the URLs of all learning modules selected by the broker as 'relevant' are listed in the *CourseWindow*. The next step is to structure the modules in a pedagogically and didactically useful way - again bringing in the specific broker's skills and taking into consideration the respective learner's profile. To support this task, the *CourseWindow* provides a tree-view for the visual representation of the URL entries collected there. Then, structuring the course can be done by assigning each learning module to a certain level of the tree and within a level to a certain position. This procedure is - in analogy to the structure of a book - equivalent to the assignment of a text passage to a certain (sub-)chapter. By clustering the learning modules according to this chapter paradigm, a navigational structure in form of a guided tour is inherently assigned to the course. All the necessary data for this (structure of the tree, URLs of the included learning modules, etc.) is stored as meta information in a common ASCII file (*CourseFile*). This *CourseFile* serves as the basis for the application of the course using the *CourseNavigator* (cf. chapter 4).
In the context of an individual course configuration, the *CourseComposer* provides a set of features to enrich the course with specific added values. These features can be activated via a corresponding button panel and include:

- Direct access to a HTML editor, which enables the broker to revise or adjust a pre-selected learning module according to his own ideas. Furthermore, the HTML editor can be used to compose a new learning module ad hoc which can then be added to the customized course. For this purpose, the adjusted or new learning modules must be stored on a broker's WWW server. The respective URL in the *CourseFile* is automatically adjusted.
- The opportunity to address and include learning modules which are not covered by the *PreSelector* but nevertheless should be part of the course according to the personal rating of the broker.
- Definition of means for communication amongst students and tutors (e. g., pre-addressed email forms for student-tutor communication or bulletin board systems for student-student communication).
- Integration of online manuals, online glossaries, etc. into the course.

4 Using Web Courses via the *CourseNavigator*

The *CourseNavigator* (see [Fig. 3]) enables a student to access a course composed by the broker, supports navigational guidance (e. g., guided tours), and provides a set of added values. To fulfil the tasks of presenting the learning modules and providing flexible navigational guidance, the *CourseNavigator* uses the meta information stored in the *CourseFile*. According to its definition by the broker, the course structure is represented in a tree-view. The tree-structure implies - as mentioned above - a guided tour as a consequence of clustering the learning modules according to the chapter paradigm of books. Using the learning module in the root of the tree as the starting point (= the 'homepage' of the course), the inherent guided tour is defined as a sequence of chapters and sub-chapters.
In this context, the *CourseNavigator*'s buttons 'next' and 'previous' can be used to move one step forward or backward respectively on the guided tour. The 'up' button leads the student to the parent node in the upper-next level relative to the location of the current learning module. If the student leaves the guided tour to freely explore additional sources of information by following external links integrated into the learning modules, the 'previous' button allows a direct return to the guided tour. Obviously, each learning module of a course can also be accessed directly by clicking on the respective entry in the tree-view.
Besides the navigational guidance, the *CourseNavigator* provides further course-specific and broker-defined added values (cf. chapter 3.2), reachable via dedicated buttons. Some examples are: an online manual, an online glossary, specific means for student-tutor communication (e. g., pre-addressed email forms) and a bulletin board system for student-student communication.

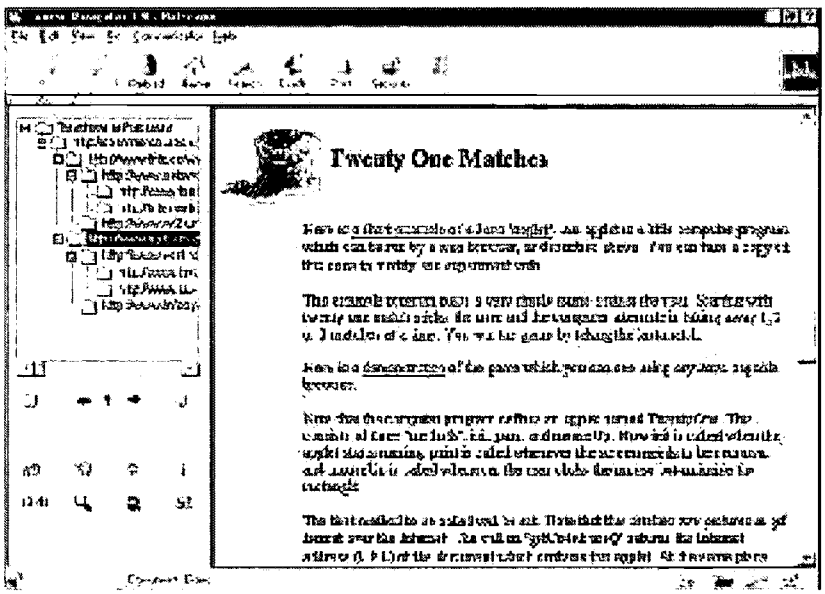

Figure 3: The *CourseNavigator*

5 Experiences and Outlook

Taking into account the increasing commercial structures in the fields of education and training in recent years, media-based teaching and learning concepts with promising market potential are being prototypically realized and evaluated at the University of Erlangen-Nuremberg (cf. [Bodendorf, Grebner & Langenbach 1997], [Langenbach & Bodendorf 1997]). Alongside those content- and application-related research activities, systems supporting communication and coordination tasks between suppliers and customers in an emerging Electronic Education Market are being focused on. In this context, the Electronic Education Mall concept seems to be a promising approach. Among the multitude of specific services provided by an EEM, the broker service is of special interest because this intermediary is responsible for the individual customization of learning resources according to the respective students' needs, preferences and qualifications.
To support this crucial task, the education broker toolset introduced in this paper was designed and prototypically implemented in Java. A first evaluation of these tools took place in January 1998. Three lecturers

of our university had access to the *PreSelector* and the *CourseComposer* in order to customize Web courses for a group of test students. The feedback of all participants was mainly positive. The lecturers described the tools as stable, easy to handle, and the layout of the user interfaces as well structured. They particularly appreciated:

- the chosen approach to operationalize the students' needs, preferences, and qualification criteria by assigning individual values and weights,
- the ability to bring into the customization process their pedagogical and didactical know-how, and
- the value adding features of the *CourseComposer*.

The students confirmed the intuitivity and flexibility of the navigational aides provided by the *CourseNavigator* as well as the value adding features (especially the means for student-tutor and student-student communication). One negative aspect highlighted by the lecturers was the limited size of the test set of learning modules from which they could draw. In order to achieve a broader evaluation platform, this set as well as the database of learning modules' descriptions are to be enlarged in the next months. In this context, an automated indexing of learning modules would be a very helpful feature. This is considered as an interesting field for future research activities with rich potential for innovative soft computing approaches.

Furthermore, the students' remarks showed the desire for additional value adding features. Promising ideas for further development include:

- a monitoring component which depicts the progression of students' learning process
- adaptive and generic modules to automatically adjust and generate guided tours according to the current students' navigation and learning behaviour

Besides the improvement of the already existing broker tools, the design and development of additional services and tools (e. g., systems to support the mediation of human resources like tutors, coaches, and trainers) and their integration into an education broker system providing a self-service-oriented, homogeneous user interface is planned. In parallel, support systems for various other transaction tasks in an Electronic Education Market are on the agenda, e. g., flexible accounting and payment systems for the financial clearing provider, and electronic product and service catalogues for the marketing unit of an EEM.

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