A Web-based Framework For On-line Collaborative Learning

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Abstract

This paper presents a framework for design of on-line courses and collaborative learning based on Web technologies. It provides the following features: construction of structured learning materials in a distributed environment; personalization of course contents in the run-time that adapts to the progress of individual students; and that can supply relevant Web resources to the students by analyzing the learning history dynamically; students in a group can exchange their learning experiences and discover relevant knowledge via the communication channels provided by the framework. The proposed techniques could be deployed to a variety of on-line computer-assisted modules to improve the effectiveness of Web-based E-learning.

Keywords: Collaborative Learning, Web, Distributed Environment, Personalization.

1. Introduction

The boom of the Internet has given rise to a new generation of distributed environments for chatting and socialization that include a graphical desktop component, allowing users to share a multimedia virtual space. As a result, computer-supported collaborative learning has become an active research area since the late 1990s. The paradigm of collaborative learning is rooted firmly in the social constructivist principles [3]. Despite the popularity of on-line collaborative learning, it is however a great challenge to the instructors to develop effective pedagogical methods in order to reduce the cost of education and to improve the efficiency and quality of the teaching and learning process. Meanwhile, there are challenges to the authors of the course-ware, in that the course-ware should be developed to meet the integral requirements of the course and to cater for diversity of the students' backgrounds.

The main challenges with web-based on-line collaborative learning could be categorized as the following aspects:
- Pedagogical method, namely the teaching method used by the instructors (or the course designers)
- Design of course materials, which describe how the course materials meet the requirements of the course; how the contents of the course materials are produced and constructed to facilitate collaborative learning; how the course materials are presented to the collaborative users (students).
- The learning process, which describes the collaboration modes and the semantics of learning. The first issue is not discussed in this paper as it should be addressed in pedagogical research instead. We shall focus on the design of course materials and the learning process in the proposed framework.

We propose the CoCoWeb (namely Collaborative Course-ware for the Web) framework to support design of course materials for on-line collaborative learning. CoCoWeb is a generic web-based system framework, which utilizes the state-of-the-art technologies in semi-structured data management and personalization of web contents, for the design of on-line collaborative learning. In the framework, course materials are classified into two categories: local documents and remote links. A local document can be either a HTML page, a piece of video, or a JPEG picture stored in the course-ware database, while a remote link points to some Web resources on the Internet. Documents on different topics and at various levels could be organized in the framework, and structured to produce a personalized sequence of learning materials for each user (student). For on-line collaboration, the background and preferences of all users are described in their mathematical representations, and computed for appropriate grouping of collaborative users. The Internet resources could also be classified and recommended to the user based on the user's preferences and knowledge background.

The rest of this paper is organized as following: In section 2, we briefly review some related work. In section 3, we discuss the construction of the course infrastructure in the framework. Personalization techniques of the collaboration learning, including both the personalization of the material and that of the collaboration method, are presented in section 4. The implementation issues are described in section 5. We conclude the paper with discussions to the current framework and visions to possible future work in section 6.
2. Related work

Personalization has become a general paradigm for many web-based applications since the late 1990's. Researchers have developed personalized systems for various purposes such as web-surfing [6], searching [5].

Sequential path, which indicates that the document titled "SQL" should be presented before the one titled "Query Optimization";

- Document("SQL") generalizes Link ("MySQL")

Generalization, which indicates that the document titled "SQL" has a higher level in the semantic hierarchy than a link to the MySQL database over the Internet, as the latter
Definition completed, course extraction and dimensional feature query, set suppose

\[(W_1, W_d)\] - matrix (The knowledge matrix)

For example, the background topic would be browsing on-line documents. However, if those who access the topic, the inference 

\[U_2, D\] can be obtained by adding elements together:

\[U_2, D = \sum_{i \leq \sigma} \{ \text{vector}(i(u, k)) \} \]

After an interval time since the topic is interested to the student, we can assert the interest value. After looking at the coursework, the user has the same knowledge need in the student's needs.

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A document is needed. To simplify the description of the problem, this observation can be depicted in a table format, as figure 2 shows. Knowledge background and interests to find out an appropriate course material during the course. The selection of the material is restricted to a certain number of points (users) clustered. 

We shall obtain the following equations:

\[ \begin{align*}
\text{If } a &< b, \\
\text{then } a &< c, \\
t &< x, \\
\end{align*} \]

Based on the above, we conclude that one equation is obtained from the knowledge background. We use the following equation to determine the similarity between the interest of the user as follows:

\[ a + b = c \]

For the user of the framework, the equation is obtained from the knowledge background. In this case, the equation can be redefined as:

\[ a + b = c \]

After the above steps, the result is produced, which can be further classified. Therefore, the interest of the user can be defined as:

\[ a + b = c \]

The social constructivism theory attempts to achieve much better accuracy in clustering. Clustering (HAC) technique is described in the above section. Beside the main course material, the framework also recommends supplementary materials. Euclidean distance between the respective interest of the users is computed. From the result, we can observe that the algorithm produces better results.

To compute the feature, we use the following equation:

\[ a \times b \]

The algorithm automatically updates the page as the interest of the user changes. The students can be further classified into groups for collaborative work. The course material, the framework also recommends supplementary materials. Euclidean distance between the respective interest of the users is computed. From the result, we can observe that the algorithm produces better results.
5. Implementation

The prototype of the CoCoWeb framework is implemented on the Microsoft Windows NT server. The Apache web server and the related software modules developed in the C and Perl languages run on the same machine.

The functionalities of the system are presented in the following.

- **The local course database**: This database stores and manipulates all local course material.
- **The course document database**: This database stores and manipulates all course documents.
- **The intelligent course generator**: The presentation engine is responsible for generating personalized presentations of the course materials based on the user's profile.
- **The rule base**: The rule base maintains the federation rules that course designers have specified. When a designer presents a new course material or link to the database, the relevant rules are checked to ensure the soundness of the new documents.

The rule base is implemented using existing commercial software components (such as the MSN Messenger). The rule base is implemented using existing commercial software components (such as the MSN Messenger). The rule base is implemented using existing commercial software components (such as the MSN Messenger).

Figure 3: The system architecture of the framework

4.5. Personalization of the group collaboration

Collaborative activities in the CoCoWeb framework are categorized into two types: synchronous activities and asynchronous activities. Possible synchronous activities include online chat, voice communication, and video conferencing. These kinds of collaboration can be implemented using existing commercial software components (such as the MSN Messenger).

This framework can use different styles of collaborative activities. For example, some students may prefer to undertake a small-group chat with each other while learning new course materials, another group of students may like to ask questions via the web community system and get answers from the learner from the community system as well. These collaborative activities can all be supported using the flexible collaboration component. After a user selects his/her own collaboration component, a local course document is retrieved from the server and loaded into the system. When the user logs in again, the system uses the personalized tools to manipulate the course content. The selected course materials are stored in the local course database and processed with the personalized course contents. During the process, the designer can select new relevant course missions or links and add them to the database. The database can also store and retrieve course materials, course documents, and other information.

The presentation engine is responsible for generating personalized presentations of the course materials based on the user's profile. During the presentation process, the presentation engine is responsible for checking the validity of the presented course materials. The intelligent course generator applies the course documents to the database. The intelligent course generator has a set of rules to check the similarity distances between the documents. The links are sorted and listed based on the similarity distances.
therefore be played on a player (such as RealOne player) on the client side.

* The collaboration manager
The collaboration manager takes charge of the collaborative activities on-line. Communications such as on-line chatting, web-based community, are managed by this module. The collaboration logs (such as chat records) can be saved to secondary storage for future research. The clustering of user groups is implemented in this software component.

* The session manager
The session manager keeps log of all users' learning history. When a user finishes a course, the user's profile would be updated. Data such as the knowledge vector and the interest vector would be modified to reflect the latest learning results.

6. Discussion and conclusion

collaborative activities due to the common interests inside a group.

For future work, we would consider the problem of on-line design of course material and courseware by multiple collaborative designers. This issue is more challenging as the database of the course materials would need to be synchronized for frequent updates from multiple designers. We would also look at the problem of personalized collaborative learning based on mobile devices. In such mobile context, adaptive organization of the displayed content and personalized UI design would be the key issue.

References