TOWARDS LIBRARY SUPPORTED COLLABORATIVE LEARNING

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Keywords: Library Marketing, Digital Libraries for e-Learning, Collaborative Learning/Filtering, Data Mining.

Abstract: Due to the development of information and communication technology our information environment has greatly changed. People's requests to libraries have been changing along with it. As a result the library materials are changing from printed ones to network media. Considering such a circumstance we anticipate that learning assistance should be one of the major library services in the future. In this paper, we propose a model of collaborative learning in which the library users, or patrons, are implicitly helping each other as they learn. The basic idea of this approach to collaboration comes from the mechanism of collaborative filtering. Not only the learners but also the librarians are supposed to help the learners with advising their learning materials and managing their learning processes; which is considered to be a style of extended reference service by libraries. We anticipate that by mixing up the traditional reference services and the ones that support patrons' learning processes the future libraries would be able to keep existing as reliable organizations and librarians would be considered to be their reliable supporters.

1 INTRODUCTION

The aim of this paper is to propose a model of library supported (implicit) collaborative learning (CL) system and to demonstrate its importance.

The spreads of information and communication technology (ICT) is one of the most influencial changes for our society in these couple of decades. Accessing to the Internet with mobile phones becomes very popular now. We are able to access a wide variety of information anytime, anywhere.

Libraries have been playing an important role in our society as organizations that provide us with services for reading materials (Ranganathan 1957). Due to the development of ICT, the library materials are changing from printed ones to digital media privided via network. Then what sort of library service is required in such an ICT age? Our answer is that the services that support the library users, or patrons, with their learning. People in these days are eager to keep studying. Libraries have advantages for playing such a role because they have good experience in assisting patrons' learning.

Our goal is to construct a system so that the librarians support their patrons based on their professional skills and the data that are collected as the patrons learn. This model is a kind of CL in the sense that the data are used for helping others. There are two types of CL; explicit and implicit. Explicit CL is the one that learners collaborate by explicitly communicating each other by using a chat system, for example (Ueno 2005). Implicit CL is the one that learners do not communicate explicitly; they just study. The data are automatically collected as they learn, shared by them, and used for helping them.

2 COLLABORATIVE LEARNING

2.1 A Model of Collaborative Learning System

Figure 1 illustrates an overall organization of the collaborative learning system poposed in this paper. The left part indicates the system users who learn a subject. Patron 1 studies materials based on the library's recommendation. Patron 2 uses an intelligent bookshelf (IBS) (Finkenzeller 2003) (Minami 2008) (Zhang and Minami 2007) that is connected to the home server. The learning server detects what books are taken out and returned at which times. Such timestamp and other data are used

Minami T. (2009).
TOWARDS LIBRARY SUPPORTED COLLABORATIVE LEARNING.
In *Proceedings of the First International Conference on Computer Supported Education*, pages 431-434
DOI: 10.5220/0001974704310434

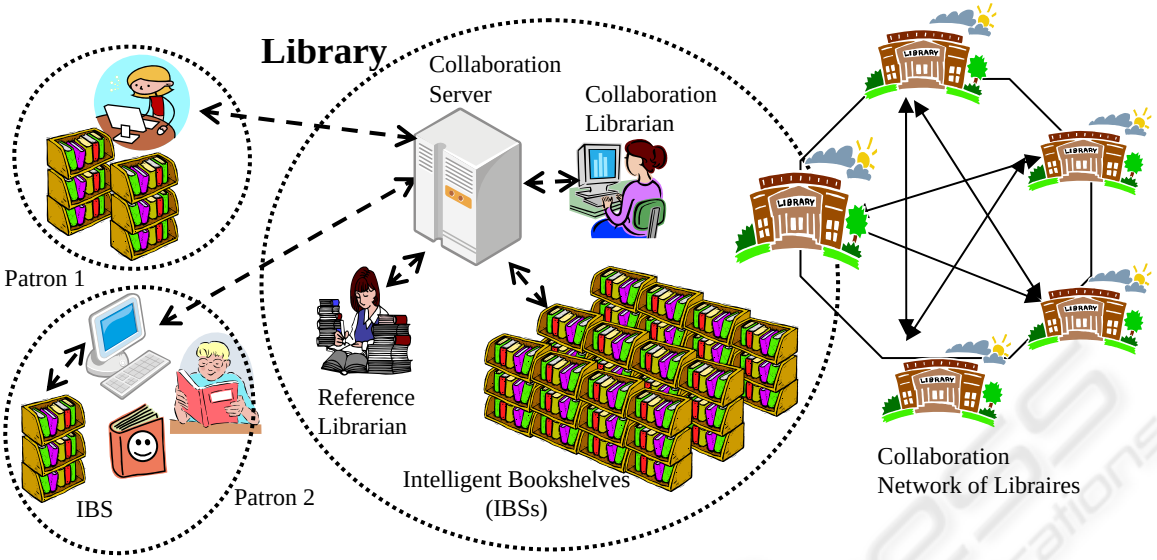

Figure 1: A Conceptual Model of Collaborative Learning System Supported by Libraries.

for supporting Patron 2 with his study.

The middle part is the library, which has the central collaboration server. Each patron is connected to this server. All, or some, of the IBSs access the server. Further, the librarians also access the server in order to carry out their jobs. Reference librarians use it for collecting data about reference services as well as use it for looking for the information and knowledge provided by the server. Collaboration librarians also use the server. The system provides them with information obtained by analysing the raw data. The collaboration librarians can change and/or add extra knowledge or policies that specify how to use the knowledge of the server.

Libraries are also working collaboratively. They have already been working cooperatively such as in inter library loan (ILL) service.

2.2 Implicit Collaborative Learning

Learning Assistance with SASS

SASS (Searching Assistant with Social Selection) (Oda and Minami 2000) is a system which was planned and developed as a keyword recommendation system for information searchers (Fgiure 2). The input area is in the upper pane. It also contains the given keyword(s), the type of recommendation among several candidates. One type is based on the relatedness of keywords. Another example one is to find keywords which are used in combination with the given keyword and also which are closely related to the keywords that are used in combination with the given keyword.

It is a surprise for us when we found SASS can be used as a learning assistance in a sense that we can recognize our knowledge level with the recommended keyword list from the system. They are related to the original keywords that are given by the user in some senses. So we try to find the reason how the recommended keyword is related to the original keyword and why other searchers used them.

If we are can guess the reason then we can think ourselves that we know well about the field that is represented by the keywords. If we can not explain, then we may consider that we do not know the field sufficiently well. Thus we will set a goal of studying this field in learning the recommended keywords; starting with learning what the term means and then learning what it is related to other terms and concepts in the target field.

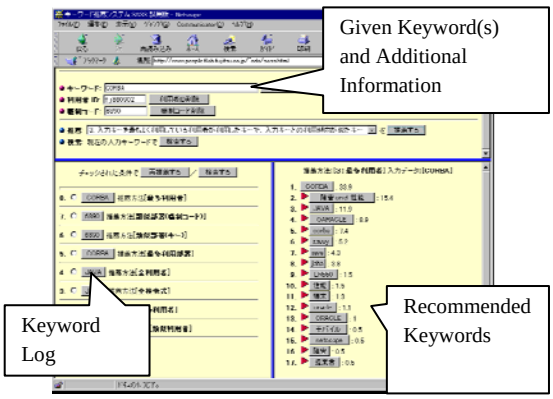

Figure 2: A Screen Shot of SASS.

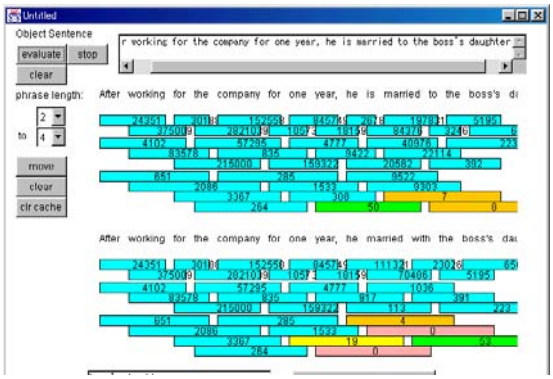

Figure 3: A Screenshot of WebLEAP.

Learning Assistance with WebLEAP

WebLEAP (Web Language Expression Assistant Program) (Yamanoue, Minami and Ruxton 2000) is a system that helps users with writing articles in English (Figure 3). The input field is in the topmost part, where the user types an English sentence or an expression as a list of words. Then the system replies with occurrence numbers of combinations of consecutive words (n-grams) in the expression. The occurrence numbers come from a Web search engine specified in the system. The users are supposed to read and compare the occurrence numbers and try to find out what they mean including if the expression he/she has given is right or not, if it is appropriate, if it is popularly used, and so on.

In order to put appropriate conclusions by reading and comparing the numbers, we have to think hard, which is very good for us in training ourselves in our studying of English. This is another type of system that is good for educating ourselves.

2.3 Learner Profile Estimation

Figure 4 illustrates an example set of learning materials M1, M2, ..., M6 together with the arrows for representing their dependencies. Suppose that these materials are the ones a learner has to study in order to master a subject field. Let us take the material M1 for example. There are two arrows toward the material M1, which means that in order to study the material M1, the learner must have studied both of the materials M2 and M3.

Material Construction

The original material structure comes from the knowledge and decision from experts in the target field. We can refer textbooks for this. A lot of companies have already provided such coursewares.

In addition to logical dependencies, we may use other types of dependencies. Suppose, for example, the material M3 has no direct dependency with M4. We also suppose that M3 and M4 both contain proofs that use mathematical inductions. We further suppose that the mathematical induction used in M4 is simple and easy to understand, while the one in M3 is somewhat difficult to understand.

We suppose further that it becomes easier to understand the proof in M3 if the learners have already studied the proof in M4. In such a case we may consider that M3 is dependant with M4 not in logical sense but in the sense of learning procedure. In such a case we can put another dependency arrow from M4 to M3. It also could happen that such hidden dependency relationship may be detected from the log data of patrons' learning procedures. Let us take the similar supposition as the previous paragraphs. Then the learners may feel difficulties if they study M3 before studying M4 and they would feel it easier to study M3 after studying M4. This difference may appear in study time and/or achievement test of M3 or M4.

Learner's Profile

In order to give advice to the patrons as they learn, the librarians need to recognize the learning status, or profile, of the patrons. In this paper we take the set of learning materials and the patron's achievement degrees as the first approximation for patrons' profile data.

The achievement degree is from 0 to 1, or 0% to 100%, where 0 means that the learner has not studied the material yet, or even after learning he/she has failed to solve all the questions in the achievement test or in some other methods of evaluation. Degree 1 means that he/she has solved all the test and he/she can go forward to the next step.

For other methods of evaluating the achievement degree, we can take one described in Section 2.2; for example, the system or librarian put a list of terms that are supposed to have learned in the study topic

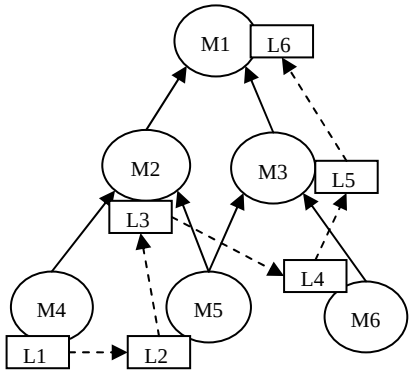

Figure 4: An Example Structure of Material Dependencies and a Path of Learning for it.

and ask the learner to explain what they mean, how two terms are related each other.

Study time is also a good index for assessing the learner's achievement. If the learner spends a lot of time in studying, he/she may be in difficulty in the studying material. Suppose, for example, the learner's study time is 20% longer than the standard study time of the material then his final achievement degree for the material may be calculated as the raw degree times 0.8 or in other method.

It would be good to combine some types of achievement degrees and decide the learner's final degree for the material. It is not necessary to require the degree of 1 to go forward to the next step. We put some threshold value, say 0.8, and the degree is more than this value, the learner can go forward to the higher level.

2.4 Material Recommendation

A learning plan is recommended by the collaborative learning system. Then the reference librarian checks the plan and modifies it if necessary. The final plan will be decided upon negotiating with the learner himself/herself.

Due to the dependency constraint, the possible study order is limited. For example, the set of study material in Figure 4 has 16 possible study orders. An example order [M4, M5, M2, M6, M3, M1] is shown in the figure. How can the system evaluate and choose a possible study order? A possible way is to use importance of study order. Let us suppose the importance is in the order of M1, M2, M3, M4, M5, and M6. The possible first material to start with is either one of M4, M5, or M6, because other materials are depending on some other materials in this set. From the importance order the material M4 is the most important, so the system chooses M4 as the first study material. Then the next material to be studied is either M5 or M6 and M5 is more important to study than M6, thus M5 is the next. As M4 and M5 have studied, the next candidates are M2 and M6, and M2 is more important than M6, so the system takes M2 as the next one. By repeating such processes the recommended study order becomes the one in Figure 5.

3 CONCLUDING REMARKS

In this paper, we proposed a new library service model of implicit collaborative learning. A key feature is that the data are automatically collected as a patron learns with the system, stored, and are used for assisting all the patrons. Another important feature is that not only the system but also the librarians are involved in assisting the patrons with providing their expertise and make final dicisions on the ways of assisting. Also we discussed about the methods of recommending study materials, including their study orders.

The CL system proposed in this paper is an education system in two different aspects. One is that for patrons, of course. This is the major aim of the system. Another one is that for the librarians. They can learn as they use the system and help the patrons with their learning. Even though this aspect is rather a sub-aim, it is very important for both sides.

One of the biggest aims of this paper is to suggest a direction to future library service when libraries are facing difficulties in finding the way to keep being as reliable organizations for our society.

The next goal of this research is set to design the CL system in detail, implement, and demonstrate its usefulness through experiments.

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