

An Agent-Based Support System for Grasping Learning Situations

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Abstract

In flexible education style based on learners' selections of materials, it becomes more important for instructors to grasp learning situations for effective guidance than in current style. In this research, it is assumed that any web documents on the Internet are utilized as learning materials. In such an education style, all referring histories to any web documents have to be watched and valuable information for grasping learning situations should be provided to instructors. The navigation for learners' selecting materials should also be performed properly. The purpose of our study is to develop a support system to solve these problems. In this paper, a support system for grasping learning situations, which is composed of the functions to gather referring histories automatically and to produce the visual informations from them, is mainly described. An experiment with this system has shown the effectiveness of the supports for grasping learning situations.

1. Introduction

In recent years, several activities including educational one have been performed on the network environment with rapid development of network technologies. On the other hand, the problems in current education style with bad uniformities have been indicated. It motivates us to realize an effective education style based on learners' interests and understanding states. In current education style, learning contents are fixed for all learners and it is impossible for learners to select contents and materials flexibly by themselves corresponding to their own states. In this research, an effective learning with learners' flexible selections of materials is assumed. To come true such an education style, effective supports for instructors and learners are essential. In general, it is difficult to perform effective guidance to learners corresponding to their understanding state since instructors have to guide many learners in restricted time. In flexible education style supposed in this research, this problem becomes very

serious. So, effective supports for instructors to grasp learning situations are important. On the other hand, selecting materials with no condition is one thing and flexible selecting with least conditions specified by instructor is another. Instructor's intentions for selecting materials should be informed to all learners properly.

Some researches have been performed to solve these problems. Kanenishi et al. developed teacher support system called LOGEMON [1], which produces the information on learners' referring histories to web documents. In this system, classification of web materials into some categories, main explanation, extra explanation, and so on, is assumed. This system cannot be effective for various learning needs since the work of classification costs much time to instructors. Kayama et al. developed a support system for exploratory learning [2], which navigates learners to explore materials. This system also cannot be sufficient for various learning needs since instructors have to put parameters of attributes to each material. Kuwabara et al. developed a support system which focuses on learners' stalled states [3]. But this system cannot be practical since grasping learning situations based on just answers of exercise problems. Matsumoto et al. developed record and playback system of physical data in learning such as mouse movements [4]. This system has some effectiveness to improve materials, but cannot be effective for grasping learning situations in class time. Nakayama developed a support system for testing in class [5]. This system also cannot be useful for grasping learning situations except testing since it produces just some information on testing such as answers of quizzes, times of questions of each learner. Nishino et al. developed a support system for grasping learners' motivation by focusing on learners' mental states [6]. This system has some advantages for grasping learning situations, but cannot be utilized for real-time use in class. Taniguchi developed a support system for programming education [7]. This system produces some information to improve exercises by getting historical data on programming and comparing it with final grades. This system also cannot be sufficient for grasping learning situations in real-time class. These systems need

specialized materials for them or are available only for limited materials specified by instructor. So learner-oriented material selecting has not been considered. On the other hand, there are some researches on structures of materials and visualization of referring history [8]-[12]. These systems are used to guess the web contents without referring them by visualizing of their structures. So, they cannot be sufficient for grasping learning situations at this moment since referring history is not considered as learning history. It is important to get referring histories to materials and to generate information from them to instructors' grasping learning situations. Visual presentation of their information is also important for effective grasping.

In this research, we propose a support system, which consists of three supports as described below.

- Support for grasping learning situations
- Support for easy authoring
- Navigation for learners to select materials

This paper focuses on supports for grasping learning situations and describes the outline of supports for easy authoring and navigation for learners' selections of materials. These supports enable instructors to grasp learning situations easily and to guide learners effectively.

2. Ideas of support system

In this research, web documents are assumed as learning materials. Although some previous researches have also used web documents as learning materials, almost all of them was restricted to one produced by instructor and those materials are ordered by instructor. So, it was possible for instructors to produce them by themselves. But it is impossible for instructors to prepare all materials by themselves in flexible education supposed in this research, since it is assumed that learners select materials corresponding to their interests, understanding state, and so on. Therefore, materials on the Internet should be utilized. In this case, instructor cannot order them and set conditions of selecting to all materials corresponding to each learner's state. So, we assume that learners select not only materials produced by instructor but also any web documents on the Internet by exploring. The learning style supposed in this research is not a self-learning, so instructor should perform guidance to learners corresponding to their situations. In such an education style, it is more difficult to grasp learning situations than in current style since each learner's advance and state differs so much each other. To solve these problems, we propose supports for grasping learning situations, supports for easy authoring and navigation for learners to select materials.

3. Supports for authoring

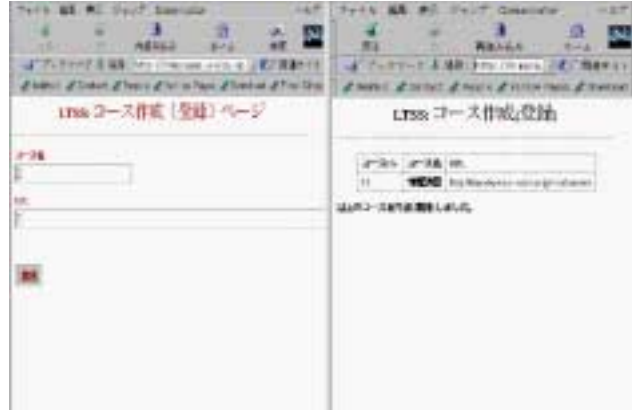


Fig. 1 Course preparation module

In this research, it is assumed that learners select materials flexibly corresponding to their interests and states. So, supports for authoring so that instructor can use any web document as learning materials and can set conditions for selecting easily. It is also important that these conditions are informed to learners precisely corresponding to their learning situations.

3.1. Authoring

To solve these problems, we developed a support system for authoring, which consists of modules as described below.

- Course preparation (registration) module
- Course deletion module
- Course search module
- Material preparation (registration) module
- Material deletion module
- Material search module

Furthermore, databases to manage information on courses and materials as described below are constructed.

- Course management database
- Materials management database
- Learner management database
- Learning history management database
- Requirement condition management database (*)
- Prerequisite condition management database (*)
- Continuation condition management database (*)

*Details of conditions are described in 3.2.

[Course preparation/deletion module]

Before the class using this system, instructor registers web document as materials on course preparation module (Fig.1) at first. All instructors have to do is to register course name and URL of web document as top page for that course. Then course No. is assigned to that course automatically and these information are registered into database. These information are used in other module through this system. On the other hand, instructor can delete these information by inputting just a URL, a course



Fig. 2 Material preparation module



Fig. 3 Condition setting module

name, or course No. Special knowledge on database is not required for instructor, since all processing on database such as update is performed automatically.

[Material preparation / deletion module]

Instructor is able to register any web documents as materials to any course just by inputting URL on material preparation module (Fig. 2). Deletion of material can be performed in a way same to course deletion. As any Web documents are managed with their URL, instructors utilizes not only materials produced by themselves but also any documents on the Internet easily.

3.2. Setting conditions for material selection

In this research, there are three conditions, requirement condition, prerequisite condition, and continuation condition, for learners' selecting materials. Supports for easy setting of those conditions are provided in this system (Fig. 3). Requirement condition is a rule expressing the



Fig. 4 Basic screen

combinations of materials, which have to be completed by all learners. Prerequisite condition is a rule expressing the combinations of materials, which must be completed before the trying to a material. For example, "To try material P, learner has to complete material A and B before that". Continuation condition expresses a restriction on a series of materials. For instance, "learner X has to try material D after material C".

4. Supports for grasping learning situations

4.1. Gathering learning history

Gathering learning history and utilization of them is important to grasp learning situations. There is one approach using proxy server to gather learning histories and some previous research adopted this way [1]. In this case, we can get learning histories easily since data on referring to web documents are stored automatically in a server. But, there are many restrictions to use proxy server and management of proxy server is heavy work for instructor. Furthermore, this approach is not practical since it is assumed that all learners refer to any documents via the proxy sever. On the other hand, there are some methods using CGI and SSI related techniques to gather learning history. In this case, we can develop the system to gather learning histories corresponding to our own needs. But, instructor has to describe SSI in all documents before the class. Even if description of SSI is performed, we cannot gather learning histories for other documents without SSI description on the Internet. In our system, the function to refer any web documents by learners' inputting URL is provided with web browser as interface (A in Fig. 4). So referring using this function has to be also watched.

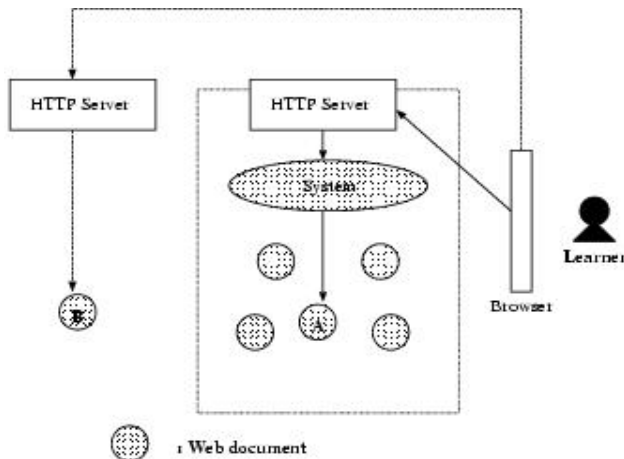


Fig.5 Gathering learning history (1)

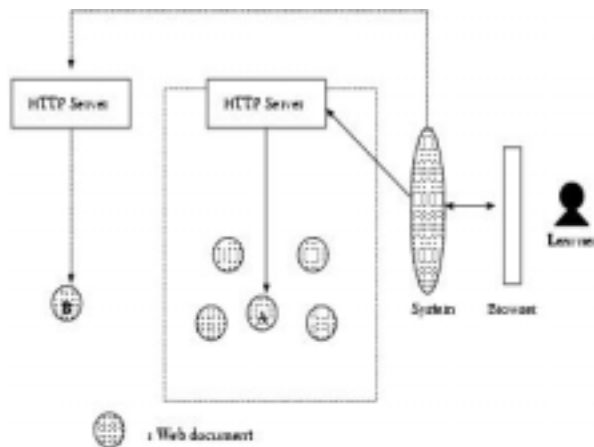


Fig. 6 Gathering learning history (2)

This problem is caused by the theoretical location of the system to gather learning histories as shown in Fig. 5. Although referring to the documents on the server with our system can be watched as learning history (document A in Fig. 5), referring to the documents on other servers cannot be watched (document B in Fig. 5).

To solve this problem, we developed the system to gather learning histories for any web documents on the Internet without proxy server. In this system, the information as described below are mainly gathered as learning history.

- Learner ID
- Course No.
- URL of web document
- Material No.
- Referring data
- Learner's host name

Web browser gets web documents generally, but browser is used only to display web documents and the task of getting them is performed by our system. So theoretical location of the system to gather learning histories is changed as shown Fig. 6. This theoretical location of the

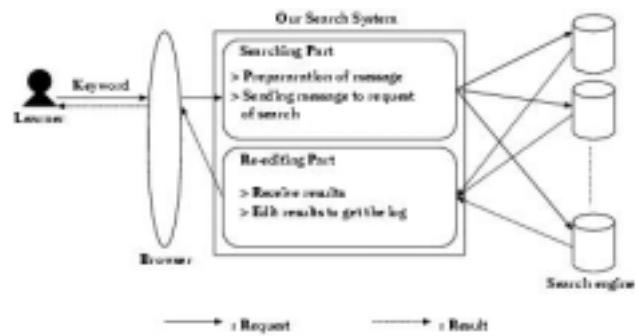


Fig. 7 Gathering learning history (3)

system enables us to gather learning histories not only for web documents on the server with our system but also for any documents on the Internet. Nevertheless, there is still one problem on gathering learning history. The function to search web documents on the Internet is also provided and searching is very important in flexible learning style assumed in this research. Referring to web documents with searching cannot be watched since results of searching are produced by searching engine and the request to get web documents by this result are reported to web browser. To solve this problem, we developed the system, which performs second editing of searching result. After editing, requests for getting web documents and for watching the referring to them are reported not to web browser but to our system to gather learning history (Fig. 7). Since this editing is made recursively, referring to any web documents on the Internet can be watched.

4.2. Visualization of learning history

USER_ID	教材 No.	DATE	HOST_NAME (IP)
e0001137@vsn.ac.jp	4	20091230-WED 18:25:45	e0000113@vsn.ac.jp[045.143.27.86]
e0001003@vsn.ac.jp	5	20091230-WED 18:08:13	e0000113@vsn.ac.jp[045.143.44.82]
e0001137@vsn.ac.jp	6	20091230-WED 18:41:14	e0000113@vsn.ac.jp[045.143.27.86]
e0001137@vsn.ac.jp	7	20091230-WED 18:40:08	e0000113@vsn.ac.jp[045.143.27.86]
e0001137@vsn.ac.jp	4	20091230-WED 18:02:02	e0000113@vsn.ac.jp[045.143.27.86]

Fig. 8 Example of learning history

Learning history is hard to understand as shown Fig. 8. So, our system produces the visual information to grasp learning situations from learning history. Information on learners' distribution, referring times, and personal learning history is provided to instructor by our system.

[Learners' distribution]

Learners' distribution is the information, which expresses the all learners' distribution to each material. This information is expressed in bar graph style (Fig. 9) and is updated automatically. Instructor can grasp the learning situation that how many learners are trying to which document. This enables instructor to make effective guidance to learners. For example, if many learners are



Fig. 9 Learners' distribution



Fig. 10 Referring times

trying to materials A, instructor can make an explanation about A.

[Referring times]

Referring times is the information, which expresses the each learner's referring times to a material. This information is also expressed in bar graph style (Fig. 10) and updated automatically. This information supports instructor to grasp the learning situation that how many times each learner refers to a materials. Instructor can guide a learner effectively with learners' distribution and referring times. For instance, if learners' distribution indicates that many learners are trying to material B and referring times means that learner P referred to B so many



Fig. 11 Personal learning history

times, instructor can make detailed explanation about B to P.

[Personal learning history]

Personal learning history is the information, which expresses each learner's leaning history. This information is expressed in map style (Fig. 11) and updated automatically. Each referred material including any one on the Internet expressed as a node. This information enables instructor to grasp each learner's detailed learning situation. Instructor can also refer any materials in a map just by clicking nodes and improve materials after class.

5. Navigation for material selection

In flexible learning style supposed in this research, it is very difficult for instructor to inform the conditions of selecting materials to all learners corresponding to their state. Furthermore, in such a learning style, instructor should spend as much time as possible for detailed guidance to each learner. On the other hand, selecting of materials should be performed easily. To support them, our system provides navigation for material selection to learners. This navigation expressed in visual map style as shown in Fig. 12. A Map for navigation consists of each learner's learning history and candidates of next materials. Learners can see he/her learning history easily by this map and refer them again just by clicking nodes. Candidates of next materials are produced based on judgment of each learner's state on satisfaction of conditions for material selection. Learners can select next materials precisely with candidates in navigation map. After learning a material, navigation map is updated automatically.



Fig. 12 Navigation for material selection

6. Experiments and evaluations

The prototype system is implemented mainly by CGI and Perl on workstation. We performed an experiment in exercise class in the university of Aizu with this system. At the end of experiment, we perform an interview to instructors and teaching assistants about this system. There were the opinions as described below.

- Guidance with this system is more effective than current education style.
- This system is useful for grasping learning situations.
- Not only referring times but also more detailed information are needed.

On the other hand, we administer a questionnaire to learners. The results have shown that learners thought that more effective guidance are performed than previous class without this system. Especially, they felt delightful for instructors' precise grasping their learning situations.

7. Conclusion

In this research, a support system for the flexible education style based on learners' material selection was developed. This system consists of support for grasping learning situations, support for easy authoring, and navigation for learners' materials selection. To grasp referring history for any web documents on the Internet, we developed the system to watch them without proxy server. This system enables us to grasp any learners' referring including the one using searching engine. This support system produces the information on learners' distribution, referring times, and personal learning history from gathered data of referring. These information are provided to instructor visually and are updated automatically. It enables instructor to grasp learning situations precisely and perform effective guidance to learners based on them. This system also provides the navigation to learners to select materials in visual map style. An Experiment has shown the effectiveness of this system for grasping learning situations.

An effective navigation method corresponding to learners' interests and understanding states will be developed as a future works.

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