Module Development for Learners' Study Logs and Peer Evaluations for CSCL

Yoshinori MIYAZAKI
Faculty of Informatics
Shizuoka University
yoshi@inf.shizuoka.ac.jp

Yusuke SUGIURA
Graduate School of Informatics
Shizuoka University
gs07030@s.inf.shizuoka.ac.jp

Abstract

The objective of this research is to develop a module supporting CSCL on Moodle, with the additional function of peer evaluation among learners. This module records various actions and events arisen in the course of CSCL and stores as learners' study log data, which help learners to review each group member's activities for the purpose of fair and objective evaluations. On teachers' side, this module comes with an environment where they can check learners' activities including peer evaluation results and can apply AHP technique for grading each learner synthetically with the inclusion of their subjective weightings (one-on-one comparisons). Since each manipulation requires several steps (in order to scrutinizing learners' log data), the AJAX technology is adopted to prevent excessive change of screens.

1. Introduction

In recent years, computer-assisted educational methods have been diversified, in contrast with the conventional ones by which teachers provide study contents for students with no interactivity. One good example is CSCL (Computer Supported Collaborative Learning), where students discuss and study online, for doing assignments collaboratively, and sometimes for mutual understandings. Lately, the computer programs facilitating CSCL activities have been implemented here and there, but according to [1], there are still many rooms to be filled to a full-fledged system.

In collaborative learning activities, [2] shows that learners' motivations get boosted when they are given the chance for peer evaluations with their group members. In order to introduce this system, however, it is necessary to provide learners with an environment where they can scrutinize the study logs of his/her group peers, taking into the consideration that they basically work online and hardly see each other.

In this research, the authors aim to develop a module on Moodle which allows learners to view study logs of other members for the purpose of peer evaluation. The second objective is, with the application of AHP (Analytic Hierarchy Process) technique, to make the module (mentioned above) more usable for teachers who play a role of grading the learners, judging from diverse types of study logs (such as number of page access, discussion, submission of assignments, and the like) and peer evaluation values. AHP is a mathematical decision-making technique allowing consideration of both qualitative and quantitative aspects of decisions and reduces complex decisions to a series of one-on-one comparisons. With this technique, the total ranking synthesizing diverse study log data is also enabled. The experiment conducted shows the feasibility and validity of this module (with the limitation of the small number of subjects).

Also, we are tuning up user-interface, by incorporating AJAX (Asynchronous JavaScript + XML) for smoother interactivity, since the manipulations require several steps with various kinds of log data.

2. Previous Research

As a reference on CSCL, [1] investigates corresponding papers for the present trend of this research field. This points out that few cases have reached for practical use, in spite that many researches on CSCL are conducted, and that the developed systems with file-sharing functions have low traceabilities as to who, when, and how changes

were made to which files.

Three pieces of literature related to peer evaluation (or mutual evaluation) are shown below. [1] has obtained the result that an additional function of peer evaluation to collaborative learning can be a trigger for a higher motivation to study. On the other hand, [3] warns, as a con of peer evaluation, that there be cases where the average point of learners depend on evaluators if they are evaluated by subjective feelings. [4] conducted experiments assuming that the following 5 conditions lead to a better effect on collaborative learning, and confirmed the higher maturity of learners' understanding: 1. giving a chance for peer evaluation, 2. small-sized groups (at most 5 per group), 3. monitoring group members' activities at random, 4. allocating roles to each member, and 5. having learners learn about collaborative learning beforehand.

An environment enabling to make an analysis of learners' study logs was developed by [5], from the points of view that

1. teachers can "loiter around" a variety of study logs
2. details of learners' activities are shown
3. synthetic ranking is made by adopting AHP.

This computer program was made, intended for the final application to CALL system. Our target differs, but has a lot in common with those of CALL systems in terms of viewing learners' log data.

3. Objective of This Research

The investigation of previous research showed that the introduction of peer evaluation in CSCL raises learners' motivations and understandings. Based on this fact, the authors adopted peer evaluation in the developed module. In the module, a function to manage study logs is also incorporated. In spite of a large number of modules already developed for managing log data, teachers have found it difficult to link them to evaluating learners. On the contrary, our module was implemented enabling AHP, cluster analysis, and diverse analyses with graphs.

4. Study logs and peer evaluation module

The module implemented in this research has a "peer evaluation" function facilitating collaborative learning, as well as its basic functions. This function is executed in one compact frame with the use of "inline framing", aiming to lessen the number of manipulations by learners. In order to make good use of these functions, study log data have to be stored in detail and displayed in easily comparable formats.

4.1. Basic "collaborative learning" function

As a matter of course, this module equips basic functions for conducting collaborative learning:

(a) Group management
(b) Role allocation
(c) Peer evaluation
(d) Uploading files
(e) Management of study materials
(f) Management of study logs
(g) Collaboration in forum
(h) Downloading study log data in CSV formats

4.2. "Peer evaluation" function

As collaborative learning progresses, each learner will get to grasp how much each group member has contributed to the group study, and sometimes how much he/she has understood the topic, even more to the details than the teacher in charge of the class. This is why this "peer evaluation" function was determined to be implemented. Evaluation is made based on the criteria (with methods and maximum values), set by a privileged user. There are three ways to input their scores:

I. any value in the pre-defined range
II. five-grade system
III. Boolean (Yes/No)

In order to collect data (of peer evaluations) swiftly, this module automatically sends e-mails to those who haven't finished evaluating others.

4.2.1. Displaying the result of peer evaluations. The result of peer evaluations can be displayed in various formats. By default, averages of evaluated values are shown in array, for each criterion. For example, the second column of the first line of Fig.1, or, "76/69/69", means the averaged values of first, second, and third criterion for "S 浦 Y 祐" are 76, 69, and 69, respectively . Likewise, the third column, or, "78/72/78" shows the triplets of the second round of evaluations for the same learner.

Clicking some member's name moves to the screen for the list of evaluations he/she has made so far, giving a hint if he/she is a rigid or generous evaluator. Also, clicking a triplet shows the list of primitive data by evaluators.

Evaluated Members	1st	2nd
S浦 Y祐	76/69/69	78/72/78
K山 T	78/60/72	*
O津 T実	71/62/73	*
K嶋 Y介	83/64/78	*
K林 A史	70/66/54	*
T M恵子	85/87/82	85/81/81
N村 K佑	88/80/90	86/77/79
I口 Y	81/72/83	*
U垣 T裕	82/77/78	*
O笠原 M彦	85/80/84	*
S藤 Y	72/62/50	*
K野 S	80/71/77	*

Fig. 1: Display of arrayed scores of evaluation

4.3 "Study logs management" function

With the use of "study logs management" function, one can view various types of study log data arisen in the course of collaborative learning. The followings are the actions (or "events") when log data are stored.

(A) Login
(B) Submission to forums
(C) View of study logs
(D) Execution of peer evaluation
(E) Submission of assignments
(F) Addition of shared files
(G) Addition of study materials
(H) View of study materials

Study logs are collected by groups, and are displayed in descending order as Fig. 2. This is the result of ranking in each group, and this function can also display the ranking among groups, to know which groups conducted collaborative learning actively. In this case, the score of each group is the total sum of the score of all members of the group.

Ranking by Categories (#)

Login

Order	Name	Value
1	K山 功	41
2	K嶋 Y介	24
3	O津 T実	12

Log Data View

Order	Name	Value
1	K山 功	8
2	O津 T実	0
2	K嶋 Y介	0

Submission to Forums

Order	Name	Value
1	O津 T実	0
1	K山 功	0
1	K嶋 Y介	0

Peer Evaluation

Order	Name	Value
1	K嶋 Y介	3
1	K山 功	3
3	O津 T実	2

Materials View

Order	Name	Value
1	K山 功	10
2	K嶋 Y介	8
3	O津 T実	0

Completion of Materials View

Order	Name	Value
1	O津 T実	0
1	K山 功	0
1	K嶋 Y介	0

Assignments Submission

Order	Name	Value
1	K山 功	1
2	O津 T実	0
2	K嶋 Y介	0

Materials Update

Order	Name	Value
1	O津 T実	0
1	K山 功	0
1	K嶋 Y介	0

Shared Files Update

Order	Name	Value
1	O津 T実	0
1	K山 功	0
1	K嶋 Y介	0

Fig. 2: Display of the ranking, using study log data

Study logs are displayed by graphs too, using JpGraph[1]. This enables to make a visual comparison between individuals and the whole group, with time-series data.

Fig. 3 is the graph for login times data of one user. This shows this user has logged in the system pretty constantly.

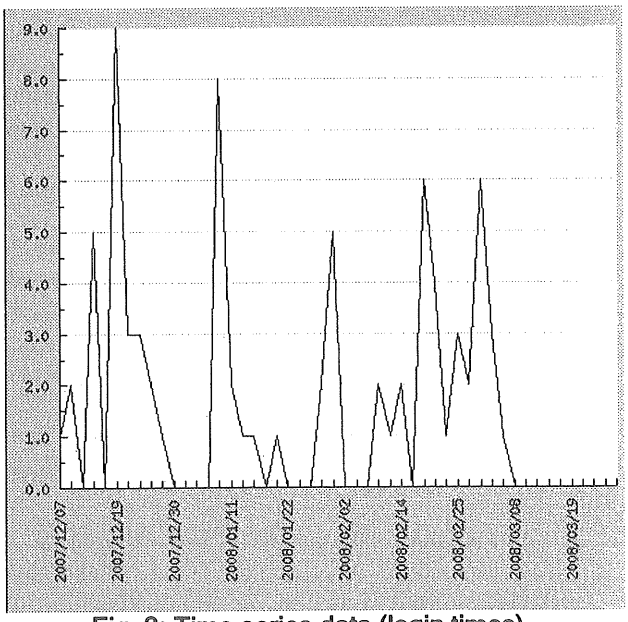

Fig. 3: Time series data (login times)

Fig. 4 is a radar chart for making a comparison of study logs of one user with other members, from different viewpoints. Primitive data are converted into standard scores.

[1] http://aditus.nu/jpgraph/

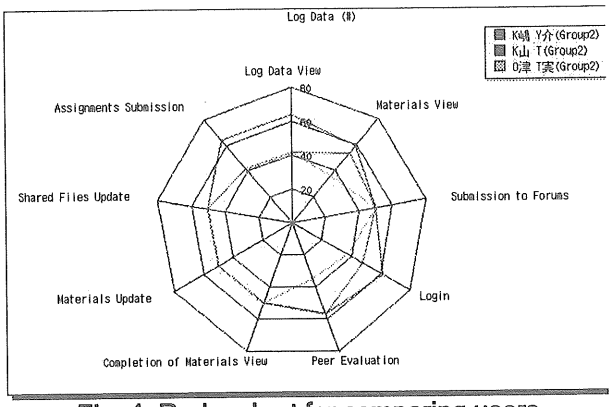

Fig. 4: Radar chart for comparing users

This module is also equipped with cluster analysis function. When evaluating learners by cluster analysis, learners are automatically divided into clusters (which depends on by which log data learners are to be divided and on the number of clusters), and the targeted cluster is displayed with the average of other clusters (Fig. 5).

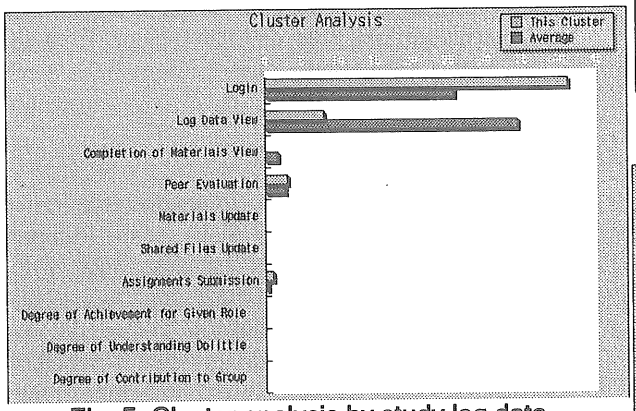

Fig. 5: Cluster analysis by study log data

4.4. Evaluation by AHP

Generally speaking, it is difficult to reflect teachers' subconscious priorities (weights) upon evaluations of learners, especially when there are different types of study logs. To help this, AHP technique is adopted in this module as [5].

AHP is an analytic method to decision-making problems developed in the 1970s by Thomas Saaty [6]. This method enjoys the feature to be able to digitize objective and subjective data synthetically. In this function, AHP is not used to make a decision, but to make a legitimate evaluation based on importance of each criterion derived from one-on-one comparisons. In this research, we have taken it for granted that a set of values obtained by peer evaluation is one of the significant information to evaluate learners.

Fig. 6 & 7 are one example of AHP analysis, when the teacher chose 4 criteria (or, "Login", "Log Data View", "Peer Evaluation", and "Degree of Understanding Dolittle") for grading learners (See Section 5 for "Dolittle"). As Fig. 6, all the pairs of the criteria pop up with radio buttons. This is the figure after the teacher selected each button depending on subjective importance. Since the teacher weighted "peer evaluation" more than other criteria (in making one-on-one comparisons), the corresponding scores occupy largely in total scores of members (see Fig. 7). By clicking each bar graph, the viewer can jump into the corresponding page showing the relevant log data. The profiles of one-on-one comparisons are stored with its labeled name and can be reused for future configuration. If the teacher wants to make a subtle change, he/she need not make the profile from the beginning. The profiles can be referred from other teachers as well, for exchanging their weights to grade their learners.

More important		More important
Login	○ ○ ○ ○ ◉ ○ ○ ○ ○	Log Data View
Login	○ ○ ○ ○ ○ ○ ◉ ○ ○	Peer Evaluation
Login	○ ○ ○ ○ ◉ ○ ○ ○ ○	Degree of Understanding Dolittle
Log Data View	○ ○ ○ ○ ○ ○ ◉ ○ ○	Peer Evaluation
Log Data View	○ ○ ○ ○ ○ ◉ ○ ○ ○	Degree of Understanding Dolittle
Peer Evaluation	○ ○ ◉ ○ ○ ○ ○ ○ ○	Degree of Understanding Dolittle

Fig. 6 Profile of one-on-one comparisons

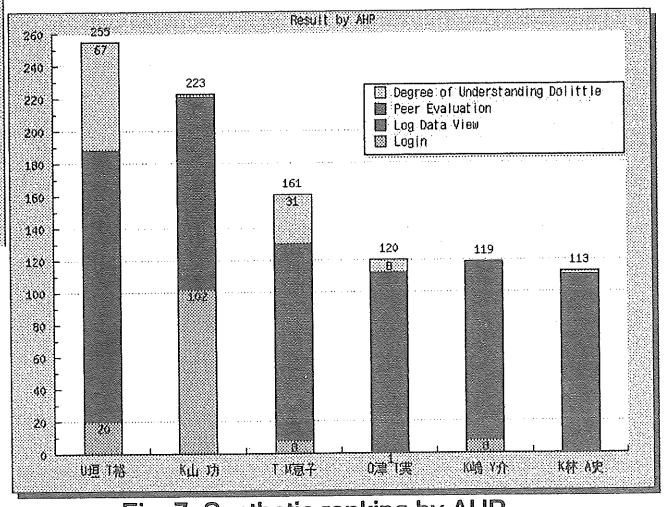

Fig. 7: Synthetic ranking by AHP

5. Experiments

5.1. Preliminary experiments

In the laboratory, 6 students (juniors of Shizuoka University, Faculty of Informatics) joined an experiment and were engaged in collaborative learning.

As a first step of the experiment, each subject studied Dolittle[2] and Suzuka[3] on Moodle using our

[2] Programming language for K12, http://dolittle.eplang.jp/

[3] Freeware to create Flash movies, http://www.cty-net.ne.jp/~uzgensho/

module. The learning contents were developed in [7]. There are 5 lessons each. Each lesson of Dolittle course is described in the table below:

Table 1: List of learning contents for Dolittle

Lesson #	Contents
1	Introduction Making figures
2	Objects & Blocks Branches
3	Timer and animation Array
4	Method Collision detection GUI components
5	Duplication of objects (with its registration) Table tennis program "Rock-paper-scissors" program

Each subject has to submit assignments in each lesson.

After this, 6 subjects were divided into two groups. Each group is given a project to make a network program by Dolittle in a month. After the deadline, the authors had each subject evaluate their peers from the standpoint of

1) degree of achievement to given roles
2) degree of understandings of Dolittle language
3) degree of contribution to the group study

5.2. Result of experiment

Each group completed their programming assignments. By the thorough observation of the study log data provided by the module, the next findings were made:

i) Each group has allocated each member's role clearly before working on assignments (such as leader, idea provider, and programmer)
ii) Members in charge of programming had checked learning contents quite frequently
iii) One of the members got low scores of peer evaluation due to the lack of contacts with other group members.

And the result of the questionnaire conducted after the experiment synchronized with the above findings.

5.3. Ongoing experiment

Ongoing experiments have taken place in the class "Discrete Mathematics" in the spring semester 2008 (the first author takes charge of this class), with a little larger enrollments (around 30 students) divided into groups (3 or 4 members per group). The results will be discussed in detail on the day of presentation. Enumeration of the rough analysis as of the present data goes:

a) Evaluated values to a learner are fairly stable in terms of standard scores. (Namely, its variance is not high).
b) There appears a co-relation between the quality of the submitted assignments and the sum of login times of its group members.
c) Learners have begun to "compete" aiming to produce better assignments among groups.

Also, in the coming fall semester 2008, the authors are scheduled to apply this module at an even larger-sized class (approximately 80 students).

6. Conclusion

As a new module for facilitating CSCL, functions to assist peer evaluations and view learners' study log data were implemented. AHP technique was introduced for teachers to evaluate the mixture of objective data (study log data) and subjective data (peer evaluation). From the experiments, it was proved that collaborative learning can be proceeded on this module, and this module gives us information on contribution and role of each subject (from the result of peer evaluation).

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