The Sixth International Symposium on Operations Research and Its Applications (ISORA'06)
Xinjiang, China, August 8–12, 2006
, pp. 212–218

An Educational System Based on the Questionnaire Proposed by the Students: Construction and Practical Usage

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1 Introduction

"Teaching evaluation by students" is a leading approach for improving lessons, and has been widely carried out in various educational facilities. In recent years, the researches which applied text mining to the evaluation are prosperous [1][2], and they have achieved success steadily.

However, the conventional evaluation has been performed mainly in the form in which a student answers to the question items of a teacher created questionnaire, that is, a teacher-initiative type. If this method is followed, the question items corresponding to a student's needs may not be reflected in the questionnaire. Therefore, in this research, leaving the items creation to the student himself, a student-initiative type teaching evaluation model is proposed "where a student creates the questionnaire of inventory or multiple choices form himself, and answers".

This research can be positioned as "practical research" which enabled the leadership shift to a student by developing and using the educational support system for realizing a new teaching evaluation modeling. Moreover, this research is also the trial which pulls out a student's inquisitive to the maximum extent, and can expect the contribution to a lesson improvement

2 Outline of Teaching Evaluation Modeling

The procedure of the teaching evaluation by the proposed model (as shown in Fig 1) is as follows:

(i) A student creates question items using the Web form on PC. The items data are stored in database.

(ii) Using the language processing technique based on the cluster model, items created by all students are grouped as regards their similarity. Then the system enumerates them on a teacher's PC screen.

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(iii) From similar items, included in the same cluster, a teacher creates the representative question item important to a lesson improvement on behalf of the group (contraction of a question sentence space), and writes it in a database.

(iv) The items created in step (iii) in the Web form, are shown to a student.

(v) Students answer the questionnaire based on their own proposed items.

3 Educational Support System

The question items (see (i) in Fig 1) created by many students also had similarities, therefore it was necessary to standardize these items by a certain method, and to show them to a student. However, if they depend only on manual operation, adjustment of an item will take huge cost. Then, when employing this model, a suitable education support system becomes indispensable.

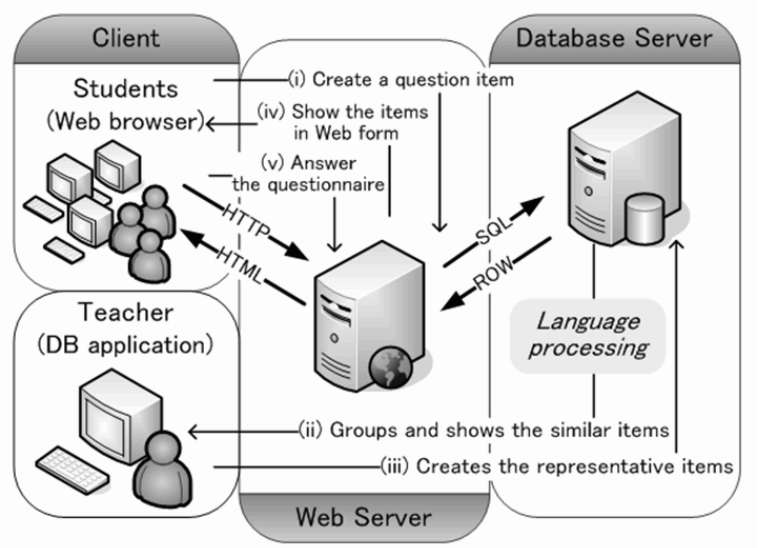

Figure 1: Teaching evaluation by the proposed model

In order to solve this problem, the system using language processing and information retrieval technology as the base was constructed, and the process of question items creation was optimized.

3.1 System Configuration

As shown in Fig 1, the educational support system consists of servers (a database server and Web server) and clients (Web browser and C/S type database application). Among these, a student uses a web browser where as a teacher uses database application.

SQL Server™ 2000 Desktop Engine (MSDE 2000) was used for the database server, and IIS 6.0 (it mounts in Widows Server™ 2003) was used for the Web server, and the system was constructed. Furthermore, the language processing module was coded using Visual Basic®.NET 2003.

3.2 Language Processing Model

The language processing in the educational support system includes (i) The term extraction from a question sentence, and (ii) clustering of question items based on information of their term frequency.

(i) The question sentence was decomposed into the morpheme using ChaSen [3], and then the noun, the adjective, and the verb were extracted as a term. Next, out of these, terms such as "today" and "lesson" were deleted as 'stop words'. Thus the extraction terms were decided.

The question sentence which the student created can be expressed through the vector which makes the terminological number of differences a dimension.

Here, the component of a question sentence vector was set to value $tf(t,d)/\sum tf(t,d)$ which divides the frequency of appearance $tf(t,d)$ of each term "t" in each question sentence "d" in the term appearance to the total in the same question sentence.

(ii) The question sentence was clustered hierarchically based on the degree of similarity, using the cluster model.

The cluster model is an information retrieval model which used cluster analysis as the base. In this research, the Euclidean distance between terminal point coordinates of the question sentence vector was found, and the hierarchical cluster was formed by the complete linkage method. Question sentences with high similarity will be contained in the same cluster as a result of clustering based on extraction terms.

4 Evaluation of the System

4.1 Enforcement of Teaching evaluation Questionnaire

Teaching evaluation based on the proposed model was performed by using the information processing-related basic training subjects called "Spreadsheet" and "Pasokon Communication" which were opened in the 2005 fiscal year. The number of total lessons was 15. Subjects were 65 N junior college female students. These students were divided into three groups of 20, 20, and 25.

The item data was made to create a questionnaire item at the time of the 14th lesson by the students of each class. Teaching evaluation was carried out at the time of the 15th lesson respectively in November, 2005, and January, 2006.

As a general rule, creation of the question item by each student carried out for 1 minute as a standard. By the actual questionnaire, in consideration of reply time, the teacher set up about ten of 20 items, and the remaining ten items were assigned by a student proposal.

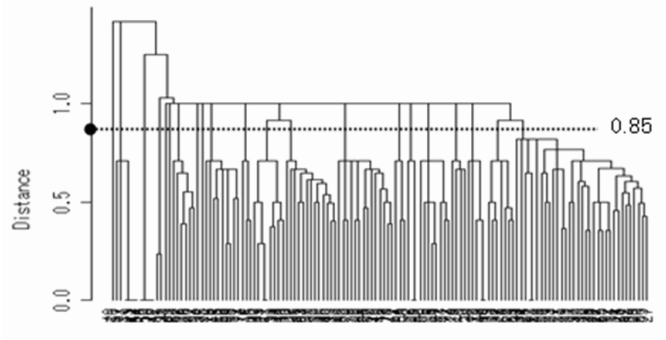

Figure 2: Grouping of the question items by the cluster model

4.2 Simulation of Question Items Contraction

Batch processing of question item data of total of 133, collected by teaching evaluation of 3 classes comprising 2 subjects for the purpose of a verification of a system of operation, was carried out; and the simulation of (iii) was performed from the process (i) in Fig 1.

The document size of the question sentence which the student proposed was an average of 41 bytes. The dendrogram of a clustering result is shown in Fig 2.

The level dashed line is a division line about the cluster in distance 0.85. The number of clusters obtained by division is 21, and it is shown in Fig 3 which took up the contents of four clusters arbitrarily among those.

The result of clustering is good in general and brought a result which can expect drastic reduction of contraction cost. However, when the number of questions belonging to a cluster increased, though natural, the low question sentence of the degree of similarity will live together, and the cluster with difficult contraction also existed

A teacher performs contraction of the question sentence belonging to each cluster manually after judging a semantic content. Here, a teacher will contract and create one question sentence for each cluster. For example, Cluster1 of Fig 3 can be contracted as if “Do you thinks that the contents of a lesson will be useful in the future?”

4.3 Evaluation to Student-Initiative Type Questionnaire

The question sentence that is “Do you think that the Student-initiative type questionnaire can raise motivation?” about the teaching evaluation modeling itself was included in the carried-out questionnaire.

Fig 4 is the total result of the reply (five-step consultation) to this question carried out in “Pasokon Communication”.

cluster_No	qi1
1	Excelは難しいと思いませんでしたか？？
	授業内容は、今後に役立つと思いますか
	この授業が今後役に立つと思うか
	この授業は自分にとって役立つものだったと思いますか
	この授業で学んだことは将来、役に立つと思いますか？
	この授業は将来役立つと思いますか？
	社会に出て役に立つと思うかどうか
2	先生の授業はわかりやすかったですか？
	わかりやすい説明だったか
	わかりやすい説明でしたか？
	授業の内容はわかりやすいものでしたか？？
	授業の説明は丁寧でわかりやすかったですか？
3	ノートをきちんととっているか。
	ノートをとる時間をとってくれましたか。
4	ノートを書く時間があったか。
	授業で何か得るものがありましたか？
	授業は関心のある内容でしたか
	今日の授業を受けてわかりにくいところはありましたか？？

Figure 3: Question items (in Japanese) included in each

5 Consideration

5.1 Usefulness of Proposed Model

In the former type teaching evaluation, the question items of a questionnaire is created by the teacher side. Most of these are inventory form and will carry out total analysis as fixed-quantity data after the questionnaire enforcement.

However, only the inventory item included in a questionnaire cannot estimate all the contents of a lesson comprehensively. Then, in order to minimize “leak”, the evaluation criteria of a free symbolic convention are put side by side in many cases.

Recently, it is common in the trial to apply the technique of text mining and carry out knowledge extraction from such a description sentence. However, various costs occur in the process of knowledge extraction in case of this method.

In the proposed model, by creating the question item from a student’s viewpoint beforehand, an effect equivalent to the knowledge extraction from a description sentence can be acquired, and reduction of cost can be achieved as a result. Moreover, it is considered that it was high and the evocation effect of respondent volition has also proved the usefulness of the model as shown in Fig 4 .

5.2 Contraction of Question Items Using Cluster Model

In the cluster model, the computational complexity at the time of cluster composition poses a problem. However, this problem will not become so big although based also on the amount of documents which the document (question sentence) in teaching evaluation is an average of 41 bytes, and is accumulated in a database.

Since the discernment capacity in an extraction term declines, the small question sentence in size has a bad influence on the accuracy of the formation of a similar question sentence group.

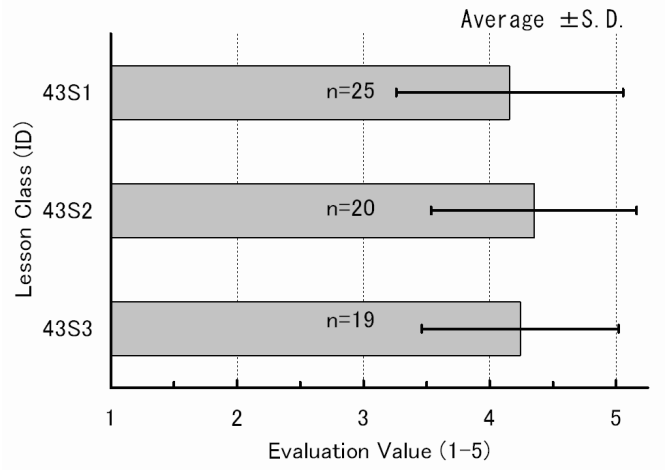

Figure 4: Evaluation result to a student-initiative type questionnaire

The morphological analysis was used for term extraction in this research. However, if it becomes as the degree of similarity between question sentences is only calculated, using the technique for which it does not depend on dictionaries, such as n-gram, as a remedy of accuracy will also be considered.

Since the keyword in the question sentence which the student proposed can serve as an important index when making a lesson improvement, it is difficult for it to avoid term extraction.

We intend to use n-gram and a morphological analysis together from now on. The verification of term as an improvement index using a morphological analysis will be needed for discernment of similarity in n-gram.

6 Conclusion

As a result of performing teaching evaluation based on the proposed "student initiative type model", it contributed also to evocation of the point that the lesson analysis and the improvement from student's viewpoint are realizable, and a student's evaluation volition, and the result was accepted in that the satisfaction of having participated in the lesson improvement positively was given to the student.

Moreover, we assume that cost required to perform knowledge extraction from a free description sentence was reducible. It will be necessary to examine the applicability of the system to a wide range question sentence, such as using language models, and n-gram, together from now on.

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