Lecture Data Analysis towards to Know How the Students’ Attitudes Affect to their Evaluations

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Abstract—The goal of our study is to make a learner-model of students with lecture data analysis and to help them learn to be more effective by advising. In order to achieve this goal, we have pursued a series of studies on effort-achievement, effort-self evaluation analysis, etc., and have found that the students with higher outcome tend to evaluate themselves more objectively, whereas those with lower outcome tend to be more optimistic. The major aim of this paper is to analyze the students' self- and class-evaluations deeper, based on an evaluation questionnaire. In order to pursue such analysis, we introduce a new measuring index named self-confidence, with which we investigate the correlations between self-confidence, self-evaluation, lecture evaluation, effort and achievement scores. Even though this approach of study is just in its early stage, it has a high potential so that it could become a necessary tool for lecturers in the near future.

Index Terms—Lecture Data Analysis, Educational Data Mining, Evaluation Questionnaire, Faculty Development.

I. INTRODUCTION

Thanks to the popularization of university, quite a lot of students are able to get higher education. On the other hand, e.g. in Japan, notable ratio of students who lack sufficient motivation to learning enters into universities. This is a common recognition among Japanese professors. Under such circumstances, universities have been putting efforts in improving their educational abilities. They have meetings for exchanging tips in teaching, get lectures by experts in teaching, improving their educational abilities. They have meetings for exchanging tips in teaching, get lectures by experts in teaching, have questionnaire to ask the students for evaluating the classes, etc., as a part of faculty development (FD) activities.

Even with such efforts, situation does not change accordingly. As we observe the students in the classrooms, we find that considerable rates of students are just attending the classes without learning diligently. Thus it needs to reform the students so that they understand the importance of learning for their future and raise their motivations to learning as a part of the student development (SD) activities.

Our approach to this issue is to make the models of students as learners on both of their achievement and attitudes to learning, then to utilize them for giving advices to the students. Our research interest is also on developing the knowledge finding methods by analyzing everyday lecture data.

The research on data analysis in education has been mainly conducted as a part of KDD (Knowledge Discovery and Data Mining) and in EDM (Educational Data Mining). For example, the paper [11] gives a comparative study of data mining algorithms for classifying students using data from e-learning systems. Its major interest is on predicting the student's outcome. Ours is on the student's psychological tendency in learning such as eagerness, diligence, etc., which is different from those in KDD and EDM where they use the target data which are obtained from learning management systems, whereas our target data are those we can create in every ordinary lecture.

The papers [1] and [2] have similar intention and approach as ours in the sense that their data also are not automatically collected in e-learning systems, but those coming from the students’ reports. Their method is based on the manual data mining from text data. We also use the students' self-evaluation data but use only the score data in this paper.

In our studies we use the data such as attendance, homework, everyday exercise, and term-end examination, which are obtainable in every lecture. Our aim is to develop practical methods that will extract useful tips for improving lectures from lecture data. We do not intend to develop the tools which are applicable only to big data but to develop those which are applicable even to small data [4].

We have been taking such an approach in the analysis of library data. In the papers [5], [6], [8] and [9], we take library's circulation records as the target data and analyze them with proposing new concepts such as expertise levels of books and of library patrons. The seat usage data of a library were also analyzed in [3]. From these experiences we are convinced that such an approach is useful for small data.

II. TARGET DATA

The data used in this paper are the term-end examination, attendance, and homework scores in the class of “Information Retrieval Excercise” in 2009 in a women’s junior college [4], [5], [7]. There were 35 attending students who were in the year 2 and thus going to graduate. This is one of the compulsory courses for obtaining the librarian certificate. Thus the students of this course were generally more diligent than other cases.

The most important aim of the course is to let the students become expert information searchers in the sense they have
enough knowledge about information retrieval, search, finding, and also have enough skills in finding appropriate search engine site and selecting search keywords based on the understanding of the aim and background of the retrieval. The course consists of 15 lectures. The attending students are supposed to solve a small quiz at every lecture, which turns into the attendance records and the basic data for attendance scores.

Also homework is assigned every week. Its aim is to make the students review what they have learned in the class and to study preliminary knowledge for the next class. At the same time, the students is requested to write a lecture note every week, which is also aiming to make the students review what they have learnt. The homework score reflects the frequency and quality of the submitted homeworks.

The term-end examination of the course consists of 3 problems/questions. The first question is about finding the Web sites of search engine, and summarizing their characteristic features, together with discussing about the methods for information retrieval. The second question is about finding the Web sites on e-books and on-line material services. The third question is to find and discuss about the information criminals in the Internet environment.

The aim of these questions is to evaluate the skill on information retrieval including the planning and summarizing skills that are supposed to be learned and trained in the course as they do their exercises in the classes and as they do their homeworks. The scores of term-end examination represent the evaluation results according to this aim.

III. ANALYSIS OF LECTURE AND SELF EVALUATION

A. Self-Evaluation Data

The evaluation data come from the term-end evaluation questionnaire that consists of 12 questions; 5 about the lectures and the lecturer, 6 about the students themselves, and 1 for any other comments. They are: (Q1) what the student learns in the lectures, (Q2) good points of the lectures, (Q3) bad points that need to be improved, (Q4) the score of the lectures as a whole with the numbers from 0 to 100, where the pass level is 60 as in the same way to the examination score, (Q5) comments on the course, on the lectures and the lecturer, and (Q6) good points of the student in learning attitudes and efforts for the course, (Q7) bad points of the student that should have to be improved, (Q8) evaluation of the diligence and eagerness to study of the student among “excellent,” “good,” “fair,” “rather poor,” and “poor”, (Q9) answer if the student has made any questions to the lecturer among “made questions more than once,” “made questions once,” “had no questions,” “could not make questions,” and “had no questions at all,” with the detailed information about the question(s) and if the lecturer answered appropriately, (Q10) answer if the student has had some research or information retrieval in order to find the answers of some questions after school hours among “retrieved often,” “retrieved sometimes,” “had not retrieved for solving questions,” and “had no questions at all” with the detailed information what she has done on this, (Q11) the score of the student herself in terms of her attitude and attitude toward the course from 0 to 100 as in the same way as in Q4, and finally (Q12) any other comments.

The number of the answered items varies from student to student. Among 35 students, 20 of them answered both of the evaluation scores for lectures and themselves. Thus we use these 20 score data in analysis on evaluations.

B. Students’ Attitude to Classes and Self-Evaluation [7]

Firstly we would like to investigate the correlation between self-evaluation and the homework scores. Fig. 1 shows the result. Note that the data consist of the 20 students. The correlation coefficients of them are 0.4 for attendance and 0.5 for homework. Thus the correlation for homework is stronger than that of attendance.

![Fig. 1. Correlation between Self-Evaluation Scores (x-axis) and Homework Scores (y-axis).](image)

We may consider the self-evaluation score as an index for the student's satisfaction to her efforts and achievements. The students were asked to look back what they had been doing in the course and they would give high scores if they evaluate their efforts satisfactorily. From this point of view, the data show that doing homework affects more on satisfaction level than attendance. This is a reasonable result because students might also recognize that doing homework needs more efforts than just attending the classes, and thus they would like to appreciate their efforts on doing homework than just attending the classes.

As we have a closer look at the students individually, students A, B, and C are located in reasonable positions. Student A is good in every aspect; attendance, homework, and examination. Thus it is understandable that her satisfaction is very high. It is also reasonable that C3 satisfies with average level as with the same level as her homework score. She evaluated herself in accordance with her effort on doing homework even though her attendance is a little bit higher than average. The satisfaction level of B is higher than that which reflects her efforts of attendance and homework. Even though her effort scores are very low and she should face this fact, she might be satisfied with what she got in the course. Maybe this explains why she could get one of the good scores in examination.
On the other hand, D2 and E are much different from these students. Student D2 belongs to the D Group, who attended the classes in average and did homework very poorly. Even though the homework score is one of the lowest, the satisfaction level of D2 is more than average. This might mean that D2 was satisfied with just attending the classes regularly without paying attention to what she should learn. As a result, her examination score was much lower than average, probably because she did not care about learning in a real sense.

Student E is in a kind of opposite to D2 in terms of satisfaction level in comparison with effort levels. Even though she attended and did homework in an average level, and her examination score was just a little bit lower than average, her satisfaction level was the lowest. However she might feel that her efforts were somewhat superficial and she recognized that she did not learn sufficiently. She was a good student in a point of view that she knew fairly well that she recognized that she did not learn sufficiently. She was a good student in a point of view that she knew fairly well that she recognized that she needed to put more efforts in the everyday classes and she was willing to put more efforts in learning diligently.

It is interesting to see the correlation between self-evaluation scores and examination scores (Fig. 2). The correlation coefficient of them is -0.1, which means the student in lower score tends to put higher self-satisfaction, in general! How can we interpret this phenomenon?

As has pointed out the evaluation data come from the 20 students who gave both evaluation scores. These students' average examination score 71 is higher than the average score 65.5 of all students, whereas the averages of attendance and homework scores are almost equal; 88 against 88.1 for attendance and 74 against 73.8, where the former is for these 20 students and the latter for all students. Thus the students who appear in Fig. 2 have higher examination scores, and might have better average attitude to the classes in general.

Let us divide the students into 2 groups using the average value of the examination scores; the upper and the lower groups. Most students in the upper group are located in the range from 70s to lower 80s in examination score (y-axis), and their satisfaction scores are dispersed widely in the rage from 40 to 80. Even though their achievement levels are high, each student is not sufficiently satisfied with efforts and achievement and her satisfaction level may not be high enough.

On the other hand, majority of the lower achievement group evaluate themselves with high level of satisfaction. The student D2 is a typical one of them. One possible explanation is that such students are not able to evaluate themselves in a reasonable way. Maybe they just want to evaluate themselves as good as they can, probably in order to keep them being confident with what they do and what they are.

C. Analysis of Lecture and Self Evaluation Scores

Among 12 questions, Q4 and Q11 asked the evaluation of the lecture and the students themselves, respectively. The scores range from 0 to 100 and 60 is the pass level. Among 35 attending students 23 of them answered to Q4 and 21 to Q11, and only 20 students of them answered to both questions.

The scores for lecture evaluation range from 50 to 95 and their average is 75. The peak frequency also lies in 70s. On the other hand, the self-evaluation scores range from 30 to 80 and average is 61, and peak frequency also lies in 60s.

Obviously the students evaluate them lower than lectures, which must come because the students are asked to give their names in the questionnaire. They were hesitant to give their scores higher than lectures. Also some number of students had tendency to evaluate lower than the scores they should do, because they thought they could have done better than what they really did, and thus tended to evaluate them lower than average.

As we see the correlation between the lecture and self evaluation scores, we can see 3 students gave the same scores for lecture and self evaluations and the rest 17 students gave higher scores for lecture than for self. We can see easily that the student who has higher self evaluation has higher lecture evaluation in general. Actually the correlation coefficient between these scores is 0.59.

It is interesting to see that these evaluation scores are not correlating to the achievement and examination scores. The correlation coefficients of examination score and lecture and self evaluation scores are -0.15 and -0.12, respectively. Thus the correlation between the achievement and evaluation is negative with quite small absolute value; which probably means that the students in low achievement have as much satisfaction as those in the middle and high achievement.

That the students put their own scores not greater than lecture scores might indicate that students put the two scores by in a related way and thus the given scores may not represent the “true” evaluation results. Based on this observation, we introduce a new measure for the student’s intended own evaluation as a ratio to lecture evaluation: Self Confidence = (Self Evaluation Score) / (Lecture Evaluation Score)

Fig. 3 shows the correlations between the self confidence values and lecture and self evaluation scores together with two approximation lines; y=-3x+78 for lecture and y=71x+3 for self evaluation. It is easy to see that self evaluation has high correlation to self confidence; correlation coefficient is 0.78. Lecture evaluation has almost zero correlation coefficient (-0.04).
Furthermore, by considering that the gradient -3 of the approximation line for lecture evaluation is very small in comparison with 71 for self approximation line, we can say roughly that the lecture evaluation is almost independent from self confidence. In other words, we may say that self confidence is closer to the “true” self evaluation.

Fig. 4 shows the correlation between self confidence and achievement scores. Students are covered by two rectangular areas; one from 0.7 to 0.9 in self confidence and from 30 to 80 in examination scores, and the other from 0.4 to 1.0 in self confidence and from about 60 to 80 in achievement scores. Incidentally the central value 0.8 of the self confidence values of the first area and the central value 71 of the examination scores of the second area happen to be the average values of all students. Students are arranged more neatly in Fig. 4 than in Fig. 2, thus the concept of self confidence is more appropriate to use in clustering the students and analyze their behaviours than of the raw data of self evaluation.

The whole area can be divided with each axis into three parts; upper, middle, and lower. For self confidence, upper area is with the value greater than 0.9, middle area from 0.7 to 0.9, and lower area with the value less than 0.7, and for achievement, upper area is with the value greater than 80, middle one from 60 to 80, and lower one less than 60.

In this way of division we have 9 areas. However no students are located in the 4 far ended areas; upper-upper, upper-lower, lower-upper, and lower-lower. Remaining 5 areas; i.e. upper-middle, middle-upper, middle-middle, middle-lower and lower-middle, are left for the students to be located. Most students are in the central area; middle-middle. Other students locate in the area of right-most (upper-middle), upper-most (middle-upper), lower-most (middle-lower), left-most (lower-middle) areas are somewhat minorities.

Students in the right-most area; having greater values in self confidence, are located in a relatively narrow area; from about 60 to 80 in examination scores. Even though they have highest self confidence, their achievements are not in the highest (upper-upper area) which indicate that the self confidence (true self evaluation) does not mean they have high achievement.

We can see also that the students’ achievements in this area are not very low (not in the upper-lower area) either. Thus we can say that students who do not study a lot and who could not expect to have high achievement in the coming examination do not evaluate themselves with very high scores.

Similarly with the students in the right-most area, just a small number of students locate in the upper-most area, where the self confidence is in the middle value area and their achievements are the highest. Probably they know they have studied quite diligently and still think they could do even better and could learn more. They may think also they would not want to boast too much on their efforts.

It is interesting to see that some students evaluate themselves with relatively high self confidence scores even though their achievements are very low; located in the lower-most area. These students may recognize that they have not studies hard enough and still, or maybe because of this, they do not want to admit this fact and to evaluate themselves with low scores so that they have to face the fact and have to admit their idleness. Even though they do not want to admit their idleness, they have to admit that they do not deserve high scores. Probably this explains why there are no students in the upper-lower area.

Again there are a small number of students who locate in the left-most area with lowest self confidence and middle achievement. So they evaluate themselves with relatively low scores than they ought to be in consideration of their achievement.

Our understanding is that they think themselves basically in the similar way as the students in the upper-most area. They are not satisfied with what they have achieved in the class. They might think they could do better than they actually did based on the strong desire to improve themselves. Maybe they have even stronger desire than the ones in the upper-most area because in comparison with the differences of the examination scores between these two areas, the difference in self-confidence scores is even larger.

D. Analysis of Attitude to Answering Questions

Now we take the answers to the term-end evaluation questions into consideration differently from the previous sections, where only the scoring questions 4 and 11 are dealt with. We introduce two measures for evaluating the attitude of students to answering the questions; total description length of answers and the number of items to be answered. We chose
these measures because we have observed that the students who are diligent in learning are also diligent in other activities that do not directly relate to the learning materials. Thus we would like to investigate if our observation matches to the analysis result of our data.

Due to the big difference of the index values of the two measures, we give normalization in order to compare them easier. The normalized values are calculated in two steps. In the first step, we change the raw value into the percentage of the contributed amount of the student for each question.

For example a student wrote an answer to question 1 that consists of 207 characters and it occupies 3.45% of total answers that contain 5993 characters for the question 1. So her score for question 1 is 3.45.

By summing up all of her scores for 12 questions, the total score becomes 95.22, which becomes the score for the index of description length. For the index of answered items, the initial value becomes 1 instead of 207 for question 1 and its normalized score becomes 3.03 because 33 out of 35 students give answers to this question. The final score of this student for the index of number of answered questions becomes 95.07.

![Fig. 5. Correlation of Examination Score with the Number of Answered Questions (◆) and the Description Length (□).](image)

Fig. 5 shows the correlation between the examination scores and the (normalized) scores of description length and number of answered questions. It is interesting to see that the correlation coefficient 0.54 for number of answered items is greater than 0.36 that for description length. Thus in terms of the influence to achievement, the difference whether the student answered to the question or not is more important than how much amount of message the student answered.

As we compare the correlation coefficient of examination scores with the description length of each question items, the largest value is 0.41 for Q4, which is the evaluation value for the class which has been used so far. The second largest one is 0.36 for Q3.

![Fig. 6. Correlation between Examination Score and Total Length of Description for Q3.](image)

Fig. 6 shows the correlation between examination scores and the description length for Q3, together with the number of answered students, which has 0.38 as correlation coefficient. It is easy to see that the student with higher achievement answers more possibility of writing and description length is longer than the student with no answer and who gives shorter description.

The largest correlation coefficient of examination scores in comparison with each question in terms of the number of answered items is 0.54 for Q8, which asks the students of their self evaluation of diligence. As we see the correlation between examination scores and the number of the students who answered to Q8, it is easy to see that the students who answer the question, i.e. the ones who have the vertical score of 4, have larger examination scores than those who do not answer, i.e. the one who have the vertical score of 0, in general.

There are 5 possible answers to Q8 because students are supposed to choose one of the answers given in advance from “excellent,” “good,” “fair,” “rather poor,” and “poor.”

As we see the correlation between examination scores and the answers to Q8, students only chose “good,” “fair,” and “rather poor,” and did not choose the extreme ones of “excellent” nor “poor.” It is interesting that the students who answered either “good” or “rather poor” are those in the value area for medium achievement with achievement scores from 50 to 80. On the other hand the range of examination scores for the students who answer “fair” to Q8 is much wider; from about 25 to 100.

Thus we may be able to see here again that the students who have high achievement tend to think that their efforts are not special and evaluate “fair.” We can see that the students who have low achievement also tend to evaluate their efforts as the same level as other ordinary students, even though they are not sufficiently diligent in reality.

The students who have medium achievement are separated into 3 groups according to their self evaluations. Most students in this group evaluate their efforts as “fair” just like the other groups. Even if the numbers are relatively small, some students evaluate their efforts as “good” and some other students evaluate as “rather poor.” Probably, the students who evaluate their efforts with good might be too optimistic by considering their achievements; especially the students with the examination scores in 50s.

On the other hand, the rest of the students who evaluate themselves with “rather poor,” might think that they can do better than what they really have done. So they might be very aggressive in learning and have intention to improve them than what they are now.
IV. CONCLUDING REMARKS

The eventual goal of our study is to discover knowledge that helps the lecturers with improving their lectures and also assists the students with learning more effectively. In this paper, as a step toward this goal, we pursued a case study of lecture data analysis in which the correlations between student's attitude to learning such as attendance and homework as effort, and examination score as achievement. We also showed our study on investigation by analyzing the students' own evaluation on themselves and lectures based on a questionnaire.

Our approach is different from other studies in a couple of points such as (1) we do not suppose to use the data that are obtained automatically from a computer system, and our data are obtainable in any classes, (2) our main concern is not to find the statistical relationship between the examination scores and the lecture data, but to make a student model relating to the student's ability to learn in the classes that include the student's attitude to the class at the first step, and then by using this model to extract effective tips for advising the students, and (3) our approach does not only intend to find knowledge but to define new concepts and to develop the analysis methods as the tool which are applicable to a wide variety of classes.

Relating to the issue (2) above, we would like to point out that one of the typical studies in lecture analysis is to estimate the outcome of the students in a class. Furthermore, relating to the issue (1) above, our data may not be large so that they may not provide highly reliable knowledge because they may change due to a small change of data. So we analyze the data not with standard methods but with non-standard ways by defining new concepts, introducing new measures, and by other ways. This paper has given an example of an approach.

In this paper, we took the attendance and homework scores as the indexes for measuring the students' effort, and we take the scores of the term-end examination as the outcome or achievement of the students, we investigated their relation. As a result, we find that some students seem to do the exercises in the classes and doing the homework just for finishing them without intending to learn as much as possible in the classes. So we, as lecturers, need more effort in the classes to inspire the students of the importance of learning in a real sense.

We tried to analyze the students’ satisfaction by using the evaluation scores for themselves and for lectures obtained from the term-end questionnaires. We defined a new concept called self confidence as the ratio of the two scores. As a result of the investigation, we found that the students in the high and low achievement group give medium self confidence, whereas those in the medium achievement group give much wide range of self confidence; from low to very high. Thus we can see that such students recognize the reality and evaluate themselves in the medium scores probably because they think they should and could have put more efforts. It is interesting to see such type of evaluation is given from the student in both groups of high and low achievements scores.

On the other hand the self confidence, which reflects the student's self evaluation, of the student in the middle achievement group is given highly depending on the student's character. Some students think their efforts, and probably their performance also, as satisfactory, and some students think it is not satisfactory and should have done more efforts, even though their achievements are in the similar level. One possible tip from this fact is that the lecturer can give feed-back data to the students who tend to over-evaluate themselves, and let them recognize their real positions in the whole class.

From the results of the study in this paper, we are convinced that our approach can be useful for extracting valuable knowledge and tips, so that the analysis methods developed in such studies could become necessary tools in the future.

The issues to be investigated toward this direction include:

1. to develop other analysis methods in trial and error with new ideas for indexes to measure the students' diligence, effort, attitude to learn, etc.,
2. to collect other types of lecture data and compare the implications of various courses, and
3. to generalize and automate the analysis methods so that they are applicable to wider lecture data.

REFERENCES