

How Student's Attitude Influences on Learning Achievement? --An Analysis of Attitude-Representing Words Appearing in Looking-Back Evaluation Texts--

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Abstract

Universities have been trying hard in order to help students learn more effectively. However, students' learning outcomes do not look like increasing accordingly. As we observe how students learn, we presume the main reason is not on lack of professors' teaching neither skills nor students' learning abilities, but rather on lack of students' attitudes to learning. In order to make sure if our assumption holds or not, we have been investigating the students' attitude by taking the approach of analyzing the lecture data and trying to find out useful knowledge. In this paper, we investigate correlations of students' achievements and their learning attitudes by analyzing the usage of words of students which appear in the answer-texts of their looking-back self/class-evaluation questionnaire. Precisely, we classify the words into 4 types based on the students' attitudes to learning, represented by the words. As a result of the study, we found that the students in the middle-achievement group have differences in their word-usages, whereas the high- and low-achievement students rather use ordinary words.

Keywords: *Text Analysis, Attitude Representing Words, Influence on Achievement, Educational Data Mining, Lecture Data Analysis*

1. Introduction

It has been pointed out that university students' academic skills are declining. A variety of causes will exist behind this phenomenon. Even though it is hard to clarify what cause affect how much amount, it is real that a lot of students who do not have sufficiently high skills and knowledge have entered universities and are attending the courses in higher education.

In order to deal with this problem, universities have been making big efforts by providing them opportunities for increasing their basic knowledge and skills, such as the “remedial courses” for raising the students' academic abilities, “additional courses for the first-year students” in order to help them start university life more smoothly, and strengthen the faculty development (FD) activities, etc. Even with such efforts, the situation does not improve suitably, though.

According to our experiences and observations, the main cause of this phenomenon is not on the lack of neither the potential study skills nor the amount of knowledge of students, nor lack of teaching skills of professors, but rather on the lack of students' attitudes to learning such as eagerness, curiosity, motivation to learning, etc. Actually, as we observe the students who have low achievements, they tend to have a very weak motivation to learning, do not have sufficient awareness what learning means for them, do not make much efforts in making notebooks, in doing reviews of classes, in doing homeworks, and thus their attitude to learning looks like the biggest factor of their low achievements.

Based on our observation, the most important thing to be pursued is to search for the causes of low achievements from fundamental level of capturing students' attitude to learning. This is the motivation of our study of lecture data analysis. Our eventual goal is to find out the most appropriate teaching/advising/leading methods for the students to learn the most out of the lectures. To achieve this goal, we have pursued a series of lecture data analysis [3-6], by using the answers to a term-end self/lecture evaluation questionnaire. From the self-evaluation data analysis, we found that the students having more than average examination scores evaluate themselves from very low to very high, whereas the students who have low examination scores rather evaluate themselves more than average.

From the analysis of looking-back evaluation texts [3-4], we found that the students having high examination scores tend to use the words which represent a wide viewpoint. On the other hand, the students with low scores tend to use the words which directly relate to the lecture's main topic, and thus they look like diligent students superficially; which is a surprising result for us. In this paper, we intend to investigate further on this topic and to confirm our findings by using text-analysis method, which is more objective than our observation.

Based on such a motivation, we are carrying out the studies of analyzing the data obtained in our lecture, which can be seen as a part of the Educational Data Mining (EDM) [7]. In other point of view, it is part of the Knowledge Discovery and Data Mining (KDD). Other studies of educational data analysis are conducted and reported to the conferences and journals in these fields.

For example, [8] gives a comparative study of data mining algorithms for classifying students, for predicting the student's outcome. Ours is rather on the student's psychological tendency in learning such as eagerness, diligence, seriousness, etc. There are some differences of our approach in comparison with other related work. For example, Goda *et al.* [1] also analyzed the text data which are provided by the students. However the texts are written as a part of everyday assignment. Further, their aim is to predict the outcomes of students. Our studies use wider data such as attendance, homework, exercise, term-end examination and looking-back questionnaire. Furthermore, our aim is to develop some kinds of practical methods for extracting tips for improving lectures even from small data [4], including library data, which is also different from other related work.

The rest of this paper is organized as follows: In Section 2, we describe what data we will use in this paper, together with some of the findings we have had in our analysis so far. In Section 3, we conduct the analysis by focusing attention to the types of words used by the students. In Section 4, we compare the words used by the students with high and low achievements (examination scores). Finally in Section 5, we conclude the discussions and findings in this paper.

2. Findings in the Analysis So Far

The aim of this section is to demonstrate the potential capability of lecture data analysis in order to understand what the students are like, by showing some findings we have had in our previous studies.

In order to achieve this aim this section is organized as follows:

In Section 2.1, we show a rough sketch of the target data. The target data for analysis consist of two types: numeric and text data. These data are obtained as the answers of the students of a course for a looking-back self- and lecture- evaluation questionnaire, and their term-end examination scores, which are considered as the measure for their achievements/outcomes in the course.

In Section 2.2, we investigate how their self-evaluation scores relate to their achievements. The data we use in this section are numerical data only.

In Section 2.3, we investigate the answers obtained as text data. Precisely, we extract the words used by the students and investigate how the words correlate to their achievements. The important finding in this study is that there are differences in student's usage of word types between those who took high examination scores and those who took low scores.

Based on these findings in this section, we will investigate further on the question how word type usage profile affects to achievement grade in Section 3.

2.1. Target Data

The target data were generated in the class named "Information Retrieval Exercise" for 2009 [4, 6]. The aim of the course is to let the students become expertized in information retrieval so that they have sufficient skills for information retrieval, search, finding, etc. The term-end examination of the course consists of 3 questions. It aims 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 during the lectures and as they do their homeworks.

We also imposed term-end looking-back questionnaire for evaluation of themselves and the class, by the following question items:

- (Q1) What did you learn in this class? Did it help you?
- (Q2) What are the good points of the lectures?
- (Q3) What are the bad points that need to be improved?
- (Q4) What score you give to 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) Write comments on the course, on the lectures and the lecturer, if any,
- (Q6) What are your good points in learning attitudes and efforts for the course?
- (Q7) What are your bad points that should have to be improved?
- (Q8) How do you evaluate of your diligence and eagerness to study? Choose one of "excellent," "good," "fair," "rather poor," and "poor".
- (Q9) Have you made any questions to the lecturer? Choose one of "made questions more than once," "made questions once," "had no questions," "could not make questions," and "had no questions at all". Describe in detail about the question(s) you made, and if the lecturer answered appropriately,
- (Q10) Have you done some research or information retrieval in order to find the answers of some questions after school hours? Choose one of "retrieved often," "retrieved sometimes," "had not retrieved for solving questions," and "had no questions at all". Describe in detail about what you have done,
- (Q11) What score you give to yourself as the evaluation of your own efforts and attitude toward the course. (With the numbers from 0 to 100 as in the same way as in Q4), and finally,
- (Q12) Write other comments, if any.

2.2. Correlation between Self-Evaluation Score and Achievement

Figure 1 shows the correlation between self-evaluation scores and examination scores. It is against our prediction, because the correlation coefficient is negative (-0.1), which means the student in lower score tends to put higher self-satisfaction, in general! How can we understand this phenomenon?

Actually, only 20 students appear in Figure 1, whereas the number of students who attended the class is 35, and these 20 students are considered to be diligent, and are supposed to have better attitude to the class in general than other students. The resting 15 students do not appear in the figure because they did not answer to (Q11) for self-evaluation. As we see the average examination score of these 20 students, it is 71, which

is much greater than the average score 65.5 of all students. Furthermore, the average scores of attendance and homework do not make big difference; 88 against 88.1 for attendance and 74 against 73.8, where the former are of these 20 students and the latter for all students.

Let us divide the students into 2 groups; those who have upper-than-average examination scores (upper) and who have lower-than-average scores (lower). Most students in the upper group are located in the range from 70 up to 90 in examination score (y-axis), and their satisfaction scores are dispersed widely in the range from 40 to 80. Even with their achievement levels are high, some students are not sufficiently satisfied with their efforts and achievements and their self-evaluation scores are rather low (around 40).

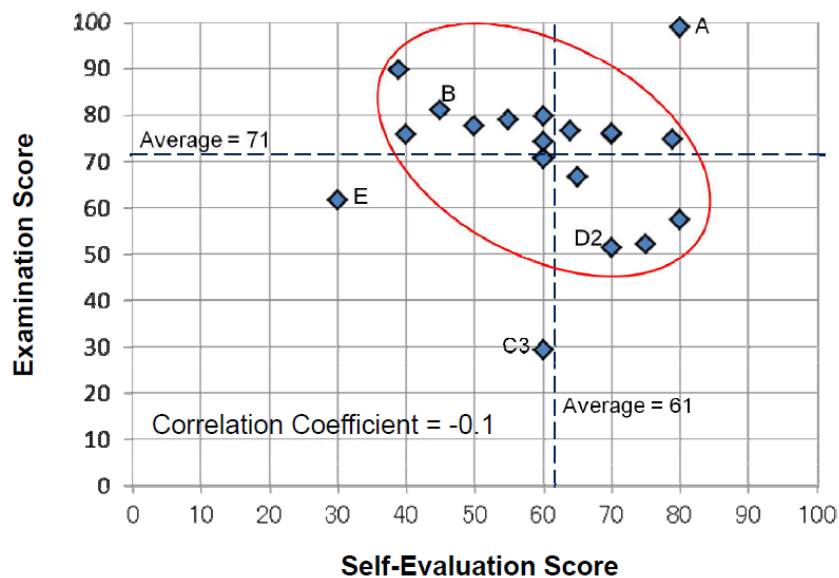


Figure 1. Correlation between Self Evaluation Scores (x-axis) and Examination, or Achievement, Scores (y-axis)

On the other hand, the students of the lower group generally evaluate themselves with high scores. The students C3 and D2 are typical examples. Why do they evaluate themselves so high? One possible explanation is that the lower group students are not able to evaluate themselves in a reasonable way, and they just believe that they did well enough. Another possibility is that they knew fairly well that they lacked sufficient efforts, and still they wanted to evaluate themselves as good as possible, probably in order to keep their prides by denying their lack of reasonable efforts.

2.3. Analysis of Looking-Back Evaluation Texts with KH Coder

In this section, we choose (Q1) “What did you learn in this class? Did it help you?” for analysis, because this question asked the students to summarize what they have learned in the class. The answer is given as a text that expresses the student's recognition of her achievement.

In order to conduct text analysis, we have to transform the texts into the data that are available for the analysis method we apply. To start with, we use the KH Coder [2] as the analysis tool. KH Coder is free software equipped with the facilities of morphological analysis for Japanese language, extracting words, and statistical analysis including correspondence analysis. In our study, we consider the answer text of a student as a single document of KH Coder.

2.3.1. Extraction of Words which Appear in the Answers: Table 1 shows the top 75 words in their frequencies of appearance in the texts, together with their frequencies. The verbs are conjugated. Note that two appearances of the words “Various” and “Use” marked with * are different expressions in Japanese, which have the common corresponding expression in English. The shaded words are those relating deeply to the subject the students have learned in the lecture and other non-shaded words are generic words.

We can see the words related to the lectures appear in high frequencies in Table 1. For example, the word “Search” appears 88 times in the answers to (Q1), which is the most frequently used one among all words. Also the words “Information,” “Library,” and so on appear in the list. The lecture-related words are 10 (13%) among 75 words, whereas 6 (21%) among 28 with frequencies more than 6.

Table 1. Extracted Word and its Occurrence (Top 75)

Word	Occ.	Word	Occ.	Word	Occ.
Search	88	Function	7	Site	3
Class	37	Result	7	Challenge	3
Information	37	Important	7	Answer	3
I think	34	Opportunity	6	Again	3
Library	33	Now	6	Overseas	3
Learn	32	Tag	5	Basic	3
Know	30	Previous	5	Find	3
Myself	21	Question	5	Device	3
How	21	Seek	5	Go	3
Now	17	See	5	Reference	3
Way	16	Type	5	Librarian	3
Examine	16	More	5	Time	3
Keyword	13	Adequate	5	Received	3
Are various	11	Various *	4	Collect	3
Use *	10	Differ	4	Homework	3
Help	10	Excercises	4	Leave	3
Necessary	9	Use of	4	Introduction	3
Use *	9	Lecture	4	Detailed	3
Internet	8	Learn	4	World	3
Personal Computer	8	Body	4	Corrct	3
Think	8	Knowledge	4	Other	3
Do	8	Tune	4	Large	3
Get	8	Really	4	Content	3
Various *	7	Good	4	Difficult	3
Feel	7	Way	3	Usually	3

*: Different Words in Japanese Language

2.3.2. Correspondence Analysis of Words and Students: It is important to know not only the words themselves but also their relations such as between a word and another word, and between a word and a student. Analysis of such association would give us more useful information about students and their attitude to learning.

Figure 2 shows the results of the correspondence analysis in a two-dimensional principle component space. The words appeared in the figure include those in Table 1;

those with more than 2 times of appearance for (Q1). The underlined ones with st0** in the figure represent the students of the class.

Now we manually divide the students in Figure 2 into 5 groups; say, from Grp1 to Grp5. Table 2 summarizes some of their features such as number of students of the group, the member's average examination scores, and their variances. The groups consist of 3 members in minimum (Grp4) and 16 members in maximum (Grp5). For the average scores, Grp3 is the highest with the score 83.5, which locates in the upper-right part in Figure 2. Grp5 takes the lowest score with 59.3 which locates in the lower-left corner.

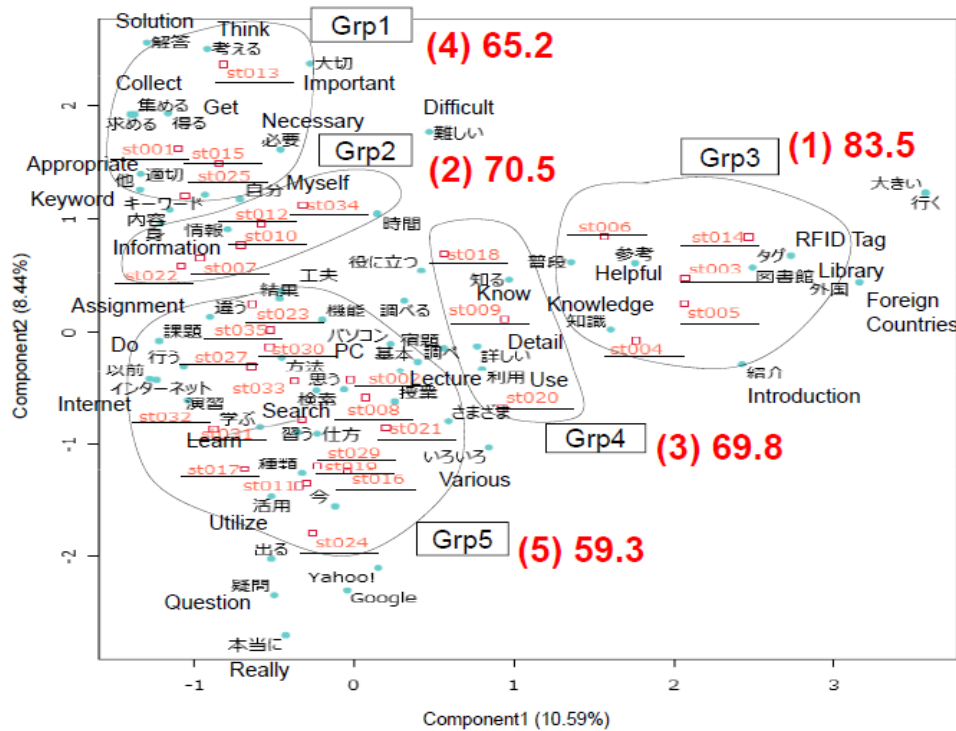


Figure 2. Correspondence Analysis Map of Related Words with Students. The Underlines for each Student, and the Grouping Line and the Number by the Authors

As the P-value is 0.0469, and it can be seen that there is a difference between the averages of these five test scores among the groups statistical significance at the 5% level.

Table 2. Analysis of Variance Table of 5 Groups

Grp No.	Number of Samples	Average	Variance
(1) Grp3	5	83.5	107.2
(2) Grp2	5	70.5	98.8
(3) Grp4	3	69.8	68.7
(4) Grp1	4	65.2	27.3
(5) Grp5	16	59.3	335.3

2.3.3. Relation between the Words Used by a Student and Her Examination Score

We deal with the correlation between the characteristic words that appear in the answers to (Q1) and the examination scores. Table 3 shows the top 10 characteristic words of some of the students using the Jaccard similarity measure. Note that the Jaccard similarity of student p and q is defined as the ratio of the number of words which are commonly used by p and q against the total number of words which are used either or both of p and q. Thus the Jaccard similarity ranges between 0 and 1. The value becomes 1 if every words used by p and q are the same, and it becomes 0 if p and q do not use a word in common.

The words marked with “●,” “▲,” and “■” in Table 3 indicate that they are classified as those for the general information, for frequently appearing words that relate to the lecture, and for characterizing the subject, respectively. The values in the right-hand side of (st0***) represents the examination score of the student.

As we investigate further by taking attention on the words used by the students, we can find that the students in Grp1 do not use many of the characteristic words and the correlations between the students are relatively low. Its examination score is the 4th highest among 5 groups.

For Grp2 (2nd highest in examination score), students commonly use such words as “problem,” “time,” and “examination,” which are relating to the actual activity directly relating to the lectures. For Grp3 (the highest in examination score), they characteristically use the technical characteristic words and those words from the broader point of view in comparing Japan and the world such as “foreign,” “national,” and “Japan.”

It is interesting to see that the words relating to the homework matters do not appear in Grp3. Thus we can see that the students in Grp3 have the lectures in the standpoint of seeing things in a broad perspective of the lecture.

A lot of technical words appear in Grp4, with the 3rd in examination score, and there do not appear frequently-used words. The students in Grp5, with the lowest examination score, use quite a lot of words of frequently-used general information, and do not use technological words.

It is interesting to see that many students use the words learned in the lectures such as “teach,” “master,” “study,” “useful,” and “used.” So we can guess they are too much concentrated on the words themselves and may not pay much attention to what they really mean to them and to the society they live.

Table 3. Characteristic Words of Students (Examples)

(1) Grp3

st005	st006	st003	st004	st014
Foreign ●	Library▲	Put together	Show	Go
Library ▲	Individuality	Country	Limit	Foreign country
Latest	Summary	Box	Interesting	Automatic
Effort	Take	HP	Photo	Especially
World	Relationship	Closed■	Introductio n	Completely
See	Plus	Books■	Familiar	Lending■
IC■	Whole country	Appear	Japan	Electronic●
Tags■	At the same time	Root	Copyright●	Large
Various	Reference■	Tackle	Every time	Usually
Feel	Also	Province	Learn	Library▲

(5) Grp5 (6 students out of 16)

st002	st008	st011	st016	st017	st019
Layout	Screen	Website●	Fresh	Application	A long time ago
Item	Open	Question	In addition to	Uphill battle	Question
Report	Menu	See	Type	Various	Really
Study	Word	Rich	Yahoo! ●	Find	Now
Writing style	Save	Anxious	Learn	Nice	I think
Master	PC●	Someday	Now	Accurate	Learn
Server●	Help	Little	Google●	Number	Respond
Begin	Way	Intersting	Various	Compared	Answer
Recently		Sense	Use	Increase	Prior
Weak		Problem	Keyword▲	Enormous	Current

3. Word-Type Analysis for Investigating How Word-Usage Correlates to Achievement

Based on our observation shown in Section 2.3, we investigate how the usage of words of a student is correlated with her achievement, by taking attention to the types of words instead of the words themselves, in this section.

In Section 3.1, we set 4 word-types and assign each word used by the students in their answers to a question of looking-back evaluation. Then we show how much amount of words in these types is used by each student.

Then in Section 3.2, we assign a weight to each word-type so that the weight reflects how much it is used by each student and how much examination score the student has achieved.

Finally, in Section 3.3, we estimate the grade of each student using the weights of word-types, and compare it with the original grade in order to investigate how much the type-usage data, which are supposed to represent the attitude of the student, correlate with her achievement.

3.1. Word-Types and Type-Based Analysis of Achievement

We have found so far that the examination scores and the word usage in the answer to the question (Q1) are correlated [4, 6]. For example, the students in the highest score group use such words that indicate their interest in the world affairs and comparing in and out of Japan; such as “Foreign,” “Overseas,” “Japan,” and “National.” On the other hand, the students in the lowest score group use the words such as “Remember,” “Learn,” “Useful”; thus they look like good students superficially. However, by considering their poor scores, it is highly possible that they take attention to the lecture-related keywords without understanding them.

For confirming our observation, we start with assigning one of the 4 types to each word/expression used in the answers of students. The 4 types are as follows:

- (A) Those which directly relate to the lecture's main topic of “information retrieval”; *e.g.*, library, retrieval method, key/keyword, library's opening/closing time, PC (personal computer), etc.
- (B) Those which relate to the subjects which are taken in the lectures, but are not directly related to the main topic; *e.g.*, IC tag system (for libraries), introduction (of libraries where the teacher has visited), user-operated check-out machine, *etc.*

- (C) General words which appear frequently in the answers of students; *e.g.*, know, go, way/method, think, etc. Note that the frequently used words are those which appear more than 2 times; about 20% of general words. Thus the students, who use high amount of words in this type, will attend the class and learn in the same way as many other students.
- (D) General words which do not appear frequently; *e.g.*, use, inner part, tackle with, route, object, etc. Thus the students, who use a lot of words in this type, will have his own point of view.

The process of confirming our observation consists of two main steps;

- (1) We assign the weights to each word type, where the weight represents the contribution of the type to the grades of students who use the words of this type. This assignment is conducted based on the relation between the students and the type of words the students use, and
- (2) We use the weight of the word type and estimate the student's grade/score, by using the relation again between the student and her usage of word types.

Formally, the first step is as follows: Let $S = \langle s_1, s_2, \dots, s_m \rangle$ and $G = \langle g_1, g_2, \dots, g_m \rangle$ be the sequence of students and their corresponding scores, respectively. Also, let $T = \{A, B, C, D\}$ be the set of word types, where we assume the order $A < B < C < D$ for convenience. Further, let $F = (f_{ij})$ be the matrix of frequencies of word types; where f_{ij} is the number of occurrences of the word of type j ($j \in \{A, B, C, D\}$) in the answer texts for (Q1) by the student s_i . In order to normalize the matrix F , let $F^* = (f^*_{ij})$, where $f^*_{ij} = f_{ij} / \sum_{j \in \{A, B, C, D\}} f_{ij}$. Thus $f^*_{i,A}$ is the ratio of the word occurrence of type A in the answer text of the student s_i , for example.

Figure 3 shows the ratios of word types used by the students. They are arranged in the decreasing order of examination scores. It is not easy to see how the usage of types of words affect to the examination score, such as, whether each type gives positive or negative effects to the examination scores.

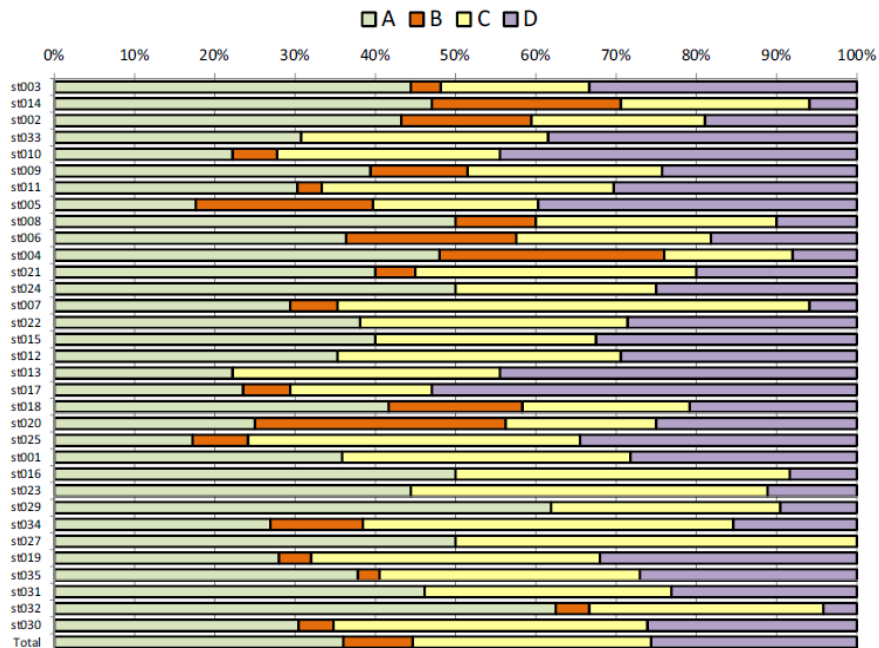


Figure 3. The Ratios of Word Occurrences of Types from A to D of Students. Students are Arranged According to the Decreasing Order of Grades; *e.g.*, st003 Takes the Highest Grade, and st030 Takes the Lowest Grade

3.2. Weighting the Types of Used Words so as to Represent Amount of Contribution to Student's Achievement

In order to investigate how the amount of usage of each word-type affects the examination score of the student, we have a look for each type, how the amount of usage affects the examination score.

Figure 4 shows the correlations of word occurrences and grades of students for each type. It is easy to see that type A and C show negative correlation/gradient, which mean that the grade decreases as the student uses more words of type A and C. On the other hand, the correlations are positive for types B and D, i.e., the grade increases as the student uses more words of type B and D.

Here we estimate the student's grade by using the differences of the affects of the word types to the grade of students. In order to estimate the grades of students, we define as follows: Let $f_j^\# = \sum_{i=1}^m f_{ij} / \sum_{i=1}^m \sum_{j \in \{A,B,C,D\}} f_{ij}$. From the definition we have: $\sum_{j \in \{A,B,C,D\}} f_j^\# = 1$. Here, $f_j^\#$ is the ratio of type j as a whole. In our data, they are as follows: A: 36%, B: 9%, C: 30%, D: 26%. Then, let $g^\# = (1/m) \sum_{i=1}^m g_i$, the average of the grades of all students. In our data, $g^\# = 66.4$.

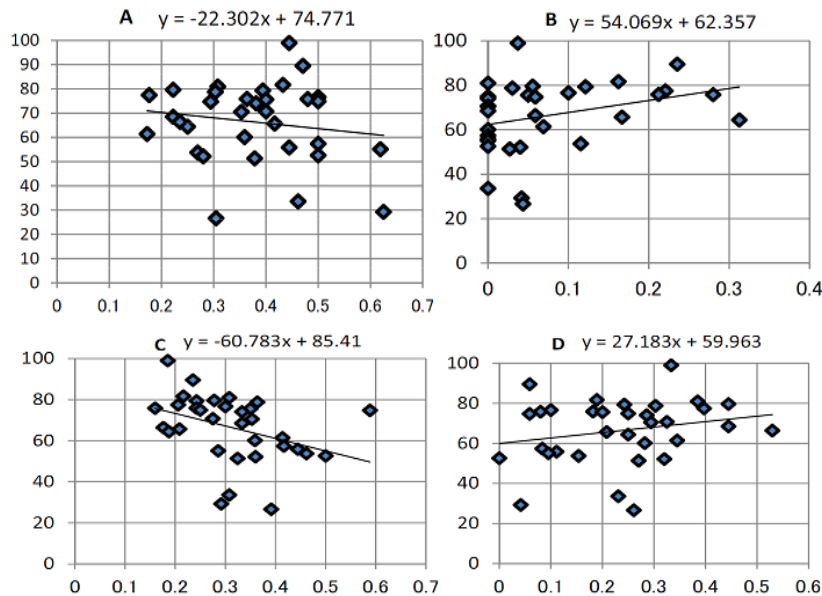


Figure 4. Correlation between Frequencies of Words of the Type and Grades; (top-left) Type A, (top-right) Type B, (bottom-left) Type C, and (bottom-right) Type D

Now we define the original estimation grade of students. For the student s_i and for the word type j, the estimated grade g_{ij}^* is defined as follows: $g_{ij}^* = f_{ij}^* g^\# + r_j (f_{ij}^* - f_j^\#)$ where r_j is the gradient of the approximation line in the correlation graph between ratio of type and grade. In our case, as was shown in Figure 4, $r_A = -22.302$, $r_B = 54.069$, $r_C = -60.783$, and $r_D = 27.183$.

The right part $f_{ij}^* g^\#$ of the right formula gives the basic assignment of the grade to student s_i from the average score of $g^\#$. The right part gives the differences of grade from the basic grade given by the average score. The differences in terms of ratio is given by $f_{ij}^* - f_j^\#$, where $f_j^\#$ gives the average ratio for the word type j and f_{ij}^* gives the student s_i 's individual ratio for the word type j.

The coefficient r_j is given from the graph for the word type j, which gives how much grades would be different as the word type ratio differs.

3.3. Grade Estimation of Student Based on the Types of Words

Finally, the estimated grades of student s_i is given by summing up all the estimated grades for the types from A to D: $g^*_i = \sum_{j \in \{A,B,C,D\}} g^*_{ij}$

Based on this estimation method, the average score $g^{*\#}$ of the resulting grades in estimation may be different from the original average score $g^\#$. So we have the finally estimated grade of the student s_i by $g^*_i (g^\# / g^{*\#})$. In our data, for example, student st003's grade changes from 99 to 74, for st014, from 90 to 73, and for st030, from 27 to 62.2.

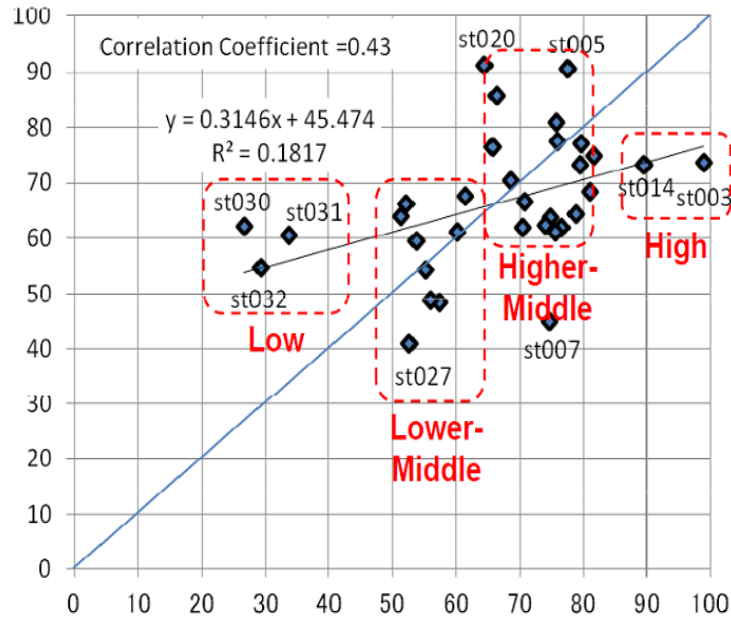


Figure 5. Correlation of the Original, or Real, Grade (x-axis) and the Estimated Grade (y-axis)

Figure 5 shows the correlation between estimated and original grades. We can see that the general rule also holds here because the gradient of the approximation line is positive (0.31). So we may roughly evaluate the students' grades according to the word types they used. We need to collect more data in order to evaluate even more accurately.

The graph shows that the students having maximum or nearly maximum estimated grades are located in the upper-middle group, i.e., from near the average score 66.4 up to near 80, in their original grades. With one exception (st007), all the students in this region take the estimated grades more than 60. On the other hand, the top 2 students (st014, and st003) in the original grades have much lower grades than the estimated ones.

Now we can rephrase our findings: The students having very high grades may not take attention to the wide areas of topics. The students in the high-middle group pay attention to not only the directly-related topics of the course, but also other topics as well. The students having the lower-middle grades prefer to study the topics directly-related topics of the course. The students having very low grades may not be very bad in their attitudes. Their poor grades may come from different causes.

4. Comparison of Used Words of High and Low Achievement Students

As we have observed in the previous section, the 2 students having the highest examination scores, who we will call the H2 students, and the 3 students having the lowest scores, who we will call the L3 students, have somewhat close to the average value of the estimated grades, even though their scores are very different. Still, there are

differences between the estimated grades of H2 and L3 students, as we take attention in detail. We would like to see their differences in this section.

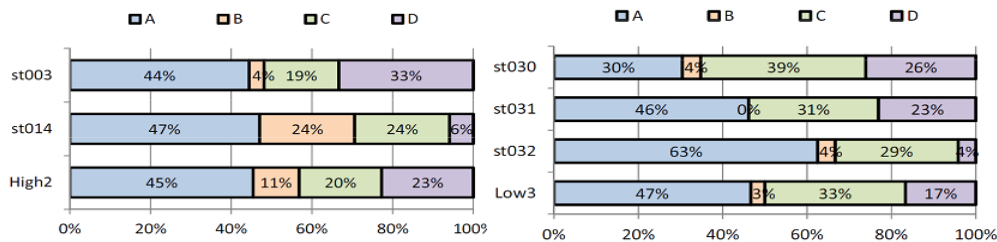


Figure 6. The Type Ratios of H2 Students (left) and L3 Students (right)

Figure 6 shows the profiles of 2 students of H2 and 3 students of L3, together with the totals for H2 and L3, in terms of the ratios for the word types from A to D. As we can see, the 2 students, st003 and st014 have similar ratios for the types of A and C, whereas they have differences in the ratios for B and D. The student st003 has much higher ratio for D (33%) in comparison with the student st014 (6%). On the other hand, st014 has much higher ratio for B (24%) than of st003 (4%).

Even though their estimated grades are very close (74 for st003, and 73 for st014), their word usage ratios are different. As we compare the cosine similarities of these students with the average profile (which is: 36% for A, 9% for B, 30% for C, and 26% for D), st003's value is 0.96, while st014's value is 0.88. Thus we can say that st003 uses the words closer to the average than st014. According to our observation, st014 is close to the typical higher-middle students and st003 looks like an average class students in their looking-back evaluation texts for the question (Q1).

The differences of the word-type usage of st003 in comparison with the average usage are that st003 uses more type A words than type C among the types A and C, and she uses more type D words than type B among the types B and D. Considering that the use of type A words indicate that the student is interested in the lecture topic and thus use of type A words itself is rather preferable from the lecturer's point of view. The problem lies not on the usage of type A words, but on too much concentration to the lecture's main topic, especially in superficial means. Thus st003 might be a typical student who pay much attention to the lecture topic, who tries hard to learn not superficially but in reality.

The right side graphs in Figure 6 show the type-profiles of the L3 students together with that of L3 students as a whole. As in the same way with H2 group, the ratios vary a lot according to the student. However, in comparison with the profiles of H2, the ratios for type A and D are somewhat similar, whereas the ratio for type B is very small and that for type C is much large, as a whole.

In other words, the students in L3 group use the words of type A as the similar amount of other students, thus their interest on the lecture topic itself is about the same with other students, if we say roughly. In other words, their interest to the topic relating to the words of type B is much smaller than the ordinary students, and than the H2 students as well. Such the narrowness of interest range might cause the poor achievement in their examination scores. Considering their estimated grades are not very-low, even with their poor usage rates for type B, their usage ratio for D is relatively high, or not very-low. Comparison with H2 students, the bigger ratios for type C words will become another reason why the estimated grades for L3 students are lower than H2 students. Because the ratios for type A and D of H2 and L3 students are not so much different, their differences of estimated grades come from the differences of ratios for type B and C. As a summary of the investigations of H3 students, we may say, that the usage of the type B words makes more difference than other word types, especially for those students of low achievement.

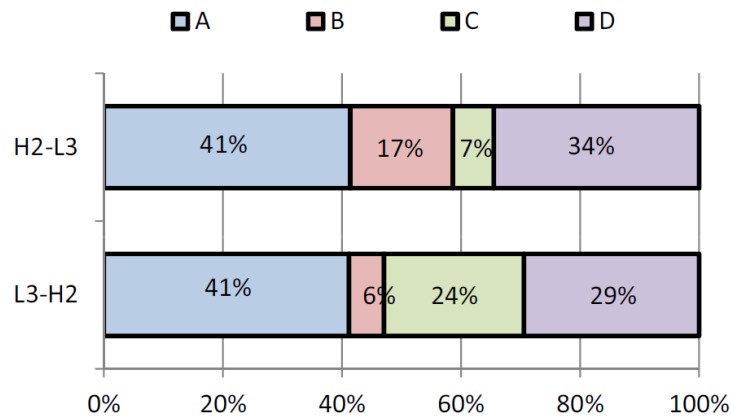


Figure 7. The Type Ratios of the Words Appearing in either One Group of H2 and L3. (above) Words Used Only by H2, and (below) Words Used Only by L3

As another approach to investigate the differences between the students of H2 and of L3, we extract the word which is used by one group and is not used by another group. Figure 7 shows the type ratios of the extracted words. The above graph shows for the words used by a student in H2 and do not used by any student in L3, and the other one shows the similar results for the words used by L3 and not by H2.

The graphs of Figure 7 show clearly the results of the discussions we have had above. The ratios for type A are very close and those for type D are somewhat similar. On the other hand, the ratio for type B in H2-L3 is much bigger than that of L3-H2, thus we can see clearly that H2 students use the words of type B much more preferably than L3 students; H2 students pay much more attention to the subjects indirectly related to the lecture's main topic than L3 students.

On the contrary, the ratios for type C in H2-L3 is much smaller than that of L3-H2, thus we may say that L3 students prefer to use popular words than other students including H2, which means that L3 students pay attention to the topics that most students are interested in. Thus, in other words, the students having low examination scores attend the classes without paying sufficient attention to the subjects which attract her in her own sense.

5. Concluding Remarks

In this paper, we investigated how the student's attitude represented by the types of the words she uses correlate with her outcome, or examination score, as an extension to the results reported in [5].

The keyword types were chosen by reflecting our observation; A for directly related to the main topic of the lecture, B for non-directly related to the lecture but indirectly related to it, C for the general words that appear frequently, and D for other general words. As we investigated the correlation to the usage of these types of words, we found the A and C affects negatively, whereas B and D affects positively to the grades of students.

Then we experimented with estimating the student's grade based on the contribution factor of the word types. The results gave a positive correlation to the original and estimated grades, so our assumption is basically confirmed.

Lastly, we pursued further on comparing the H2 students, who have the highest examination scores, and the L3 students, who have the lowest scores.

From the study performed in this paper, we may say that the students who used the words of types B and D more than others have higher examination scores, and those who

used more words of types A and C, have lower scores. Among the 4 types, type B affects to the examination score more than other 3 types. Even with the similar usage ratios as a whole of types B and D, the students using more type B words have higher scores, in general.

The topics to be investigated in the future include:

- (1) To develop a method to devise new ideas further, and to perform refinement of dedication to the study of student's effort, and attitudes to learning, especially further analysis of the answers to other questionnaires.
- (2) By collecting lecture data from other classes, we need to analyze them, and to verify if the results of this study are also holds or not.
- (3) To generalize the analysis methods, and to integrate them into an automated data analysis method.
- (4) Furthermore, toward the future, universities have to consider building the campus information centers [10], and to archive all the records of their students, especially what courses they take, what are their outcome scores, how do they use libraries, etc., so that the universities can advise their students more appropriately based on educational data mining. In such a process, textual stream mining [9], might become a very important subject to be studied, in order to predict their students' outcomes more exactly, and thus to be able to advise them more appropriately.

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