Evaluating Health-care-related Active Learning Class Lectures using Class Achievement and Text Mining of Free Descriptions

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Abstract: Active learning is defined as "a general term for professors and learning methods that incorporate participation in active learning of the students, unlike teachers' unilateral lecture style education." Universities that improve classes from the viewpoint of active learning are increasing in recent years. A class evaluation questionnaire has been established to improve the understanding and satisfaction of students' classes. In many cases, the Likert scale is used for the class evaluation questionnaire. There are also aspects for which statistical processing is easy to do. However, it is difficult to ascertain the students ' specific opinions and ideas alone. Therefore, we attempted to evaluate health-care-related subjects from the two viewpoints of 'free description' and 'degree of accomplishment of class goal' for active learning classes aimed at students' subjective learning.

1 INTRODUCTION

In recent years, many universities in Japan have adopted classes incorporating class evaluation questionnaires and active learning. However, there are indications that active learning classes are attracting attention only to activities. They do not engender learning improvement (Matsushita, 2017). Active learning in Japan is a generic name of a professor or learning method that incorporates participation in active learning by a student, unlike the unidirectional lecture style of education by teachers. It is defined as a means of training universal capabilities including cognitive, ethical, social abilities, cultural knowledge, knowledge, and experience with active learning by students, including discovery learning, problem solving learning, experiential learning, survey learning, etc. Group discussion, debate, group work, and other methods within the classroom are also effective active learning methods (Central Council, 2012). Some reports describe effects on students' degree of comprehension (Nekoda, 2012). Depending on the class design, it is clear not only from Japan but also from research conducted around the world that it affects students' understanding and learning motivation in various ways (Matthew-Maich et al., 2016). Moreover, overseas universities are using

methods such as Problem Based Learning (PBL) as one method of active learning, which is more effective than lecture-based learning (Faisal et al., 2016). Furthermore, in overseas medical education, information and communications technologies (ICT) and Technology Enabled Active Learning (TELE) are used actively (McCoy et al., 2016). In overseas research, active learning is said to help acquire knowledge and establish knowledge in the field of medical education (Graffam, 2007). Active learning has effective aspects for the field of medical education, but it is important to clarify whether students are understanding contents well by conducting proper evaluations when doing active learning classes. In Japan, class evaluation questionnaires have also been conducted from long ago as part of class improvement: a five grade Likert scale is often used for evaluation. Although this scale is readily adaptable to statistical processing, it is difficult to grasp concrete opinions and ideas from such a scale. Therefore, we used free description. It is extremely difficult to read enormous numbers of entries carefully and assess them individually. Furthermore, even assuming careful perusal in understanding the text, the risk of subjective bias of an analyst remains. Therefore, for this study, text mining of free descriptions was conducted with quantitative analysis of questionnaire results.

2 RELATED RESEARCH

Analyses of free description parts of class evaluation questionnaires have been done with text mining many times in the past. Etchu (2015) attempted to capture the overall trend of free description of students while ensuring objectivity by summarizing and presenting data, with multivariate analysis. Matsukawa (2018) conducted a topic model analysis. By linking extracted topics with free description data, he presented information using a cross table for features of topic distributions of subject groups compared with the overall trend. In fact, although many studies have been undertaken to visualize free descriptions and elucidate trends, finding specific factors to improve classes remains difficult. Therefore, one must consider students' degree of comprehension and satisfaction to the greatest degree possible. Nevertheless, few analyses have made such a class evaluation (Matsukawa and Saito, 2011). This study evaluated active learning classes by assessment of items of class achievement goals and free description data and by consideration of the students' degree of comprehension, and evaluating their mutual relation.

3 HOW TO PRACTICE ACTIVE LEARNING CLASSES

3.1 Subject Course

For this study, we will examine three classroom practices used by the same teacher. Two of these are elective subjects for information system students: 'health care system' and 'health care service'. These are similar in class systems and have a small class size of 20–30 people. 'Epidemiology' is a compulsory subject for nursing care training courses for nursing students. The students are mainly 100 people with simultaneous classes.

3.2 Active Learning Method

Active learning is defined as "a general term for professors and learning methods that incorporate participation in active learning of the students, unlike teachers' unilateral lecture style education." Various methods are used under the title of active learning. Mizokami examined the active learning method separately for lecture type classes and practical type classes. (Mizokami, 2007) Therefore, we classified the three classes to be analyzed this time according to classification examples proposed by Mizukami. Table 1 presents a summary of active learning methods adopted for the respective classs. 'Health care system' and 'health care service' are aimed at active learning, so they adopt group work. 'Epidemiology' emphasizes knowledge conservation, and urges the creation of quizzes to sustain knowledge necessary to pass a national examination.

In particular, as group work, all three classes have "Today's news presentation". This is that designated students select topics of their own interests about each class's them and share them among students in presentation style.

Table 1: Active learning method used in class.

		Contents	Method	Healthcare System / Service	Epidemiology
Learning process	Lecture style	Have students write comments/ questions	Class Portfolio/ Peer review	○	○
		Reflection		○	○
		Debate		○	
		Response analyzer	Clicker	○	○
		Make students observe familiar phenomena			
	Practice style	Data collection	Task presentation	○	
		Interview /Questionnaire/ Experiment			
		Production	My note, question-Posing(quiz)		○
		Field observation			
		Group discussion	Today's news presentation and discussion	○	○
		Group learning		○	○
		Presentation		○	○
		Q & A with teachers / other students		○	○

3.3 Achievement Level of the Class Goal

In viewing the relevance of this analysis, we specifically examined the 'degree of accomplishment' self-evaluated by the students at the end of the class for 'class goals'. There are seven items in 'epidemiology', five items in 'health care services', and three items in the 'health care system'.

The students evaluated self-assessed whether each class goals were achieved in five-point Likert scale.We used the average of them as personal class goal's score.The items in each class achievement of objectives are presented in Tables 2, 3, and 4.

Table 2: Epidemiology class objective.

	Class objective
①	Can understand and explain concepts and basic terms of epidemiology.
②	Explain epidemiology frequency and indicators of risk or effect.
③	Can explain the epidemiological investigation method.
④	Explain the principle and method of mass screening.
⑤	Can explain the main demographics and health statistics.
⑥	Can explain the frequency and distribution of major diseases, risk factors and prevention.
⑦	Explain the importance of the epidemiological viewpoint in public health nurse activities.

Table 3: Health care service class objective.

	Class objective
①	Through active learning, you can improve general -purpose abilities including cognitive, logical, social skills, education, knowledge, and experience.
②	Think about the future modes of healthcare services and can practice one.
③	Understand and explain the fundamental human body structure, organ function s and pathology necessary for basic knowledge of healthcare, international standard disease classification, and clinical nursing.
④	Understand and explain the roles, duties and concrete measures of health care professionals concerning the collection, storage, transmission, information disclosure and use of personal information related to health care.
⑤	Can understand and explain general knowledge related to health care field (insurance / medical / welfare) so that you can communicate smoothly with healthcare professionals.

Table 4: Health care system class objective.

	Class objective
①	Understand the circumstances and the current state of information policies in our country, about the necessity and application method of imaging communication technology to provide advanced health care service (insurance / medical / welfare /) guaranteeing effective picture and quality.
②	For the current needs of healthcare users and the problems that they hold (subject privacy and protection of personal information, unification of health data and secondary usage method.). Based on the development of information technology, cultivate the ability to create concrete solutions and future developments.
③	Learn practical basic knowledge and basic technology skills related to health care systems to plan, develop, operate, and maintain systems that operate in the healthcare field.

4 ANALYTICAL METHOD AND RESULTS

4.1 Analysis Target

'Health care system', 'health care service', and 'epidemiology' were classified as subjects. The target period of the healthcare system was the four years of 2015–2018. The total questionnaire number was 156, of which the free description response rate was 42%. In healthcare service, the total number of questionnaires was 104, with a free description column response rate of 35% for the three years of 2015–2017. In epidemiology, for the seven years of 2011–2017, the questionnaires were 876, with a free description response rate of 32%. For all 1136 cases above, a 34% free description response rate was obtained. Table 5 presents the duration of each class, the number of aggregations, and the free listing response rate.

4.1.1 Class Form

First, we analyze 'health care system', 'health care service' and 'epidemiology' in two stages. 'Health care system' and 'health care service' are elective subjects with small classes. 'Epidemiology' is a compulsory subject with students of different classes participating. All are assessed together: the same faculty adopted the active learning method.

Table 5: Class evaluation questionnaire number of total.

Class	Period	Total Questionnaire	Free description response rate
Health care system	2015-2018	156	65(42%)
Health care services	2015-2017	104	36(35%)
Epidemiology	2011-2017	876	282(32%)
Total		1136	383(34%)

4.1.2 Analytical Method

A summary of the analysis is presented in Figure 1. (1) Sort three class evaluation questionnaires. As a method of classification, averaging each item of the achievement level of class goal and take an average score for all the students for each class. Table 6 shows the average points of all participants in each achievement level of class goal. For the average points of each class goal, more than four points of students are 'high' (upper group), more than 3.01 points are 'intermediate' (middle group), and 3 points or fewer are 'low' (lower group). The average points of respective classes are presented in Table 7. (2) Morphological analysis is applied to extract feature data from sentences. Words are extracted. Subsequently unnecessary parts of speech and numbers are removed and the data are organized. (3) Using data arranged for classification and analysis by appropriate numerical processing, use correspondence analysis to derive each feature quantity. (4) To visualize the analysis results, we plot the feature quantities obtained using 'correspondence analysis' on two dimensions and consider their mutual relation.
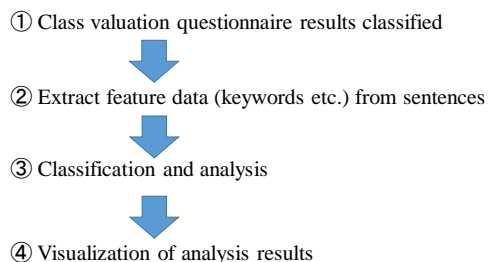
① Class valuation questionnaire results classified

② Extract feature data (keywords etc.) from sentences

③ Classification and analysis

④ Visualization of analysis results

Figure 1: Analysis summary.

Table 6: Average points of target achievement by category.

Group	Health care System Health care Services	Epidemiology	All classes
Top group	4.31	4.24	4.27
Middle group	3.58	3.48	3.5
Low group	2.94	2.71	2.74

4.1.3 Analysis by Teaching Form

In the correspondence analysis described later, when analyzing data by class form, no association was found between the class achievement target degree and free description data. The analysis combining data of all three classes clarified that active learning is linked to the degree of comprehension.

4.1.4 Overall Analysis

Using the morphological analysis tool RMeCab (12) for the upper, middle and lower groups described in 4.1.2, divide the free description data into morphemes (minimum units of language). From that, only nouns were extracted. The occurrence frequency of words was investigated. The numbers on the graph represent the frequency of occurrence of the nouns as a whole. The ratio by group is shown in Figs. Table 7 shows the numbers of people in respective groups and the numbers of nouns.
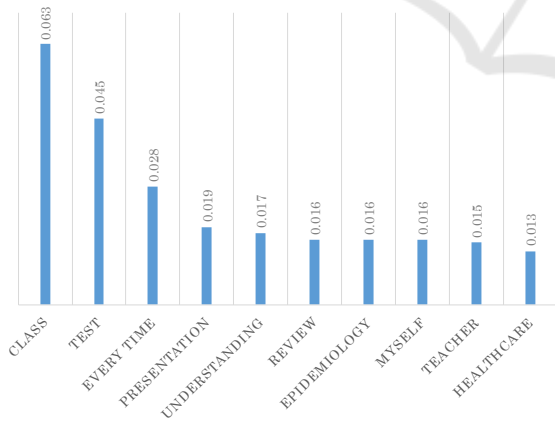
Figure 2: Percentage of word appearance frequency of the high group.
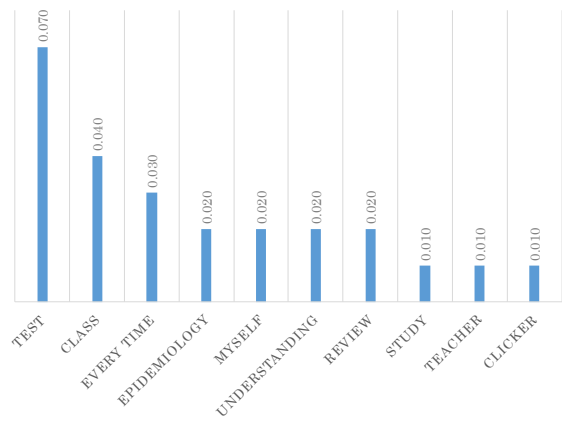
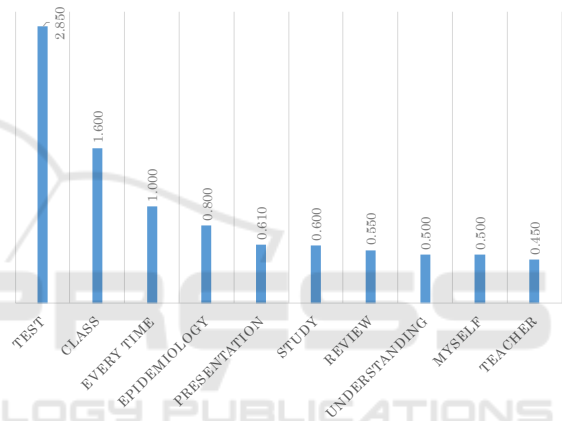Figure 3: Percentage of word appearance frequency of middle group.

Figure 4: Percentage of word appearance frequency of lower group.

Table 7: Average point of target achievement by category.

Category	Number of people	Total noun number
Top group	143	1341
Middle group	156	1525
Low group	76	620

4.2 Correspondence Analysis

Correspondence analysis is a technique for assessing the relation between two discrete variables. Because it can be replaced with a simple data matrix without losing information of the original data, one can clarify the structure of a complicated data matrix. When plotting the analysis results, a strong correlation exists in the category level where the coordinate points are close to one another: words

that are more relevant to categories are shown closer together; weaker words are shown farther away.

5 CONSIDERATION

We analyzed separately for 'healthcare system and healthcare service' and 'epidemiology'. Results show no association between the class achievement degree and free description data. In 'health care system, health care services', the data are extremely small. That sparseness of data can be regarded as a factor because it is a class with few people. Therefore, the active learning method adopted by the same teacher analyzed all class data as the same class. Results can be portrayed as shown in FIG. 5. The high-ranking group was placed on the left side, the intermediate group was placed on the upper right, and the lower group was on the lower right. As closer to the position where it is arranged, it becomes a word that characterizes the group. Words gathered in the center that are not particularly different between groups. Table 8 shows examples of words that characterize each group. Keywords surrounded by the large red circle on the upper left are middle frequency terms with the upper group. As inferred from the arrangement of the keywords, the middle and upper groups include 'active learning' and 'group'. Many words related to the active learning method are presented in Table 1, such as 'work' and 'clicker'. These groups described the active learning method to a great degree. When these words were searched from the original free description data of the middle and upper group, almost all of the descriptions were positive descriptions related to active learning. From the above, one can infer that active learning functions effectively for the middle and upper groups for the degree of class achievement. These analyses demonstrate that the group that appreciated the degree of achievement of the class goal more frequently expressed 'words about the active learning' method compared with the group with a low evaluation. By contrast, one method is not described at all. It is possible to give more effective feedback such as examining teaching materials.

The average value of the achievement level of the class target used this time is a subjective evaluation of each student, which is not necessarily the same as the actual degree of understanding or knowledge acquisition.

Therefore, future studies are needed in order to examine the introduction of objective understanding level indicators.
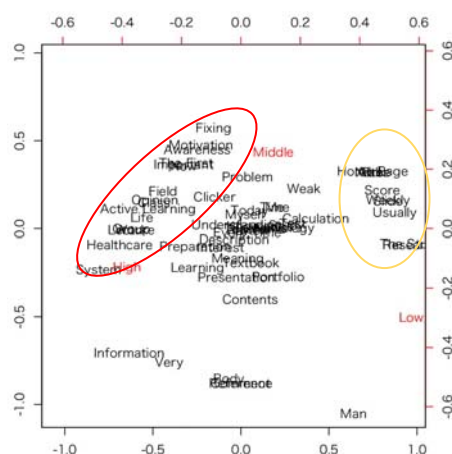

Figure 5: Corresponding analysis result.

Table 8: Words characterizing each group.

Top & Middle	Low	Center
System	The Study	News
Healthcare	Research	Description
Group	Usually	Understanding
Lecture	Slide	Class
Active Learning	Score	Meaning
Life	Weekly	Textbook
Field	Nurse	Epidemiology
Clicker	Homework	Interest

6 SUMMARY

This study used text mining from free description data and class achievement to evaluate health-care related classes using active learning. Based on comparison, we quantitatively ascertained characteristics of student groups and score differences.

Analysis using free description and class achievement evaluation will help to ascertain whether active learning is effective for learning in health care related classes, or not. The analysis included classes with few data. Beneficial results were not obtained from analyses for the respective classes. For this reason, the same learning method was adopted by the same teacher for the same class. Then we assessed data of the three classes together. Future studies will apply free description data collection methods to assess each class.

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