Questionnaire Surveys on Teaching Skills and the Degree in Which Students Understand the Uppermost Points of Importance in Their Classes

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Abstract

As an activity of one working group for the Good Practice program at Kumamoto University, we proposed a questionnaire survey on the degree in which students understand the uppermost points of importance in their classes in addition to the usual type of class questionnaire. Each class lists three uppermost points of importance which are essential for understanding the class content. The degree of understanding is classified into four levels: full, most, insufficient, and not at all understandings. Through the analysis of questionnaire replies, the degree of understanding for bachelor students in the Department of Engineering was discovered to be meaningfully affected by the degree of difficulty, the effectiveness of audiovisual aids, self-study time, and class attendance.

Keywords: Good practice program, Uppermost points of importance, Class evaluation, Degree of understanding

Ⅰ. Introduction

A Good Practice (GP) program entitled, "Quality guarantee of university education under the guidance of engineering education – Systematic quality guarantee of positive feedback type," was translated into action at Kumamoto University for the 2006-2008 (school year). To accomplish this program, five working groups were organized as follows: (1) development of support system for academic ability diagnosis, (2) development of technical English learning system, (3) survey on evaluation method for class grade, (4) development of database system for general education, and (5) improvement of questionnaire system for teaching skills and student understanding (Yamao et al., 2007).

This paper summarizes the activity of working group 5 (WG5). The purpose of WG5 was to improve educational quality. To clarify the present state of teaching skills and degree of student understanding in the Department of Engineering, we extracted educational problems and constructed a new questionnaire survey to be used in addition to the typical class evaluation.

As a first step, we investigated the temporal change of student replies to each questionnaire item from 2004. This was aimed at examining the effect of the class questionnaire on improving the quality of education. We also proposed a quality guarantee system of education from two viewpoints: (1) the ratio of successful students in taking class credit through a total evaluation by examination and report, and (2) the degree in which students understand the uppermost points of importance of the class.

For the guarantee system, we implemented a questionnaire survey on the degree in which students understand the uppermost points of importance in each class from 2007. Our aim was to clarify the distributions of student understanding prior to regular examinations. The degree of understanding is a direct result of self-study, class preparation, and daily review of classes. By analyzing the questionnaire survey results, important factors affecting the degree of understanding were identified.

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Ⅱ. Classifying the Degree of Understanding

Uppermost points of importance refer to indispensable items that students must understand to at least reach the learning and educational objectives of a certain program, such as Civil and Environmental Engineering (Kakimoto et al., 2004). As points, they are concise sentences that express explicitly the essence of class content. The merit of listing uppermost points of importance in an educational program is that students can learn to recognize the positioning of each class and its relationship to other classes in the program.

Most classes must have many important points. We limited the number of points to three per class for the convenience of questionnaire reply and to emphasize the most important. <Table 1> shows an example of the uppermost points of importance for third year students in the Department of Civil and Environmental Engineering class, Earth Environmental Engineering.

<Table 1> Example of the uppermost points of importance-earth environmental engineering

1. Does the student understand how to obtain environmental information and how to analyze/evaluate the date?
2. Can the student explain important environmental problems occurring in the atmosphere, hydrosphere, and geosphere?
3. Does the student understand on interaction between the Earth's environment and a sustainable society?

The degree of understanding was classified into four levels as follows:

4. The full level is capable of expressing the class content related to a point by using sentences or equations that correctly explain the content.
3. Most of this level is similar to the full level, but the class materials (e.g., textbook, notes, and handouts) need to be reviewed to check the correctness of understanding.
2. In the insufficient level, students are capable of remembering the class content related to a point, but need class materials to explain the content.
1. The not at all level is one in which students are unable to remember the class content related to a point.

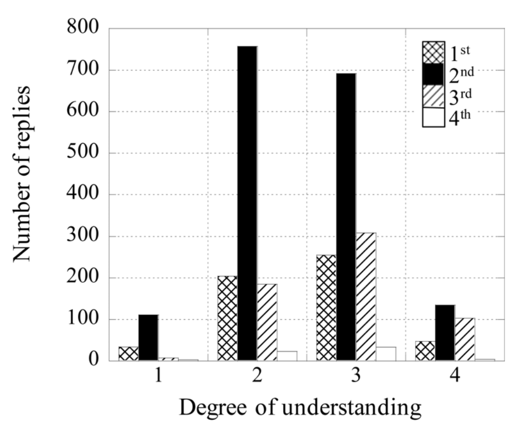
Ⅲ. Questionnaire Survey Results

A preliminary questionnaire survey on the degree of understanding the uppermost points of importance was carried out in the fall semester of 2007 with the cooperation of 24 classes from the Department of Engineering. Student replies classified by school year are as follows: 1st year, 540; 2^{nd}, 1695; 3^{rd}, 603; and 4^{th}, 63.

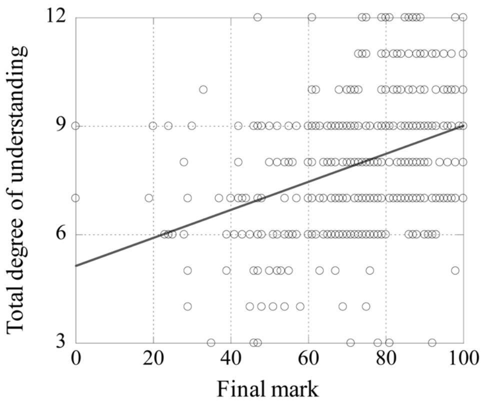
[Fig. 1] depicts a distribution of the degree of understanding. The distribution clearly shows the frequency of level 3, most degree of understanding, as the largest general tendency. However, the frequency of level 2, insufficient degree of understanding, is the most remarkable in second year students. The trends of first and third year students are similar. Our findings indicate that increasing the degree of understanding for second year students is a key point for high-level outcomes common to all departments.

By using the data of 514 students, we discovered another significant result concerning the relationship between the degree of understanding and the final mark. The maximums of degree and final mark are 12 (4 points×3 items) and 100 points, respectively. As shown in [Fig. 2], their correlation is weak, which can be confirmed by a linear correlation coefficient ($r = 0.36$).

It is noteworthy that the final mark ranges from 0-100 even at the most degree of understanding (9 points). The degree of understanding ranges widely from null to full even with the same mark. This trend can be applied to an excellent grade of over 80



[Fig. 1] Distribution for all students replying at the department of engineering



[Fig. 2] Relationship between degree of understanding and final mark.

points. These findings suggest that many students may have increased their degree of understanding by self-study prior to the regular examinations.

Our full-scale questionnaire survey on the degree of understanding was accomplished in 2008 with the cooperation of 124 classes in total. The ratio of cooperation over all the classes in the Department of Engineering is almost 50%. By analyzing the replies to these classes, the average level for students in the Department of Engineering was 2.6 (i.e., most understanding). Because the range of the averages is small (i.e., 2.45-2.74) for the six departments, the degree of understanding can be considered almost the same over the departments.

We examined a relationship between the degree of understanding and the number of class students. Contrary to our expectations, the effect of the number of students registered in a class on the degree of understanding was weak.

Ⅳ. Application of Statistical Analysis

We adopted statistical analysis to identify factors that influence the degree of understanding. We initially focused on the effect of class satisfaction on the degree of understanding by averaging three of the uppermost points of importance for all classes. The result clarifies a strong correlation between the degree of understanding and satisfaction ($r = 0.66$). If a class is satisfactory, our findings suggest that the degree of understanding can be high.

We next utilized a multivariate analysis. We selected 12 independent variables from the usual class questionnaire, which may affect the degree of understanding, and applied a regression analysis ($y = b \cdot x + e$), in which y is the average of the degrees of understanding, x is a row vector of independent variables including the constant, b is a column vector of parameters, and e is an error term. White heteroskedasticity robust covariance matrix (Wooldridge, 2002) was used for calculation because the prerequisite that e follows normal distribution is too strict for the present data.

<Table 2> summarizes the estimates of b and their significance probabilities (P values). Our results highlight the following four items as significantly affecting the degree of understanding at the 10% level: (1) degree of difficulty, (2) effectiveness of audiovisual aids such as videos and personal computers, (3) self-study time, and (4) class attendance. Among them, the degree of difficulty is found to have the strongest effect.

Our findings suggest that teachers can improve the degree to which their students understand class content by implementing the following important actions: (1) assigning homework to increase student self-study time, (2) establishing a suitable level of difficulty, (3) effective use of audiovisual aids, and (4) lowering student attrition rates by requiring mandatory class attendance and participation.

<Table 2> Coefficients of a regression model with P values

Questionnaire item on teaching skill	Coefficient	P value
Degree of difficulty	-0.556	0.00
Adequateness of class speed	-0.175	0.13
Easiness of hearing of the voice	-0.032	0.82
Adequateness of writing on the blackboard	0.034	0.32
Adequateness of teaching materials	0.002	0.98
Effectiveness of audiovisual aids	0.035	0.10
Teacher's contrivance for making understandable class	0.050	0.80
Good communications between teacher and students	-0.018	0.89
Enthusiasm of teacher for the class	-0.076	0.62
Understanding of class objectives	0.120	0.31
Self-study time	0.117	0.01
Attendance to class	0.158	0.07

Ⅴ. Conclusion

In addition to the regular class evaluation, we proposed a new questionnaire survey on the degree of understanding the uppermost points of importance in a class to identify educational problems and to improve the quality of education.

Our analysis of the replies from 24 classes in 2007 and 124 classes in 2008 from the Department of Engineering at Kumamoto University finds that the effect of the number of students registered in a class on their degree of understanding is small. Of note, our findings suggest that prior to regular examinations, the frequency of most degree of understanding prevails as the largest category within the Department of Engineering. However, many students are still categorized as having an insufficient degree of understanding.

The results of our regression analysis find that degree of difficulty, effectiveness of audiovisual aids, self-study time, and class attendance significantly affect the degree of understanding at the 10% level. A class in which students feel satisfied can increase the degree of understanding. Although the relationship between the degree of understanding and the final mark is not strong, it is crucial that students improve their degree of understanding by self-study, and thereby increase the quality of their education.

Our results may provide fundamental information to technological faculty that improves the quality of Engineering Education and promotes the advancement of educational outcomes.

Reference

Kakimoto, R., Koike, K., Sakimoto, T., Yamao, T. & Mizokami, S. (2004) Inspection of learning quality and quantity by credit rightness indexes. Journal of Japanese Society for Engineering Education, 52(5): 22-27 (in Japanese with English abs.).

Yamao, T., Kakimoto, R., Koike, K., Kawahara, 2. A. & Shiotsuki, T. (2007) Development of the educational quality at Kumamoto University based on the engineering education of high-grade degree: Organized educational quality by the positive feedback system. Proceeding of JSEE 55th Annual Conference: 774-775 (in Japanese).

Wooldridge, J. M. (2002) Econometric Analysis of Cross Section and Panel Data. The MIT Press: 55-58.

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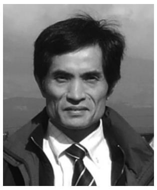

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