Towards a new assessment methodology in educational settings: Use of KWM for quantitative measurement of learning and teaching activities

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Overview Assessment of learning instruction outside class, school-wide grading systems, faculty teaching capability, and other educational aspects has become an area of active research and development. Here we propose a method of assessment based quantitative measurement of student learning activities and teaching activities, with a high level of accountability.

Keywords: university education, accountability, ICT utilization, learning activities, teaching activities

1. Introduction

Discussion has grown over many years in regard to the validity and reliability of existing methods for assessing students and faculty at education sites. The existing mainstream approach comprises assessment of student performance by teachers who may differ widely in skills and experience. Assessment of faculty instructional capability is lacking in observable criteria and standards. Accountability both inside and outside the educational institution in terms of providing clear, objective explanations of its assessments is accordingly an urgent issue. Here we describe the development and propose the adoption of a methodology of assessment based on measures of the related activities of student and faculty.

2. Method

2.1 Measurements of student and teacher activities

The measures of student learning-activities are in the three main categories of student academic sociality, post-class reporting, and viewing of teacher feedback (FB). Those of teacher teaching activities comprise pre-class preparation, post-class student retainment, and FB-related activities.

The retainment index (RI) is an expression of the level of classwork retained in the students' memory, as calculated from the retainment of main keywords (main-kws) and the related sub-keywords (sub-kws). We denote the i^{tt} main-kw by M_i , the j^{th} sub-kw of M_i by $S_{i,j}$, the number of main-kws by x, the number of sub-kws of M_i by y_i , the number of students attending the class who reported keyword retainment for the specified time by *n*, the number who reported M_i retainment by a_i , and the number who reported $S_{i,j}$ retainment by $b_{i,j}$.

The retained main-kw proportion (RMP; relative to students reporting main-kw retainment) for main-kw M_i is then RMP_i = $\frac{a_i}{n}$, and the retained sub-kw proportion (RSP) is RSP_{i,j} = $\frac{b_{i,j}}{a_i}$. The average RSP (ARSP) for M_i (relative to the number of retained sub-kws for M_i) is ARSP_i = $\frac{\sum_j \text{RSP}_{i,j}}{y_i}$, the average RMP_i for the class (CRMP; class RMP) is CRMP = $\frac{\sum_i \text{RMP}_i}{x}$, and the average ARSP_i for the class (CARSP; class ARSP) is CARSP = $\frac{\sum_i \text{ARSP}_i}{x}$. The class balance between CRMP and CARSP (the "Distance") is calculated by following equation.

Distance =

[(CRMP+CARSP)/2 + (1.0-|CRMP-CARSP|)]/2

The values of CRMP, CARSP, and Distance are taken as three indices, referred to as retainment index 3 (RI3).

2.2 Classes and measurement performance

The classes constituted a course taught by multiple faculty members (team-learning format, 24 students, 16 classes) at an engineering graduate school. A description of the assessments to be made in parallel with the class learning activities was provided in the course guidance during the first class. The Key Words Meeting (KWM) system was used to measure the amount of learning and teaching activities.

The allotted terms for reporting were on the class day for the post-class report, 2 days for

teacher FB, and 4 days for the viewing of the FB content.

3. Results

The scoring criteria and possible scores are shown in Table 1 for student learning activities and in Table 2 for teaching activities by faculty. Fig. 1 is a histogram of the grades attained after completion of all classes in the course as a result of the learning efforts. Fig. 2 shows the average learning amount per grade. Table 4 shows the instructional effort found for each teacher in the course. The mean and standard deviation for the 14 classes (excluding hall lectures) were 85.5 ± 11.1 for the learning activities and 99.0 ± 3.2 for the instructional activities in the classroom lecture format.

4. Discussion

Three elements that need to be met in conducting performance assessment at educational institutions and any other organization with continuing development and growth as part of its basic purpose are: a capability for performing measurement; а capability for imparting improvement through education; and, a capability for agreement between assessor and assesse. Student grading depending on the amount of student learning activities as defined here serves as an absolute scale which can be expected to eliminate divergences due to differences in grading standards among faculty members. Assessment for teaching activities as defined here can be expected to indicate the actual quality of instructional activities by individual faculty members and contribute to consistency throughout the faculty as an objective indicator of teaching capability. These methods of activity assessment by the persons involved are considered to provide a high degree of accountability inside and outside the educational institution, and are feasible for taking measures to facilitate improvement. The KWM system provides a convenient means of relevant information gathering, and its use can also be expected to improve the regularity of the learning process, in part, by the opportunity it provides for students who have been absent from class to peruse the teacher FB on that day's study.

Category	Learning activity criterion		Extra
Category		points	points
ciality	Prior notice of absence	1	0
	Class attendance and on-time report submission	10	0
So	(on-time: 100%; late: 75%; partial: 20%; none: 0%)	0	0
mic	On-time viewing of class notifications in the term specified	0	0
Acade	Viewing of syllabus by next class	0	1
	Subtotal	11	1
	Class attendance (full attendance: 100%; late arrival or	25	0
	Massage utilization	0	1
	Submission of rateined keywords	1	0
÷	Submission of retained keywords	1	1
Ioda	Net the	10	1
ss re	Note taking	10	0
clas	Entry of questions	0	5
ost-e	Entry of additional main-keywords	0	1
Pc	Entry of additional sub-keywords	0	1
	Submission of realizations in class	5	0
	Submission of in-class assignments	0	5
	Downloading of class materials	0	0
	Subtotal	41	14
20	Viewing of FB before next class: 100%; viewing during class: 75%		
	Viewing of personal FB page	10	0
	Viewing of note list shared with others	10	0
ving	Viewing of realizations list shared with others	10	0
viev	Viewing of assignment and test lists shared with others	0	0
FB	Viewing of supplementary explanation list shared with others	15	0
	Continuous discussion concerning supplementary explanations	3	5
	Subtotal	48	5
	100	20	

Table 1. Criteria and scores of learning activity

Cotagory Instructional activity criterion		Base	Extra
Category		points	points
Preparation	Pre-class syllabus viewing	0	1
	Pre-class keywords setting	10	0
	Uploading of class materials	0	1
	Subtota	1 10	2
Retention	CRMP	20	0
	CARSP	20	0
	Distance	25	0
	Subtota	1 65	0
FB-related provision	On-time FB in the term specified	20	0
	Additional explanation	0	2
	FB on note entry	0	1
	FB on questions	5	0
	FB on in-class realizations	0	1
	FB on assignments given in class	0	1
	Subtota	1 25	5
	FB on follow-up discussion	0	2
	Utilization of messages	0	1
	Subtota	1 0	3
	Tota	1 100	10

Table 2. Criteria and scores of teaching activity



(F: Fail; P: Pass; G: Good; E: Excellent; S: Superb) **Fig. 1** Histogram of student grades



Fig. 2 Mean scores of learning activities by grade

Teacher No.		1	2	3	4	5	1	6	Avg.
Prior preparation	Base points	10.0	10.0	10.0	10.0	10.0	10.0	10.0	10.0
	Extra points	0.0	1.0	0.0	2.0	0.0	2.0	1.0	0.9
Retainment	Base	58.3	54.5	57.5	59.0	62.8	61.8	62.2	59.4
	points Extra points	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
FB-related	Base points	25.0	25.0	25.0	25.0	25.0	25.0	25.0	25.0
providion	Extra points	3.0	3.0	6.0	3.0	2.0	5.8	3.0	3.7
Total	Base	93.3	89.5	92.5	94.0	97.8	96.8	97.2	94.4
	Extra points	3.0	4.0	6.0	5.0	2.0	7.8	4.0	4.5

 Table 4. Teaching activity assessments