

Innovative Tools For the Assessment of Instruction

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Abstract

Current ABET Evaluation places a strong emphasis on outcomes and assessment. At the ASEE 2009 Annual Conference in Austin, Texas, the authors presented a paper on the value of teaching Civil Engineering Courses using individualized student assignments. To validate that individualized instruction was more successful than the traditional group methods of instruction and assignments the authors developed an innovative means of measuring student performance.

Objective (quantitative) comparison of student performance in courses from different years presented a challenge. Each course had different students; the common base was the instructor and the course material. The characteristic that changed in the before and after courses was the introduction of individual assignments in the after sections. To attempt to compare student and class performance in this situation, the authors developed an index system to assign a numerical value to individual student performance in a course and an index to quantify the overall performance of all students in the course.

To assign a numerical value to the individual performance of a student an index called the Capability Index (CI) was developed as a measure of a student's personal performance as demonstrated by the relationship between the grade point (GP) they achieve in a course and their cumulative grade point average (CGPA) at the same time ($CI=GP/CGPA$). The cumulative GPA at the end of the course was used as a reasonable quantitative overall measure of a student's demonstrated capability at that point in time and because it is a readily determined value. The CI is strictly an index related to an individual student. If a student is consistently a straight "A" student or a straight "C" student then his or her CI will be 1.000. However the index will show relative improvement for a student not a straight "A" student or a decline in relative performance for a straight "A" student who fails to maintain straight "A's".

To compare performance of groups of students an Effectiveness Index (EI) (the average of the CI indices for all the students in a course) was developed. It was hypothesized that a significant improvement in the EI may be used as an indicator of success of a new or different instructional strategy initiated to improve student performance. In that the EI is a measure of the average individual relative performance of all the students in a class it was the authors' proposition that it provided an objective measure of the success of a new instructional strategy such as the Individual Student Assignments proffered by the author's paper presented at the Austin Conference [1].

This paper will present an extension of possible other uses for the indexes (Capability and Effectiveness) as tools for assessment of instruction.

Key words: Assessment of instructor performance

Introduction

Historically student performance was judged through an evaluation process that was pretty much the prerogative of the instructor. The evaluation was reflected for the most part in a final grade. Upon graduation, observations and comments in reference letters by faculty either for graduate school or employment would add additional insight to the academic performance of the student. In recent years grading (evaluation) has developed into a more objective process referred to as assessment. The terms evaluation and assessment are often used synonymously. But there is a distinct difference; evaluation is quantitative judgment of performance, whereas assessment is evaluation with an added component of faculty interaction to improve the instructional process, called corrective action. In some circles the terms evaluation and assessment are reversed, such as used by ABET [2] (The Accreditation Board for Engineering and Technology).

The traditional evaluation or assessment process of faculty performance as been essentially a subjective process. This process involves peers (other faculty), administrators (department chair, dean), and in many cases students.

The authors propose the use of their Capability Index (CI), a measure of a student's performance as demonstrated by the relationship between the grade they achieve in a course and their cumulative GPA at the same time (Grade in Course/Cumulative GPA) and the Effectiveness Index (EI), the average of the CI indices for a course, as a means of developing a quantitative evaluation of **instructor** performance.

Instructor's Performance/ Instructor's Handicap (IH)

Evaluation of teaching, especially at the university level, poses many problems. Perhaps the most credible way is performance of the student in following courses and eventually performance on the job. At the time of instruction, that is, at the end of a course, it is very difficult to evaluate the instructor's performance. Many instructors are very lenient even to the point of awarding all "A" grades, and at the other extreme the professor who is so "rigid" that the student's grades are much lower than they might be, had they have had a different instructor. To account for these differences in faculty "rigor", the authors propose the following ratio for "Handicapping" the instructor's performance in a given course. The ratio is called the "Instructor Handicap" (IH) and is equal to the ratio of the average cumulative grade point average (ACGPA) of all the students in the class divided by the average grade (AG) earned by the students in the course.

$$IH = ACGPA / AG \quad (1)$$

For example: if the average grade of all students in a course was a C (2.000) and the average cumulative grade point average of all the students was a B (3.000), than the Instructor Handicap

(IH) would equal $3/2 = 1.5$. Likewise, if the average grade in the course was an A (4.000) and the average cumulative grade point average was 3.000, than the IH would equal $3/4 = 0.75$.

Adjusted Effectiveness Index (AEI)

To objectively measure the performance of the faculty member the authors propose an *adjusted effectiveness index* (AEI). This is to modify the Effectiveness Index to reflect the differences between the extremes of faculty instruction. That is between those that are very liberal in awarding grades and those that are very rigid. To arrive at the adjusted effectiveness index, the EI for a professor in a given course is adjusted by multiplying the EI by the Instructor's Handicap (IH). This results in the AEI.

$$AEI = EI * IH \quad (2)$$

If all the students in a class performed at their level of capability, their CI would equal 1 (one). Likewise, the EI for the instructor would also equal 1 (The average of the CI's). Therefore the norm for evaluation of a professor would be an EI of 1. However, if the professor is extremely rigid in his/her instruction and grading the EI will be significantly less than 1. To adjust for this anomaly, the EI is multiplied by the IH resulting in an adjusted EI, which more accurately reflecting the instructor's performance.

There are a number of reasons why the ACGPA may not be an accurate measure of a student's true capability.

1. Grading at the institution may be very lenient, or very rigid, thereby not a reflection of "true" capability.
2. Variation in teaching strategies and instructor philosophy would result in variations in student ACGPA reflecting differently on faculty assessment.

With these considerations the ACGPA and its use in the proposed indices will still be an objective measure that may be reasonably applied to the all faculty.

Faculty assessment is best utilized by the individual faculty member, for he or she is best qualified to interpret the results and, if honest with themselves, consider corrective action if the values suggest it. For example, if the AEI is significantly less than 1, perhaps the instructor's strategies should be modified. Likewise if the AEI is significantly greater than 1, improved instructional "rigor" might be considered.

Suggested Applications

These indices may be used to reflect on the overall rigor of an individual unit, such as a department or college. They may also be used to make observations on the faculties of different components in an Institutions as well as the institution as a whole. Extending this concept beyond a single institution could result in comparative studies of instruction at various institutions

Variance

The variance of the Capability indices of a class might help in describing the consistency of a professor's instruction. A study of an Instructors Adjusted Efficiency Index (AEI) might be useful in tracking the development of "good" teaching faculty. When a professor is contributing to the improvement of students as reflected by their grades, the students' CI should be greater than 1.

For this initial study seven courses taught by three instructors were selected to explore the variability of the adjusted effectiveness index. One instructor was from a support area (service course) another instructor from a discipline major (engineering) and a third one was an adjunct faculty member. This initial selection was made under an agreement with the faculty members that there would be no identification of the faculty members or courses selected.

The average Instructor Handicap for these courses was 1.543 (Table-1) resulting in an average adjusted efficiency index of 0.964. This value is very close to 1. The authors hypothesize that 1 would be the normal value expected for "*theoretical ideal*" instruction.

Table-2 shows the results of the individual analysis of each course. It is interesting to note that the average cumulative GPA (ACGPA) is almost 1 point greater than the average grade (AG) in the individual courses (0.979). Future studies will explore this difference

The smaller the variance the more consistent the class performance of the students, implying a closer correlation between student performance and instructor's effectiveness. Another way of stating this is that there is a strong compatibility between the instructor's teaching strategies and student achievement. Also as the variance (standard deviation) gets larger instruction and student performance tend to diverge. There will be virtually little if any correlation between student performance and instruction.

Future Studies

The author's plan to extend this study to look at individual faculty and their performance over time, the overall performance of faculty teaching a given course, and difference in faculty

performance, as reflected by the method presented in this paper, for various areas of instruction (sciences, humanities etc.).

1. Annual Conference, ASEE, Austin, TX, 2009, C 2009-1377: *CIVIL ENGINEERING COURSES TAUGHT WITH INDIVIDUALIZED STUDENT ASSIGNMENTS* Ahmet Zeytinci, University of the District of Columbia Philip Brach, University of the District of Columbia © American
2. ABET Accreditation Policy & Procedure Manual, 2009-2010, section II.D.1.c & II.D.1.d

Table 1 Summary of Individual Course Data

Course#	Avg Grade	Avg CGPA	Avg CI	IH	AEI	SD	AEI-SD	AEI+SD
1	2.111	3.396	0.603	1.609	0.970	0.333	0.637	1.303
2	1.714	3.012	0.667	1.757	1.171	0.310	0.861	1.481
3	2.143	3.238	0.636	1.511	0.961	0.315	0.646	1.276
4	1.167	2.229	0.409	1.910	0.781	0.474	0.307	1.255
5	2.833	3.268	0.823	1.153	0.949	0.468	0.481	1.417
6	1.786	2.869	0.589	1.607	0.947	0.348	0.600	1.295
7	2.308	2.902	0.770	1.258	0.969	0.419	0.550	1.387
	14.062	20.913	4.498	10.804	6.749	2.666		
	2.009	2.988	0.643	1.543	0.964	0.381	0.583	1.345

SAMPLE INSTRUCTOR ASSESSMENTS

Table 2 Individual Course Data

Course 1	Instructor A							
Student #	Grade	CGPA	CI	IH	AEI	STD	-STD	+STD
1	2	2.912	0.687			0.687		
2	1	3.548	0.282			0.282		
3	2	3.29	0.608			0.608		
4	4	3.964	1.009			1.009		
5	0	3.031	0.000			0.000		
6	3	3.663	0.819			0.819		
7	1	3.1	0.323			0.323		
8	3	3.571	0.840			0.840		
9	3	3.486	0.861			0.861		
	19	30.565	5.428					
	2.111	3.396	0.603	1.609	0.970	0.333	0.637	1.303

Course 2	Instructor A							
Student #	Grade	CGPA	CI	IH	AEI	STD	-STD	+STD
10	2	3.12	0.641			0.641		
11	0	2.939	0.000			0.000		
12	2	3.033	0.659			0.659		
13	3	3.579	0.838			0.838		
14	2	2.222	0.900			0.900		
15	2	3.188	0.627			0.627		
16	1	3	0.333			0.333		
	12	21.081	3.999					
	1.714	3.012	0.667	1.757	1.171	0.310	0.861	1.481

Course 3	Instructor A							
Student #	Grade	CGPA	CI	IH	AEI	STD	-STD	+STD
17	2	2.584	0.774			0.774		
18	2	3.12	0.641			0.641		
19	0	2.718	0.000			0.000		
20	2	3.186	0.628			0.628		
21	2	3.422	0.584			0.584		
22	4	4	1.000			1.000		
23	3	3.633	0.826			0.826		
	15	22.663	4.453					
	2.143	3.238	0.636	1.511	0.961	0.315	0.646	1.276

Course 4	Instructor B							
Student #	Grade	CGPA	CI	IH	AEI	STD	-STD	+STD
24	2	2.917	0.686			0.686		
25	0	0.96	0.000			0.000		
26	3	2.724	1.101			1.101		
27	2	3	0.667			0.667		
28	0	1.817	0.000			0.000		
29	0	1.955	0.000			0.000		
	7	13.373	2.454					
	1.167	2.229	0.409	1.910	0.781	0.474	0.307	1.255

Course 5	Instructor B							
Student #	Grade	CGPA	CI	IH	AEI	STD	-STD	+STD
30	2	3.651	0.548			0.548		
31	4	3.256	1.229			1.229		
32	4	4	1.000			1.000		
33	3	3	1.000			1.000		
34	4	3.442	1.162			1.162		
35	0	2.259	0.000			0.000		
	17	19.608	4.938					
	2.833	3.268	0.823	1.153	0.949	0.468	0.481	1.417

Course 6	Instructor A							
Student #	Grade	CGPA	CI	IH	AEI	STD	-STD	+STD
36	0	2.955	0.000			0.000		
37	4	3.328	1.202			1.202		
38	1	2.25	0.444			0.444		
39	4	3.803	1.052			1.052		
40	1	2.182	0.458			0.458		
41	1	3.017	0.331			0.331		
42	2	2.83	0.707			0.707		
43	4	3.429	1.167			1.167		
44	1	2.6	0.385			0.385		
45	1	2.581	0.387			0.387		
46	1	2.828	0.354			0.354		
47	2	2.756	0.726			0.726		
48	1	2.313	0.432			0.432		
49	2	3.294	0.607			0.607		
	25	40.166	8.252					
	1.786	2.869	0.589	1.607	0.947	0.348	0.600	1.295

Course 7	Instructor C							
Student #	Grade	CGPA	CI	IH	AEI	STD	-STD	+STD
50	2	2.532	0.790			0.790		
51	0	2.63	0.000			0.000		
52	2	3.079	0.650			0.650		
53	4	3.265	1.225			1.225		
54	3	2.467	1.216			1.216		
55	4	3.692	1.083			1.083		
56	4	4	1.000			1.000		
57	2	3.492	0.573			0.573		
58	0	2.493	0.000			0.000		
59	1	2.135	0.468			0.468		
60	3	3	1.000			1.000		
61	3	2.574	1.166			1.166		
62	2	2.366	0.845			0.845		
	30	37.725	10.016					
	2.308	2.902	0.770	1.258	0.969	0.419	0.550	1.387