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Teaching Evaluation and Students' Perception of Their Grades: A Game Theory Approach

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Abstract: This paper revisits the discussion of the relationship between students' grades and their teaching evaluation. The literature on this relationship is inconclusive. This paper studies a relationship between students' perception of their grades and their teaching evaluations. The analysis of this paper employs teaching evaluation surveys carried out before and after the examination. This helps segregate the effect of the grade perception on teaching evaluation from other factors. This study also tests if the difference between expected and received grades affects teaching evaluation. Using multinomial logistical regressions, we found no evidence that instructors and students trade grades for teaching evaluation.

Keywords: Teaching evaluation, Grades, Prisoners' dilemma, Repeated game; Nash equilibrium, Multinomial logical regression

1. Introduction

Instructors in most of the universities and other educational institutions of the world regularly face an evaluation of their teaching performance. Benefits of teaching evaluation for the institution, teachers themselves and the students include screening the quality of instructors and motivating them, maintaining a school's teaching excellence; enabling teachers to signal their proficiency level; providing feedback to teachers, etc.

Teaching evaluation can become a part of strategic interaction among teachers and students. Although, there are a number of factors influencing students' grades and teaching evaluation, game theory is often useful in simplifying and analysing such interactions. Consider a game between one teacher and one student, where the teacher has a choice of two strategies – assigning a higher than deserved and a deserved grade, and the student has two strategies – giving a high or low evaluation of teaching. To the extent that the teacher is more concerned with teaching evaluation rather than the student's grade, and the student desires a grade as high as possible; the game can be illustrated in a form of the following figure.

Figure-I. Game between a teacher and a student

		Student	
		H	L
Teacher	HD	2 ; 2	0 ; 2
	D	3 ; 0 (1)	1 ; 1

In this figure, the rows represent the teacher's options and the columns represent the students' options. The numbers in the table represent their respective payoffs. These payoffs in the game above can be changed without altering the essence of the game, as long as their order is preserved. The first issue to mention about the game is the unusual structure of the payoff in the outcome (D; H). It consists of the payoff to the teacher, and two alternative payoffs to the student. The choice of the relevant alternative depends on the assumption about student's preferences. If he/she is dissatisfied with the deserved grade and reflects it in the teaching evaluation, then the student's payoff in the outcome (D; H) is zero (alternative hypothesis). Alternatively, if the student is happy with the deserved grade, then his/her payoff in the outcome (D; H) is unity (null hypothesis).

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The assumption that the teacher cares more about receiving high teaching evaluation than giving a deserved grade to the student explains why the teacher's payoff is greater in the outcome (HD; H) than in the outcome (D; L). The assumption that the student desires receiving the highest possible grade explains why the student's payoff is greater with the higher grade regardless of teaching evaluation. Generally, such desire seems to be relevant to most students whose grades are lower than approximately 90% of the higher possible mark.

The outcome of the game depends on whether the null hypothesis is rejected and whether the game is played once or multiple times. Playing the game once is equivalent to the teacher's course taken by the student only once during his/her study period. When the game is played once and the null hypothesis cannot be rejected, then the Nash equilibria are (D; H) and (D; L). This is the benchmark situation, which is optimal for the education industry, where the students' grades are not correlated with teaching evaluation. When the game is played once and the null hypothesis is rejected, then the Nash equilibrium is (D; L). Obviously, this outcome is disappointing for the teacher. When the game is played multiple times, there is a possibility for the players to trade student grades for teaching evaluation. This might be achieved using a tit for tat strategy that was successful in repeated prisoners' dilemma game (Heap and Varoufakis, 2004). This outcome of the repeated game between teachers and students reduces the benefits of teaching evaluation. Therefore, it is important to study the relationship between teaching evaluation and students' grades, and consequently find out if trading of the grades for teaching evaluation takes place between teachers and students. The following section reviews the existing literature and outlines the contribution of the current paper.

2. Literature Review

During the last several decades, universities in most countries of the world have been using student evaluation of teaching (Abrami, 1989; Hobson and Talbot, 2001; Van Patten, 1994; Wagenaar, 1995). Student teaching evaluation is used as a measure of the instructor's teaching effectiveness. This measure in turn provides the instructors with a feedback on how to improve their teaching. Evaluations of teaching effectiveness affect the decisions regarding the faculty remuneration and promotion, as well as help students in their choices of courses and instructors (Kwan, 1999; Marsh and Roche, 1993).

However, for any evaluation to be reliable, a considerable proportion of students should participate in it, at least two-thirds, according to Centra (1979). There are various factors affecting participation rates. Chen and Hoshower (2003) show that students are more willing to participate in teaching evaluation if the results are expected to improve the faculty's teaching, the next attractive outcome is improvement in course design. The faculty's promotion and remuneration, as well as the students' ability to choose courses and instructors are the least attractive evaluation outcomes.

Often, paper based evaluation receives a higher response rate than electronic evaluation (Avery *et al.*, 2006; Layne *et al.*, 1990). Some scholars argue that students with higher grades are more likely to participate in the evaluation (Avery *et al.*, 2006; Kherfi, 2011; Layne *et al.*, 1990), however, there are studies that show no correlation between grades and response rates (Chen and Hoshower, 2003). Proponents of the positive effect of grades on participation rate suggest that it may be because students that perform well are also more responsible, and students with weak performance are discouraged from course related activities. However, Isely and Singh (2005) show that classes with better performing students tend to provide less favourable teaching evaluation.

There is a considerable body of literature studying the relationship between students' performance, measured by grades, and student evaluation of teaching. While many researchers argue that higher grades positively affect SET, there are some who disagree. (Powell, 1977) conducted experiments involving different grading criteria (stringent, moderate and lenient) and different tests frequency. The findings show that test scores improve with increasing grading requirements and more frequent tests. While test scores improve, stringent grading and frequent tests also negatively affects teaching evaluation.

Seiver (1983), using OLS regression, shows that students' expected grade positively influences teaching evaluation. However, 2SLS estimation shows that expected grade has no effect on teaching evaluation, while evaluation results have a positive effect on expected grades. Teaching evaluation can influence students' expected grades because better performing teachers can improve both students' learning and evaluation. Nelson and Lynch (1984) also argue that 2SLS estimation is the preferred method. Nelson and Lynch show that expected grade does not have a statistically significant effect on the teaching evaluation.

DeCanio (1986) analyses data on teaching evaluation using multinomial logit and compares the results with the linear regression model. The results of these models don't differ radically; however, the logit model is preferred. DeCanio shows that expected grade does not to have an effect on teaching evaluation.

Despite the findings of studies discussed above, many other researchers arrive at opposite conclusions. Stratton *et al.* (1994), employing individual student level data in OLS estimation, show that students' GPA positively affects teaching evaluation. Krautmann and Sander (1999), using OLS analysis of class-level data, show that the expected grade has a significant effect on teaching evaluation. They also show that expected grades are not endogenous, supporting OLS technique rather than 2SLS. Isely and Singh (2005) also analyse class-level data with OLS estimation, and find that the difference between the expected grade and cumulative GPA has a significant effect on teaching evaluation.

McPherson (2006), using class level data with OLS estimation, show that expected grade positively affects teaching evaluation. McPherson *et al.* (2009) revisit the determinants of teaching evaluation results. They analyse class-level date with OLS estimators and show that expected grade positively affects teaching evaluation.

Matos-Diaz and Ragan (2010) show that that teaching evaluation is negatively affected by the variance of expected grades, due to risk-averse students preferring less uncertainty about their grade. Additionally, the weaker place a higher value on lower variance. Their analysis employed class-level data on 1232 classes.

Langbein (2008) uses class level data on 7686 courses in OLS analysis that isolates the effects of expected and actual grades on teaching evaluation from the effects of other factors. Langbein shows that both expected and actual grades positively influence teaching evaluation, and the effect expected grades are consistently larger.

More recently, Beleche *et al.* (2012), using data on individual students in linear regression analysis, show that the students' grades are positively associated with their teaching evaluation. This effect maintains its statistical significance even after controlling for the students' learning outcomes and other factors.

Besides the effect of grades on teaching evaluation, existing studies have also considered other factors. Class size is debated to either have a negative effect on teaching evaluation (DeCanio, 1986; McPherson, 2006) or not to have a significant effect (Krautmann and Sander, 1999; McPherson *et al.*, 2009; Stratton *et al.*, 1994). A recent debate is on the effect of learning outcomes on teaching evaluation. Beleche *et al.* (2012) show that there is a positive and statistically significant relationship between students' learning outcomes and their teaching evaluation. However, Craig *et al.* (2012) do not find a positive relationship between learning outcomes and teaching evaluation, and argue that most effective instructors are within the middle percentiles of student evaluations.

Our paper expands the literature on student's grades and teaching evaluation in a number of ways. Firstly, current study employs a unique teaching evaluation data that was collected twice – both before and after examinations. This allows for a more precise measurement of the effect of the grade on teaching evaluation. Secondly, the study analyses the data using the multinomial logit model, which is appropriate for the categorical data collected during teaching evaluations. Most of the existing studies employ either OLS or 2SLS models, which are inappropriate for categorical data. Thirdly, the study makes use of individual student level data, which contrasts with the wide use of class level data in the literature.

3. Questionnaire Design

The questionnaire employed in this paper is based on previous research, for example, Collins (1990), Papanastasiou (1999) and Wenglinsky (2000). Generally, the following features are considered to be indicative of an effective teacher: knowledge of subject matter, commitment to students' learning, classroom management skills, good interpersonal skills, and professional development. It could be difficult for students to evaluate the latter one, hence there are no questions regarding professional development in the questionnaire. As mentioned above, the questionnaire is conducted twice: before examination and after the students find out their course results.

The pre-exam questionnaire consists of the following questions, with variable names in parenthesis:

1. The course material was presented clearly (mat_clear)
2. The instructor was open to students' questions (open_quest)
3. The instructor answered students' questions clearly (quest_clear)
4. The instructor's lectures were interesting (lec_int)
5. The instructor was well prepared for the lectures (prep)
6. The instructor was enthusiastic about teaching the course (enth)
7. Various types of assignments and tests were used in this course (var_test)
8. The instructor gave relevant and helpful comments on assignments and tests (comm)
9. The comments have improved my learning experience (comm_learn)
10. The instructor was available to answer questions outside of class time (out_class)
11. The instructor managed the class well (man_class)
12. The learning objectives for the course were clear and stated (obj_clear)
13. The learning objectives of the course have been achieved (obj_ach)
14. Overall I am satisfied with the quality of teaching for this course (sat_teach)
15. I would recommend this course to other students (rec_st)
16. I would like to take another course taught by this instructor (take_course)
17. I expect good grades for the course (exp_gr)

Answers to the first four questions of the pre-exam questionnaire above reflect the level of the instructor's knowledge of subject matter; questions five to ten are relevant to the instructor's commitment to students' learning, question ten may also be helpful in evaluating the instructor's interpersonal skills; question eleven is designed to evaluate the instructor's classroom management skills. Questions twelve and thirteen can show whether the possession (or absence) of the features indicative of an effective teacher has helped achieve learning outcomes. The last four questions of the pre-exam questionnaire, as well as the last six questions of the post-exam questionnaire, are necessary to achieve one of the objectives of the research – testing the effect of the difference between the expected and received grades on teaching evaluation.

The post-exam questionnaire consists of the following questions:

1. The course material was presented clearly (mat_clear)
2. The instructor was open to students' questions (open_quest)

3. The instructor answered students' questions clearly (quest_clear)
4. The instructor's lectures were interesting (lec_int)
5. The instructor was well prepared for the lectures (prep)
6. The instructor was enthusiastic about teaching the course (enth)
7. Various types of assignments and tests were used in this course (var_test)
8. The instructor gave relevant and helpful comments on assignments and tests (comm)
9. The comments have improved my learning experience (comm_learn)
10. The instructor was available to answer questions outside of class time (out_class)
11. The instructor managed the class well (man_class)
12. The learning objectives for the course were clear and stated (obj_clear)
13. The learning objectives of the course have been achieved (obj_ach)
14. Overall I am satisfied with the quality of teaching for this course (sat_teach)
15. I would recommend this course to other students (rec_st)
16. I would like to take another course taught by this instructor (take_course)
17. My grade for the course is good (gr)
18. My grade for the course exceeds my expectation (gr_exc)

Reliability and validity are important issues for any research based on surveys or questionnaires, including teaching evaluation. Current study proceeds based on the observation that the existing literature views adequately designed teaching evaluation surveys to be reliable and valid sources of information (Calderon *et al.*, 1994; Cohen, 1981; Marsh, 1984).

4. Data Analysis

4.1. Description of the Data and the Analysis

The pre- and post-examination surveys collected the answers of 186 and 142 undergraduate students respectively. The surveys were run among students in Taiwan and Sweden. In Sweden, 45 and 44 students participated at the pre- and post-exam stages respectively. The data analysis consisted of multinomial logit regression analysis of the combined data on all the students.

This analysis addresses the following. Firstly, it tests which factors have an effect on achievement of learning objectives as perceived by the students. This helps identify what skills or actions of the instructor, students consider to be important for their learning. This test was done using the pre-exam survey data. Secondly, it is tested which factors have an effect on the grades that students expect to receive before the examination. It is also tested if any factors influence the student's satisfaction with their actual grades. Finally, and most importantly, it is tested if students' grades influence their overall teaching evaluation, which is measured here by their satisfaction with teaching.

This test was done in three stages: (i) overall pre-exam satisfaction with teaching is regressed on expected grade; (ii) overall post-exam satisfaction with teaching is regressed on the students' perception of the actual grade; (iii) overall post-exam satisfaction with teaching is regressed on how much the actual grade exceeds the students' expectations. If the relationship between the variables in the second and third stages is stronger than that in the first stage, it may be an indication that teaching evaluation is affected by students' grades and/or how high the grades are relative to the students' expectations.

4.2. Multinomial Logistic Regressions

The tests identifying the factors that affect achievement of learning objectives, expected grades, and students' evaluation of teaching consisted of five multinomial logistic regressions with the variables mentioned above employed as three dependent variables (the latter one appears in three regressions). The likelihood ratio chi-square of higher than 70.89, and a p-value of less than 0.0001 for all of the models indicate that the models fit the data reasonably well.

4.2.1. About Learning Objectives

The following teaching skills are most likely to have an effect on achievement of learning objectives, as perceived by the students: clearly presenting the material in class, managing the class well, providing comments on the students' assignments, and describing the learning objectives of the course at the start. The result of regressing achievement of learning objectives on these four variables is presented in table 1. The regression result indicated that presenting the material clearly, providing helpful comments on the students' assignments, and ensuring the clarity of learning objectives have a statistically significant effect on reaching the category "agree" of achieving these learning objectives. However, these variables seem to have no effect on reaching the category "strongly agree".

4.2.2. About Expected Grades

The following factors may impact the students' expected grade: clarity of the material, how interesting the lectures are to the students, providing useful comments on the students' assignments, and the instructor's class management skills. The result of regressing the expected course grade on the four variables mentioned above is presented in table 2. The regression results indicated that presenting the material clearly, ensuring that the students

are interested in the lectures, and managing the class well have a statistically significant effect on achieving the category "agree" of expectation of a good course grade. However, these variables seem to have no effect on reaching the category "strongly agree".

A similar test was run using post-examination data, where the dependent variable was the students' satisfaction with their actual course grade. The only statistically significant effect was that of material clarity. Category "agree" of clearly presented material increases the relative log odds of good grade by 1.46.

4.2.3. About Teaching Evaluation

Testing for the effect of students' grades on teaching evaluation was done in three stages. Firstly, teaching evaluation is regressed on students' expected grades, along with other control variables, using pre-examination data. Secondly, teaching evaluation is regressed on students' perception of their actual grades, and the results are compared with those of the previous stage. If students' dissatisfaction with their grades is reflected on teaching evaluation, positive correlation between the grades and evaluation results should strengthen post-exam. Thirdly, teaching evaluation is regressed on the variable that measures how much the students' actual grades exceed their expectations. Again, if a surprise in the received mark is reflected in the teaching evaluation, one would see a positive relationship between these variables.

Tables 3 and 4 present the results of regressing teaching evaluation on expected grades and students' perception of their actual grades respectively. The control variables that are used in these regressions include: providing students with comments on their assignments, presenting the teaching material clearly, and making the lectures interesting to the students. Before the examination, the students' overall satisfaction with the teaching of the course is influenced by their expected grades, receiving helpful comments on their assignments during the semester, and the interest that the lectures attracted. After the examination, teaching evaluation is impacted by receiving helpful comments, clarity of the teaching material, and interest generated by the lectures. The regression results indicated that the perception of the actual grades by the students has no effect on teaching evaluation. This means that once the students learn about their actual grades, the relationship between the grades and teaching evaluation does not strengthen, in fact, it weakens. Hence, the students do not seem to participate in an exchange of teaching evaluation for grades.

Table 5 shows the results of regressing teaching evaluation on the variable that measures how much the students' actual grades exceed their expectations, along with the above mentioned control variables. The regression results suggest that providing helpful comments, presenting the teaching material clearly, and making the lectures interesting to the students are the factors that affect their evaluation of teaching after the examinations. Interestingly, the excess of the actual grade over the expected one does not have a statistically significant effect on teaching evaluation. This, similar to the results observed above, suggests that the students do not trade teaching evaluation for grades.

5. Conclusion

This paper studied the relationship between students' perception of their grades and teaching evaluation. The main contribution to the existing literature is in (i) using the surveys carried out before and after the examinations, (ii) applying the prisoner's dilemma to the relationship between students' grades and teaching evaluation, and (iii) in analysing the data using multinomial logit model. According to prisoner's dilemma, under certain preference related assumptions, a repeated interaction between the teachers and students may result in a trade of higher grades for better teaching evaluation. Such trade is more likely to involve students' perceived grades rather than actual received grades, where perceived grade reflects the students' satisfaction with their actual grade.

The results of the study showed that before the examinations, the correlation between the students' expected grades and teaching evaluation is not statistically significant. Similarly, after the examinations, the effect of the students' perception of their grades on teaching evaluation is also insignificant. This suggested that instructors and students do not trade grades for teaching evaluation. A limitation of the study is a relatively small sample size. Hence, further research in this area is needed for more robust conclusions.

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Tables

Table-1. Achievement of learning objectives

Multinomial logistic regression		**Log likelihood = -78.71943** **Number of obs = 186** **LR chi2(16) = 233.26** **Prob > chi2 = 0.000** **Pseudo R2 = 0.5970**	
Independent variable		Dependent variable: obj_ach	
		agree	strongly agree
mat_clear	agree	1.68607***	-0.0197651
	strongly agree	0.5058715	1.38977
man_class	agree	0.5540924	-0.9784532

Continue

	strongly agree	-0.9596112	0.1757723
comm	agree	1.202096*	17.60835
	strongly agree	1.995018**	16.79529
obj_clear	agree	3.591998***	16.85897
	strongly agree	3.959795***	20.3929
constant		-4.350718	-34.92534

Table-2. Expected grade

Multinomial logistic regression		**Log likelihood = -157.39635** **Number of obs = 185** **LR chi2(16) = 70.89** **Prob > chi2 = 0.000** **Pseudo R2 = 0.1838**	
Independent variable		Dependent variable: exp_gr	
		agree	strongly agree
mat_clear	agree	0.9016896	0.3236006
	strongly agree	-1.778059*	0.0646954
lec_int	agree	1.611082**	0.2598555
	strongly agree	1.657762*	0.8787147
comm	agree	-0.3846866	0.0406436
	strongly agree	-0.3784374	0.446623
man_class	agree	0.679072	0.1747492
	strongly agree	2.420672**	1.623777
constant		-0.8740894	-0.2387405

Table-3. Pre-exam teaching evaluation

Multinomial logistic regression		**Log likelihood = -107.37999** **Number of obs = 183** **LR chi2(16) = 179.81** **Prob > chi2 = 0.0000** **Pseudo R2 = 0.4557**	
Independent variable		Dependent variable: sat_teach	
		agree	strongly agree
exp_gr	agree	1.661624**	1.797627*
	strongly agree	0.3384774	1.111959
comm	agree	1.730906***	-0.186068
	strongly agree	2.000804*	1.001581
mat_clear	agree	0.9373759	0.8624688
	strongly agree	16.35985	18.07535
lec_int	agree	1.221064*	2.627685***
	strongly agree	15.27443	17.92076
constant		-2.65336	-3.685718

Table-4. Post-exam teaching evaluation

Multinomial logistic regression		**Log likelihood = -59.431978** **Number of obs = 142** **LR chi2(16) = 181.54** **Prob > chi2 = 0.0000** **Pseudo R2 = 0.6043**	
Independent variable		Dependent variable: sat_teach	
		agree	strongly agree
gr	agree	-0.9236359	0.7432789
	strongly agree	-1.721826	1.195565
comm	agree	2.152467***	0.184715
	strongly agree	2.709142*	1.807314
mat_clear	agree	2.464692***	1.227953
	strongly agree	-0.731639	0.3167621
lec_int	agree	1.771676**	2.355081
	strongly agree	15.41372	18.63995
constant		-2.307165	-3.992858

Table-5. Post-exam teaching evaluation (grades exceeding expectations)

Multinomial logistic regression		Log likelihood = -58.916897 Number of obs = 142 LR chi2(16) = 182.57 Prob > chi2 = 0.0000 Pseudo R2 = 0.6077	
Independent variable		Dependent variable: sat_teach	
		agree	strongly agree
gr_exc	agree	-1.001435	0.0029493
	strongly agree	14.05105	16.53961
comm	agree	2.218509***	0.5151055
	strongly agree	2.571678	1.85297
mat_clear	agree	2.294506***	1.25384
	strongly agree	-1.111025	-0.0107805
lec_int	agree	1.636792**	2.003605
	strongly agree	16.84979	20.00072
constant		-2.262444	-3.679155