Teaching and Education Commentary

No Honor Among Cheaters: A "Prisoner's Dilemma" Approach to Reduce Cheating in Online Classes

Jeffrey S. Young
Murray State University

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Abstract
Online higher education is growing at a rapid pace. Although beneficial in many regards, many studies find greater opportunity for student dishonesty. Unethical practices facilitated by e-learning include copying answers, trading solutions, or students taking turns as first mover on assignments to obtain and distribute question details or even solutions to their peers. However, if an incentive structure existed in which a student could be enticed to anonymously betray his or her peers and collaborate with the instructor, it seems reasonable that cheating could be reduced substantially. This framework resembles Prisoner's Dilemma. The objective of this study is to stylize the Prisoner's Dilemma game in the digital classroom context and propose instructor applications to set up an effective incentive structure. It is shown that a generous grade lift is a theoretically sufficient incentive to tip students toward defecting from collusion with their peers.

1 Introduction

Online higher education is growing globally at an accelerating pace (Allen and Seaman 2011; Arnold 2016), and the field of economics certainly is no exception (Harmon and Lambrinos 2008). Some courses adopt a composite or "hybrid" model of face-to-face classroom lectures (either part-time or full-time during a given semester) and list any handouts, lecture slides, homework assignments, quizzes, and even exams on an online portal (e.g., Canvas or Blackboard). Although an obvious benefit to such a system is a potential easing of the burden of grading placed on instructors, another is this allows universities to provide distance learning to students who choose not to or cannot relocate to an institution for their studies, such as military service members stationed overseas. In the recently familiar case of a pandemic, when face-to-face education suddenly becomes a nonviable option for an extended period of time, online distance learning is the logical alternative. However, online or hybrid class structures also can present additional time and effort for instructors, as well as open the door for a host of other problems, including: cheating; buying and selling of solutions to assignments; and exploitation of bugs in online tests, quizzes, and submission portals without notifying the instructor.

One issue with the increasing share of course material and assignments being moved online is the possibility of gaps in the integrity of the online system being utilized by the institution (Lanier 2006; King et al. 2009; Watson and Sottile 2010). Students are increasingly exploiting these gaps to provide personal relief to their academic workload or a host of other reasons (Ashworth et al. 1997; Hard, Conway, and Moran 2006). This is particularly true in courses with students who actively collude on assignments, quizzes, and tests, which is difficult for instructors to prevent.[1] Some have suggested a possible remedy of creating exceptionally large banks of questions and answers, assigning different sets to different students

[1] Studies find evidence of reduced cheating when proctoring is available for tests and quizzes (Rovai 2001; Deal 2002), but this is not always the case because of resource constraints.

(Simha, Armstrong, and Albert 2012). This undertaking is difficult in many cases for faculty whose duties increasingly extend much beyond teaching.[2]

Another pertinent issue facing faculty is the remarkable creativity of students to devise different avenues of cheating. For example, one such cheating method observed by the author was the "scapegoat method" of taking quizzes. Students would form study groups as encouraged but would seemingly elect one member to be a first mover in taking the quiz. This forerunner would take the quiz and document the questions encountered and the answers he or she selected for each question, inevitably making a less than perfect score. If the correct answers were readily displayed, the rest of the group would document them. If not, then a process-of-elimination scheme would ensue until each question's answer was confidently recorded, paving a safe pathway for the group members to take the quiz and achieve either perfect or near perfect scores. By taking turns as the first mover for each assignment, quiz, or exam, no one student in the group remains permanently disadvantaged.

Other, similar instances of student unethical completion tactics in online and hybrid courses were observed by other instructors interviewed by the author (e.g., one student completes the work and directly sells the solution to nonworking students, or students record postexam walkthroughs without the instructor's permission and trade with other students across courses). Because many undergraduate students are exceptionally reluctant to reveal their secrets[3]—which is a common trait of cheating frameworks in general (Dufwenberg and Dufwenberg 2018)—there is no information available on what incentive structure would tip a student toward a decision to divulge their sources and materials. It is worth noting that no question posed to a student with the goal of collecting such data would compel a student to name names, but rather name methods for obtaining and using assignment aids.

Hence, the objective of this work is to propose and describe a stylized incentive structure that could reduce cheating. This study offers a conceptual game theoretic framework for analyzing how to do so practically. The means for this would be to offer something to students that induces them to forsake any peer-collusion agreements—stated or tacit—and anonymously reporting to the instructor the presence of and solutions to students' cheating. A hypothesis to test would be whether it is possible to incentivize students to defect from colluding with their peers, and thereby reduce cheating. Indeed, there is valuable future work in collecting the data appropriate for testing this hypothesis empirically. Given the present unavailability of such data, an initial analysis using a familiar, stylized game theory model follows.

2 Model

The situation presented above closely resembles a Prisoner's Dilemma game. In this widely studied problem, one of two agents receives a reward for not cooperating at the expense of the other. But if they both do not cooperate, they both lose any reward by cooperating. The Nash Equilibrium for a single game is for both agents to not cooperate. In terms of undergraduate students, a student involved in a collusion scheme either can continue cooperating, while risking that another student confesses to the instructor before they do (presumably for some sufficiently enticing reward—such as a generous grade lift), or by making a deal for themselves to receive a reward, turning on their group, and showing the instructor documented evidence of the cheating. Without this potential of noncooperation, an instructor may not know which assignments require alteration and need to be modified in such a way that student collusion does not result in unethically inflated scores. This single-game structure assumes no penalty associated with noncooperation (considering pressure from other students).[4]

[2] Some platforms have built-in mechanisms to help with this, such as randomizers to change multiple choice ordering, random samplers for large question banks, and others. This is, of course, only useful after many hours have been invested in preparing the material required to utilize such tools.

[3] For example—and of particular interest to the author—how is(are) the scapegoat(s) chosen before each quiz?

[4] This is, of course, confined to a single class. In an infinitely repeated game, for instance where students A and B take every class together for the entirety of college, the Nash Equilibrium is for them to maintain their collusion for all classes in the long run (any noncooperation can be penalized in the next game).

A point raised previously is that the reward for the defecting student should be sufficiently worthwhile to induce a tip toward anonymous[5] noncooperation. Conversely, the prospect of the potential damage dealt to the grade of the colluding students left behind must be sufficiently menacing to entice them not to want being turned against by the defector, further incentivizing noncooperation. This problem faced by the students can be represented by a payoff function. Institutional regulations for faculty generally discourage taking severe measures for seemingly "lesser" violations of the student code of conduct or agreement of academic integrity (which, in turn, limits the instructor's options to exercise these severe game-ending measures like failing the student, or calling for their suspension or expulsion). Corner solutions to this problem involve those more serious violations of academic integrity, which, if resulting in permanent expulsion, end the game. Although an instructor can fail a student for cheating, those cases are nearly always appealed by the accused student to the university's committee for disciplinary actions on academic dishonesty and academic appeal. Additionally, many universities also have policies in place to discourage faculty as much as possible from doing anything that negatively affects student enrollment (Thomas 2017), commonly for the clear reasons of maintaining student headcount and tuition revenue (Guyette, King, and Piotrowski 2008).

3 Example and Solution

Consider a numeric example of the game and resulting relevant class policy applications to aid instructors in combatting cheating. Assume a two-student case (student A and B), which is easily generalized to a finite, arbitrary number of students. Next, let the incentive provided by the instructor be a 5-percent boost to the noncooperative student's final grade. Further, let the average value of student collusion (e.g., adopting the scapegoat method) be 7 percent of the students' final grade, but upon the instructor's correcting the problem, the cooperative students' grades drop by 10 percent. This is realistic to assume. It is without question that students who regularly engage in cheating end up with substantially less understanding of the course material, and, having lost this form of support, would therefore perform worse on assignments for which they did not study. Also assume that if, simultaneously, student A betrays student B, and B betrays A, then both their course grades get a 1-percent boost as an "honesty bonus." Finally, assume that, initially, either student is indifferent toward cheating, and the decisions are uniformly distributed with $P(collude) = P(defect) = 0.5$.

Proceeding from these assumptions, consider the game represented in the payoff matrix in Table 1. For either student, the expected payoff under collusion is:

$$V_{Collude} = (0.5) * (7) \ + \ (0.5) * (-10) \ = \ -1.5,$$

and the expected payoff for reporting the cheating to the instructor is :

$$V_{Defect} = (0.5) * (5) \ + \ (0.5) * (1) \ = \ 3.5.$$

Table 1. Example Game

		Student B	
		Collude	Defect
Student A	Collude	(7,7)	(−10,5)
	Defect	(5, −10)	(1,1)

Note: The numbers in parentheses denote (A's payoff, B's payoff)

[5] A guarantee of anonymity and protection of the defector should be provided in the course syllabus.

The expected payoff is highest for a student to defect by anonymously betraying their colluding classmate. Choosing to cheat lowers student A's course grade by 1.5 percentage points, while choosing to accept the instructor's offer raises the course grade by 3.5 percentage points. The Nash Equilibrium solution is for a student to defect and abandon the cheating strategy, given this incentive structure.

Consider, as an exercise, a hypothetical class utilizing an online system for assignments, quizzes, and exams that operates on a strict letter grade system (that is, no +/- grades). Suppose that there are two cheating students who actively collaborate (in some unspecified, general form of academic dishonesty) in this class, which has the proposed incentive structure in place. Let the students' grades both be 65 percent (that is, a "D") because of their collusion—without the ability to cheat at all, both their grades would suffer by 10 percent and be a "fail" at 55 percent (assuming they did not resolve themselves to begin studying the material). Both students would rather make a C (starting at 70 percent), but as a result of cheating rather than honest studying, neither has a C-level understanding of the course material. After it becomes clear that their grades are doomed to be so low or even lower, two thoughts occur: (1) the enticement of a 5-percentage point boost which, in this example, yields the desired letter grade; and (2) potential fear exists of being abandoned to a failing grade with the loss of the unspecified cheating mechanism. Then the standard outcome follows and at least one student defects—both for the hope of a better grade and the fear of failing the class in the event of betrayal.

4 Conclusions and Discussion

Online augmentation of college courses leads to increased risk of students cheating and looking for loopholes in the assignments to reduce the workload necessary for succeeding in a given course, though the degree to which this occurs remains uncertain (Etter, Cramer, and Finn 2006; Grijalva, Kerkvliet, and Nowell 2006; Stuber-McEwen, Wiseley, and Hoggatt 2009). However, the moral argument meant to persuade students that cheating is wrong appears to be an increasingly insufficient motivator for many students—graduate or undergraduate—to complete coursework ethically (Etter et al. 2006; Larkin and Mintu-Wimsatt 2015).

As a result, further examination of the growing problem is warranted—especially in an economic context. This study addressed the issue as an example of distorted incentives and proposed a solution developed using simple game theory. In particular, the solution is borne out by the well-known Prisoner's Dilemma game. The numeric example earlier provides a viable solution for instructors to combat cheating in such a way that students see their expected payoff as being considerably higher when they choose to perform according to the expectations laid out in a university-approved course syllabus. Additionally, the likelihood of any fallout against the instructor is small. A noncooperating cheater is not going to complain about the grade boost he or she receives for abandoning a cheating ring, and the cooperators whose grades suffer as a result of not acting first will not lodge a complaint to the department chair that the instructor took away their favorite method of cheating on assignments and exams. Any administrators concerned with maintaining enrollment should be amiably disposed to this type of solution as well.

The example solution proposed herein, if simple, is an analysis easily carried out, and the steady state Nash Equilibrium—that is, a student defecting—holds. However, doing so requires further considerations. For instance, a grade boost after midterms may be a more desirable incentive than one before midterms when a student's grade is uncertain and the student is less prone to anxiety about the effect on his or her GPA. A discounting term could account for this pre-post effect. Moreover, parameterizing a discounting factor in the analysis allows for the incentive to erode as the semester progresses (e.g., the grade boost is 5 percentage points if cooperation occurs before midterms, reduces to 2 percentage points if after; alternatively, a continuous discounting factor could be employed).

Further research should include classroom experiments closely resembling the numeric example given earlier. In the case of the author's teaching, such an experiment was recently underway. Indeed, many students openly acknowledged the general presence of cheating. In the Spring 2020 semester when this study was initiated, only a few of these appeared to harbor interest in defecting to receive the grade boost—likely waiting to see how their grades fared throughout the semester until midterm grades had posted. However, it was around the time of midterms when universities responded to the coronavirus pandemic by moving instruction to an online format. Institutions also switched to a pass-fail grading system as a concession to the students (Leingang 2020). Unsurprisingly, the students who expressed an interest in defecting—in the hope of moving a letter grade higher—ceased to show that interest, and hurriedly applied for a pass-fail grade conversion.

A limitation of using the Prisoner's Dilemma game is the reliance on preselected values of the parameters, which is unavoidable in the absence of any real classroom data. A follow-up study to the one herein could collect and analyze data from multiple courses adopting the proposed framework and determine whether and by how much cheating diminished. Moreover, values for some of the analysis' parameters could be better approximated with such data, chiefly the latent probability of the students' decision to cooperate or defect, and a subsequent Monte Carlo-type analysis could enrich both the understanding of the conditions affecting students' decision making and practical application in university teaching.

About the Authors: Jeffrey S. Young is an Assistant Professor in Agribusiness Economics in the Hutson School of Agriculture at Murray State University. (Corresponding Author: jyoung6@murraystate.edu).
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