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Letter from the Editor-in-Chief: Gaming the Classroom

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There are many ways to include active learning in our courses. One form is cooperative learning. There have been many studies about in-class and online collaboration of students (Burke, 2011; Jones & Jones, 2008; Saleh, 2011; and others in this journal). As recalled by Brame and Biel (2015), cooperative learning "is defined as the instructional use of small groups to promote students working together to maximize their own and each other's learning." (From Johnson, Johnson, & Holubec, 2008.) One day I was thinking about the value of collaborative projects and recalled the notion of cooperation in decision making in the form of game theory as shown in the 2001 movie, *A Beautiful Mind*, based on the 1998 book by Nasar. Can game theory be used in cooperative learning?

The simplest game theory example is the Prisoner's Dilemma which was proposed in the 50s to explain why two rational people might not cooperate, even if it seems in their best interests to do so (Kuhn, 2014). This scenario has become a common tool in police drama interrogations. Consider that two criminals have been arrested for a crime and are being interrogated separately. Each prisoner knows that if neither talks, the case against them is weak. As a result, they will be punished for lesser charges and each will get two years in prison. If both confess, each will get five years in prison. If only one confesses and testifies (squeals) against the other, the one who did not cooperate with the police will get 10 years in prison and the other one would go free. The payoff diagram is shown in Figure 1.

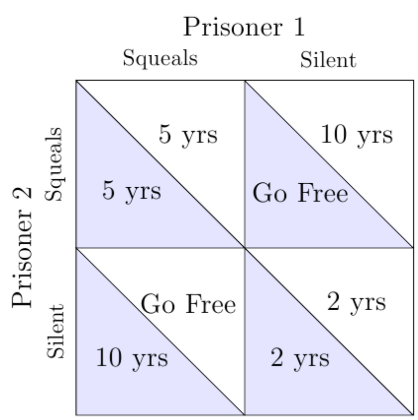

Figure 1. Typical payoff diagram for the Prisoner's Dilemma. Each prisoner has the choice to be silent or turn in the other prisoner. A region is the sentence for Prisoner 2.

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In the prisoner's dilemma there is an optimal solution for both prisoners. However, if each prisoner acts in what appears to them to be in their own self-interest, then they may end up getting a non-optimal sentence. This general two-person, two-move game can be applied to many other situations. As depicted in Table 1, there are two players (Row, Column) with two moves (Cooperate, Defect). For the Prisoner's Dilemma the move "silent" corresponds to cooperate and "squeals" corresponds to defects.

Table 1. A payoff matrix (table) similar to Figure 1.

	D	C
D	P, P	T, S
C	T, S	R, R

The goal is to find a strategy for each player. If the Column person (C) cooperates, then the Row person gets a reward (R) if he cooperates or a Temptation (T) if he defects. In the latter case the row gets the better deal. However, if the Column person defects, then the Row person gets punishment (P) if he defects or is otherwise a Sucker (S). In the first case the row gets the better deal. So, overall, the Row person should defect in either case to suit his self-interests. A similar argument can be made by the Column person. Thus, two rational players will both defect, resulting in punishment P. For the example in Figure 1, the prisoners each get two year (P,P in Table 1.) On the other hand, two irrational players might do better if T<P.

An example of using game theory in education is presented by Easley and Kleinberg (2010). Two equally good students are under pressure to complete a presentation. However, they both have to study for an exam. The exam and presentation are equally weighted. If they study for the exam, then they get a grade of 90. If not, then they are only prepared to get a 74. They know they can get an 80 on their partly completed presentation. However, if one person puts more works into it, they can raise their grade to a 90. If both work on it, they can perfect it and get a 100.

Assuming they cannot contact each other to figure out what the other student plans to do, they each need to decide whether to study for the exam or work on the presentation. The payoff, or average grades received for each player's decision are shown in Figure 2. For example, if they both work on the presentation, they each get a 100 on the presentation and a 74 on the exam. The average is an 87. However, if one works on the exam and the other adds to the presentation, the first gets a 90 and the other an 82. Just like the game in Table 1, the optimal path for each individual is to do the exam and forgo the presentation. However, if each person makes this decision, then the both get an 85 which is not the optimal grade.

There are other instances of using game theory in teaching. Lo, Nuryyev, Su, and Decosta (2015) applied game theory to the relationship between students' grades and their teaching evaluation of faculty. The choices of evaluating faculty high or low hinged on the student being satisfied with their grades. However, the discussion of game theory

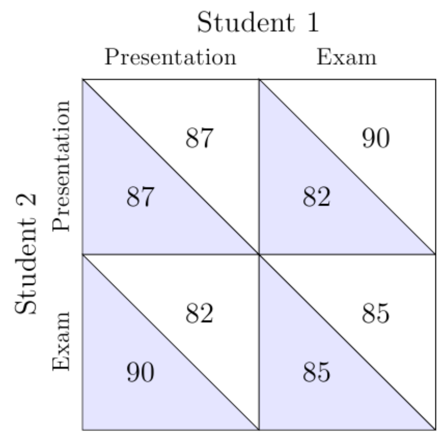

Figure 2. Payoff (grade) diagram for the student's study strategies: Each student either studies for the exam or works on the presentation. The shaded region is the resulting grade average for Student 2.

played a minor role in their overall study. Similarly, Pitt (2000) discussed applying game theory to group project assessment. In their paper the authors describe the ideas of game theory, but did not actually apply game theory. He discusses various strategies students might use indicating that the best strategies that promote teamwork in groups may disadvantage some students, affecting their assessment.

One group did a study on collaborative learning in online study groups (Chiong & Jovanovic, 2012). In observing in detail the motivations of students in online collaborative work, the authors found that in scenarios similar to the students in the above example, that the more active participants were encouraged to maximize their payoffs while the less active students remained inactive.

In 2013 a professor of behavioral ecology decided to put the game theory he was teaching into practice (Nonacs, 2013). Instead of giving a typical closed book exam in which the room remained quiet, he gave them the option to take the exam, consisting of one question, using anything they could find and even work in self-selected groups, keeping in mind that they needed to arrive at the answer as a group. Students would have to use a game-theoretic to arrive at a group result and accept the payoff as a group after collaborating on the exam. The author referred to this as cheating, though there was some structure that was described ahead of time. Overall, the averages were better, though there were a few individuals who preferred a lone wolf status and their grades were not better except in one case.

Applying game theory to collaborative learning is still in its infancy. This is probably because students are not comfortable thinking cooperatively and once the groups get larger, the payoffs are not better. Studies in game theory have come out recently indicating interesting results for the Iterated Prisoner's Dilemma (Hayes, 2013) in which the players repeat the game making decisions on the history of the decisions made by their opponents. This might be applicable to seniors who have repeatedly done collaborative learning, or made other decisions in their education process, and learned how to game the system. While using game theory might be appealing, there is still much to be learned as to how it works in practice in the classroom.

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