Simulation Use in the Undergraduate Classroom

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Abstract (79 words): The use of simulation exercises in undergraduate international relations courses is not new. Yet, many instructors faced with large classes full of students with little experience in the subject matter avoid this tool in favor of more traditional classroom techniques. This paper reports on the results following the introduction of a simulation exercise into a large, introductory undergraduate course in international relations in order to explore the validity of views that simulations are inappropriate tools for large undergraduate courses.

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The use of simulation exercises in undergraduate courses is nothing new. Yet, many instructors restrict the use of simulations techniques to advanced sections, smaller classes, or classes that have a narrow topical or geographic focus. Although simulations may be suitable for introductory level courses, that fact that these courses usually consist of large classes full of students with little prior experience in the subject matter turn many away from simulations in favor of more traditional classroom techniques. Smith and Boyer (1996, 690) argue that the "...simulation has been perceived in some teaching environments as diverting faculty and student attention away from the main goal: absorbing the lessons." Yet, given the potential benefits of simulation use in the classroom, the question that remains is whether negative perceptions about simulation use in large undergraduate classes are justified. This research project will consider whether it is both practical and worthwhile to introduce a simulation into a large, introductory undergraduate international relations course.

Literature Review

A review of the literature on the use of simulations highlights two potential impacts that simulations may have on students. First, simulations may impact student learning. Second, simulations may impact student motivation. On the topic of student learning, it is uncontroversial to argue that students process information differently. Yet, many introductory undergraduate courses retain the use of fixed teaching techniques. This creates a problem. On one hand, the combination of large class size and having students unfamiliar with the topic mandates the use of teaching techniques that allow for the rapid transfer of large quantities of basic material. On the other hand, the students in these introductory courses are often the ones who will experience the most difficulty adapting to the use of fixed teaching techniques. This is especially true if the course is taking early in a student's academic program. As Perry's (1970, 54-56) research on the stages of cognitive development highlights, as students' progress through college, they develop intellectually. As a result, freshman may experience more difficulty adjusting to the fixed learning styles found in many large undergraduate classes then students in their sophomore through senior years of college.

The most common solution to this problem is the incorporation of multiple approaches into undergraduate classroom instruction. While some view such concerns as the province of high school, the students in introductory classes often have many of the same characteristics as high school students. Expecting them to immediately adapt to a university environment may not be realistic, and undergraduate instructors should seek out opportunities to vary their teaching methods. "...[L]ecturing should never constitute the sole teaching technique in a course, or even perhaps the dominant one...the most effective teachers are those who use multiple approaches: lecturing, group discussion, problem-solving sessions, small-group work, and more" (Lang 2006, C1).

The argument that undergraduate students benefit from the use of multiple teaching methods in the classroom is consistent with research into how students learn. Kolb (1984, 30) proposes a learning model that argues that students learn best when they have access to concrete experiences, time for reflexive observation, time for abstract conceptualization, and the ability to conduct active experimentation. These are all components of active learning, and the ability to accomplish these tasks in the classroom is dependent on the use of multiple approaches. These concepts tie back to the previously mentioned research on student development. Perry (1970, 9-10) argues that how students approach knowledge, how students view their role in learning, and how students view the role of the instructor changes over time. Some students may be at different stages than others, but the role of the instructor is to design classroom instruction that appeals to all. Along these lines, Grow's (1996) Staged Self-Directed Learning (SSDL) Model which focuses attention on how much direction the student provides relative to the instructor in their own learning further supports this argument. Not all students in the classroom learn the same way, and not all operate at the same level of intellectual development. Both research on student learning and student development emphasize the importance of using multiple methods in the undergraduate classroom.

In an effort to promote active learning and experimentation in the classroom, it is a common practice for large introductory biology and chemistry courses to require students to complete laboratory exercises under the supervision of a teaching assistant. The use of teaching assistants is one way to provide students in large introductory classes with exposure to multiple teaching methods. Yet, while many introductory international relations courses also utilize teaching assistants, these classes tend not to incorporate similar laboratory type events. Shellman (2001, 827) argues that simulations can be considered the equivalent of the laboratory experiments found in the physical sciences. The use of simulations can provide concrete experiences to students that study of the social sciences often lacks.

Marchese (1998) adds to this argument by exploring the concepts of surface and deep learning. Unsurprisingly, he argues that the goal of classroom instruction should be the promotion of deep learning. The use of simulations represents an attempt to promote deep learning by incorporating non-traditional approaches into the undergraduate classroom. This can both address the need to accommodate multiple learning styles and challenging students while avoiding unproductive anxiety. Cruickshank and Telfer (1980, 77-78) argue that academic games provide a number of positive learning elements including approximating a real-world experience, providing opportunities to solve problems, providing responsive environments, and promoting psychological engagement. “Basically, research indicates that the use of simulations and games complements, not replaces, other methods of teaching and learning” (Cruickshank and Telfer 1980, 78). Research indicates that academic games can increase student learning, especially among students with “low academic ability.” These activities have a positive effect on student attitudes, interests, and satisfaction (Cruickshank and Telfer 1980, 78-79).

Lucas et al (1975, 261-262) compares student cognitive achievement and retention using simulation-gaming techniques and the lecture-discussion format. They review a number of examinations with contradictory results before concluding that students exposed to simulation-gaming techniques achieve similar levels of cognitive achievement and higher levels of cognitive retention than students exposed solely to discussion-lecture techniques (Lucas et al 1975, 266). Smith and Boyer (1996, 690) also argue that simulations enhance active learning by encouraging student participation, providing deeper levels of insight, assisting in information retention, promoting the development of critical thinking skills through collaboration, and development of speaking and presentation skills (Smith and Boyer 1996, 690-691). Although the use of simulations mandates that some course material cannot be covered, students understand what is covered better (Smith and Boyer 1996, 691). In addition, there is anecdotal evidence that simulations result in greater depths of understanding, higher levels of retention, stronger critical thinking and analytical skills, and greater enthusiasm for learning (Smith and Boyer 1996, 693-694). “Simulations are tools for understanding complex interactions. They can provide insights into why political actors make choices that seem unreasonable or irrational. Simulations uncover the real motivational forces intrinsic to players as they struggle with their choices” (Smith and Boyer 1996, 694).

So far, this review of the literature on the use of simulations in the classroom has explored potential linkages between simulations and student learning. Yet, simulations may also have an independent impact on student motivation. Since the issues of learning and motivation are often interlinked, considering the issue of motivation separately may be useful in order to demonstrate the potential ability of simulations to indirectly influence student learning through their influence on student motivation. Davis's (1993, 193-199) discussion of student motivation offers a number of ways that simulation exercises can potentially have a positive effect in motivation. First, simulations provide a way to provide students with immediate feedback about the success of strategies based on material discussed in class. Second, simulations can create a positive classroom atmosphere that promotes active participation and provides opportunities for student success. Third, simulations foster competition among students, but avoid the intense competition that can create stress harmful to learning.

Although the use of simulations may offer benefits to student learning and motivation, the use of simulations and games in the classroom does not come without costs. These costs make many instructors, especially those in large introductory classes, hesitant to incorporate simulation exercises into the classroom. Cruickshank and Telfer (1980, 77-78) point out a number of concerns about the use of simulations. First, simulations may require extensive time commitments by the instructor. These include time to plan, prepare, and process the results of simulations. Second, simulations often focus on supplemental experiences and not basic skills, which may not be appropriate for introductory students. Third, simulations are not always readily available, can be expensive, and are potentially confusing. This can be compounded if the instructor makes the decision to involve teaching assistants in the execution of the simulation. While such a move may reduce the instructor's time commitment, decentralized execution could also increase the potential for confusion. Finally, simulations can be noisy and poor simulation development can result in both failure and confusion in the classroom.

Although some instructors structure entire classes around interactive exercises, Smith and Boyer (1996, 690) point out that, "...even when teachers are sympathetic to an active learning approach, the use of simulation in the classroom is often hindered by a lack of available and applicable simulations on relevant topics. Simulation use is also impeded by a lack of good guidelines for developing effective simulations." The simulations that do exist for use in international relations tend to be specific to only one international situation and can be very labor intensive for the instructor. Simulations exercises are well represented in international relations, but the exercises that exist may not to be entirely appropriate for large, introductory classes.

One example of this point is found in Newmann and Twigg's (2000, 835) use of a simulation exercise on Kashmir in their introductory international relations course. The goal of the simulation was to provide variation in teaching techniques in order to facilitate active learning. The simulation provided students with first-hand experience with theoretical materials being covered in class. Yet, there are a number of problems associated with using this model in other introductory classes. First, implementation of the simulation required students to have specific information about Kashmir that other introductory international relations courses may not provide. In addition, the simulation required significant preparation, the instructor had to provide labor intensive role descriptions for each student, and the simulations itself required three to four class sections to execute (Newmann and Twigg 2000, 836-838). While the simulation was effective, it effectively illustrates a number of reasons why instructors are discouraged from using simulations in large introductory classes.

“The Geopolitical Chessboard”

Studies of the effects of simulations in the classroom indicate potential benefits for both student learning and student motivation. The question that remains is whether the costs associated with introducing a simulation can be overcome in order to achieve those benefits. In the case of a large, introductory class these potential problems are magnified. This research study will test whether it is possible to incorporate a simulation into several sections of a large introductory course in international relations. “The Geopolitical Chessboard” simulation used in the study was developed by Professor Dale C. Copeland at the University of Virginia. Dr. Copeland uses a version of this simulation in his classes. Permission to adapt the product for use in this research project was obtained from Dr. Copeland prior to the start of research. The description of the simulation that follows is based on Dr. Copeland’s work.

Teaching Goals[1]

The goal of “The Geopolitical Chessboard” simulation was to provide students with the opportunity to apply theoretical material about international relations to a simplified model of state interactions in an anarchic international system. The simulation reinforced the theoretical concepts covered in class by forcing students to consider the decisions they would make if they were the leader of a state. The class concepts applicable to the simulation included:

- State interactions under anarchy from realist and liberal perspectives
- Economic implications of realism and liberalism
- Role of ideas, identity, norms, culture, strategic beliefs
- Role of morality in international relations
- Impact of balances of power
- Influence of the structure of the international system
- Role of international institutions
- Influence of the democratic peace phenomenon
- Causes of internal conflict
- Influences of internal conflict on state behavior

- Influence of decision making on state foreign policy
- Role of individuals in development of state foreign policy
- Influence of development on state behavior

Simulation Construction

"The Geopolitical Chessboard" simulation was designed to be executed in a classroom with approximately 12-20 students. For most large introductory class, this means it will be executed by teaching assistants. The simulation requires approximately 10 minutes of class time before the first round to introduce students to the rules of the game. The orientation begins by dividing each class into four groups of between 3-5 students. The four groups correspond to four great powers. The names of these four great powers can be modified to any configuration desired by the instructor.[2] Within each group, each student is further assigned a role.[3] Sample roles include: prime minister, finance minister, foreign minister, and trade representative. There is no specific purpose for each role beyond ensuring that each student actively participates in the simulation. However, the roles provide the instructor with additional flexibility in the event they desire to interject additional scenarios into the simulation.

After assigning groups and roles, the orientation continues with the dissemination of "rules of the game." The goal of "The Geopolitical Chessboard" is for each group to maximize their states' security. Success at achieving this goal is measured by making relative comparisons of state power. Each state starts with 100 "units" of four different measures of power: machine capital (MC), labor capital (LC), resource capital (RC), and military capital (MLC). MC is a proxy for economic power, LC is one proxy for potential power (population size, etc), RC is a second proxy for potential power (land, raw materials, etc), and MLC is a proxy for military power. Measures of a state's machine and labor capital combine to determine each state's gross national product (GNP). GNP is a proxy for the "total" power of the state. Three different comparisons are relative to determining the “winner” of the simulation. The first compares relative economic power (REP). REP is a comparison of each states’ GNP with the sum of all states’ GNP. The second compares relative military power (RMP). RMP is a comparison of each state’s military power with the sum of all states’ military power. The final comparison computes each states’ estimated probability of survival (EPS). Each state’s EPS is determined by the average of that state’s relative economic power and relative military power.

Although these rules of the game tend to emphasize realist conceptions of state interactions under conditions of anarchy, the game incorporates a number of models that incorporate liberal arguments. For example, measures of potential power (labor capital) are heavily influenced by the domestic decisions made by each state. States that do not keep their population “happy” are subject to social stability penalties that retard economic growth. In addition, measures of “total” power are heavily influenced by a state’s trade policy. In this calculation, free trade provides a powerful trade multiplier to GNP. Finally, the simulation calculations are flexible enough that the instructor can make ad-hoc “corrections” to the simulation in order to emphasize whatever additional concepts they desire.

The final step in the orientation to “The Geopolitical Chessboard” is to provide an introduction to what will happen during each round of the game. This step is accomplished by handing out a sample game board and a sample decision matrix. The simulation “game board” is a simplified model of an international system (see figure one). It consists of one 8 ½ x 11 inch piece of paper. On the paper, there are four great powers and 24 additional territories. Each game board also contains notations about a state’s policies. These notations model a state’s intelligence collection efforts against its neighbors. The game board specifies state trade policy, foreign policy, and expansion / military policy. Of course, as in the real world, this intelligence analysis is not always accurate so that states do not have perfect information concerning other states in the system.[4]

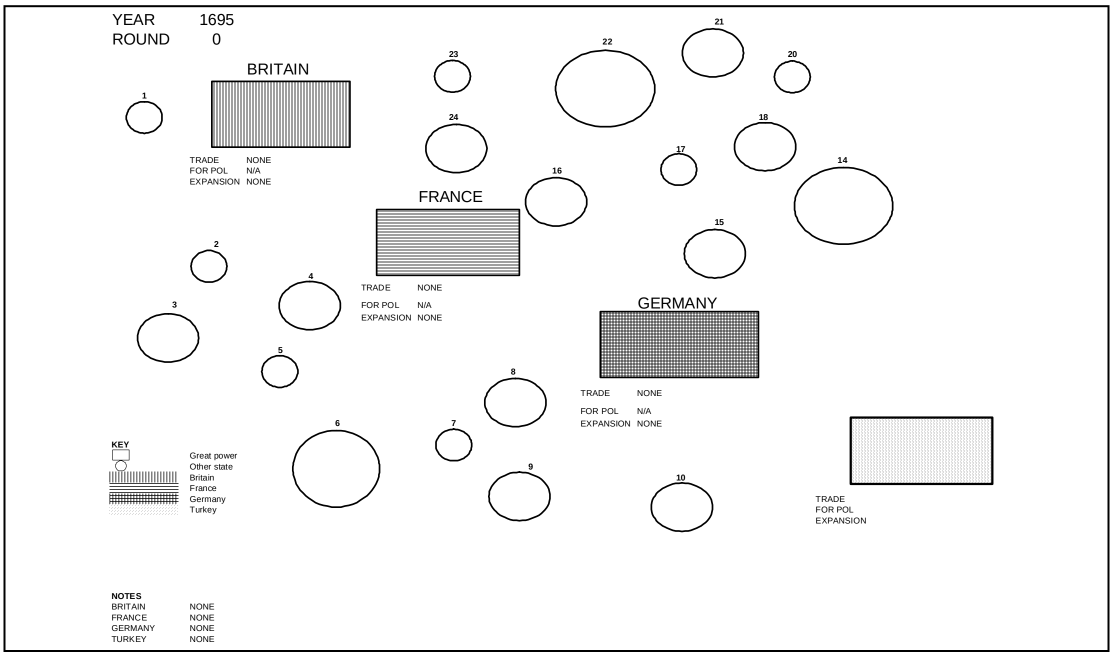

Figure 1 (Blank Game Board)

The simulation decision matrix is the product that each group must turn in at the end of the round (see figure two). All decisions made during the round must be recorded on the matrix. By listing all of the required decisions, the matrix also serves as a reminder to students about what they need to accomplish during each round. Each round, students make the following key decisions:

- % GNP to allocate to consumption
- % GNP to allocate to investment
- % GNP to allocate to military spending
- % of investment to allocate to agriculture

- % on investment to allocate to industry
- % military stationed at home
- % military stationed abroad
- Trade policy with each of the other states
- Foreign policy with each of the other states
- Military policy (including expansion if any)

The decision matrix is specifically designed with “white space” to accommodate student innovation. Each group can be as specific or as general as they desire. In order for a state to achieve its trade and foreign policies, all of the states involved must annotate the policy on their decision matrix. Failures of communication (i.e. diplomacy) are thereby incorporated into the simulation.

DATE: ______________________

HEAD OF STATE: __________________________

FOREIGN MINISTER: _______________________

FINANCE MINISTER: _______________________

TRADE REPRESENTATIVE: __________________

KEY DECISIONS

% GNP	
CONSUMPTION	
INVESTMENT	
MILITARY SPENDING	
TOTAL	100
INVESTMENT RATIO	
AGRICULTURE	
INDUSTRY	
TOTAL	100
MILITARY	
% AT HOME	
% ABROAD	
TOTAL	100
TRADE POLICY	
FRANCE	
BRITAIN	
GERMANY	
TURKEY	
FOREIGN POLICY	
FRANCE	
BRITAIN	
GERMANY	
TURKEY	
TERRITORIAL EXPANSION	

Figure 2 (Student Decision Matrix)

Although a 10 minute orientation is not an adequate time for students to fully understand the implications of these rules, the orientation includes circulation of written instructions. In addition, the student decision matrix is explicit enough that the first round can be executed with minimal preparation. Of course, real understanding of the rules of the game only comes after each group sees the impact of their decisions in the first round of the game. In addition, the simulation is designed to be somewhat underspecified since one of its primary purposes is to force students to apply class concepts to understand how states interact under anarchy.

Simulation Execution

"The Geopolitical Chessboard" simulation is executed by providing 10 minutes at the end of one class each week for students to interact. This execution is designed to accommodate large introductory courses that meet once each week in smaller sections taught by teaching assistants. To execute the simulation, the instructor hands out three products: the game board for the round, a student handout with information concerning the results of the last round, and a blank student decision matrix. No further explanation is required. Students analyze the information on the game board and handout on their own, interact among themselves, and make their decisions for the round. Each round concludes when class time runs out and each group submits their decision matrix.

After each round of the simulation, the instructor completes a number of actions to determine the round results and prepare for the next round. First, the instructor enters the decisions on each student decision matrix into a spreadsheet. The spreadsheet automatically calculates each states' power using preset formulas. Second, the instructor updates the game board with the information from the student decision matrices. Third, the instructor updates the calculations with several manual adjustments (social stability, trade, penalties) as desired. Finally, the instructor transfers information from the calculations spreadsheet to the student handout spreadsheet. Although the simulation is designed to be executed using Microsoft Excel, it is also possible to hand-write each round. At the conclusion of this process, the instructor prints the game board for the next round, the student handout with the results of the current round, and a blank student decision matrix for the final round.

Research Design

In order to measure the impact of "The Geopolitical Chessboard" simulation on student learning and motivation, this project evaluated the hypothesis that the introduction of a simulation into a large introductory international relations course was both logistically viable and beneficial for student learning. Following the research design used by Lucas et al (1975, 262) in their study on simulations, the study tested the null hypothesis that there was no difference between the control group (no simulation) and the research group (simulation). In this model, evidence to reject the null hypothesis would indicate that the simulation did have an impact on student learning.

The simulation was introduced into two sections of SS307: International Relations at the United States Military Academy during the Fall 2007 semester.[5] SS307 is a core course and is a mandatory graduation requirement for students at West Point. Students typically take the course during their third year at the university. For the study, both students and instructors were randomly assigned to their sections. Assessment of the impact of the simulation was conducted through both quantitative and qualitative means.

Quantitative Assessment

The quantitative assessment of the simulation consisted of comparisons of student performance on major graded events during the semester. This method of assessment enabled evaluation of student learning, but was not capable of measuring changes in student motivation as a result of the simulation. Given the small sample size of the research group (n=30), the comparison was conducted using a two-sample ttest for multiple graded events. The grades of students in sections using the simulation were compared to the grades of students in the remainder of the course. If the probability associated with the t values obtained from this comparison were statistically significant ($p < .05$), there would be evidence to reject the null hypothesis that there is no difference between the two groups (i.e. that the simulation does make a difference) (Hoyle, Harris, and Judd 2002, 467-472).

This research design met criteria for randomized experimentation because there was random assignment of both instructors and students to sections. However, there was not random assignment of sections to control and research groups. As a result, the research design opens the possibility of selection bias due to the fact that the instructor of the research group picked that group and did not teach any students in the control group. In order to manage that potential bias, an additional test was run comparing that instructor's student performance during the current semester to that instructor's student performance during the previous two semesters. This comparison of means enabled some control for selection bias. In addition, the limited time frame of the application of the independent variable (one semester) minimized the influence of a number of threats to internal validity. Specifically, it was reasonable to expect little influence of either maturation effects or history effects during the course of the experimental treatment. In addition, the fact that the course is a mandatory graduation requirement minimizes the danger of student withdrawal (mortality effects).[6]

Qualitative Assessment

The qualitative assessment of the impact of the simulation consisted of a combination of four elements. Unlike the quantitative assessment, which measured only student learning, the quantitative assessment measured both how effectively the simulation increased student learning of class concepts and how the simulation affected student motivation. The first measurement consisted of focused observations of each round of the simulation. Since the instructor did not actively participate during the round, there was time to actively observe each group's decision making and to compare those observations to the concepts covered in class.

The second measurement consisted of a "check on learning" conducted mid-way through the semester. This assessment tool consisted of students analyzing the decisions they made from the last iteration of the simulation. Each student was required to assess their actions from the viewpoint of the realist and liberal international relations traditions. This written product was turned in to the instructor and graded.

The third and forth measurements consisted of surveys distributed to students in the research group. One survey was administrated half-way through the research. The second survey was administered at the end of the semester. Each survey asked students to consider whether the simulation made class more interesting, whether the simulation increased understanding of class concepts, and whether the simulation facilitated practical examination of topics covered in class. Each survey also included a free- response question asking for additional comments about the simulation.

Results

Quantitative Assessment

Unsurprisingly, the results of the quantitative assessment did not provide any evidence to reject the null hypothesis that there was no difference between the control group (no simulation) and the research group (simulation). None of the comparison of means indicated a significant difference between the research and control groups. See annex A for a complete report of the results of the statistical tests. Since such an assessment would be the equivalent of concluding that the introduction of one 10 minute segment once a week was enough to make student grades significantly difference from the remainder of the class, that conclusion is unsurprising. Given the nature of the simulation, it is possible to argue that quantitative assessment alone is not an adequate means of measuring the impact of the experiment. First, the quantitative model is unable to measure simulation impacts on student motivation. Second, the model reduces student learning solely to test / paper performance. Given the topic, it is not clear that test performance alone should be considered the sole measure of the impact of the simulation.

Qualitative Assessment

Unlike the quantitative models used to measure the impact of the simulation, feedback from the qualitative measurements provided much greater support for the hypothesis that the simulation did positively influence student learning and motivation. The first measurement consisted of focused observations of each round of the simulation. Since the instructor did not actively participate during the round, there was time to actively observe each group's decision making and to compare those observations to the concepts covered in class. Observation clearly indicated that classroom concepts were influencing student decision making as they executed the simulation. Students evaluated other state's actions using topics discussed in class, and students weighed different theories as they made decisions each round. The most significant observation using this measurement technique was the significant impact of the simulation on student motivation. Throughout the semester, students clearly appreciated the "break" that even 10 minutes a week provided. They looked forward to executing the simulation, and they looked forward to seeing the results of each round. There were clear indications that using the simulation in class increased the interest of the majority of the students in learning about international relations.

The second measurement consisted of a "check on learning" conducted mid-way through the semester. This assessment tool consisted of students analyzing the decisions they made from the last iteration of the simulation. Each student was required to assess their actions from the viewpoint of the realist and liberal international relations traditions. This written product was turned in to the instructor and graded. This measurement technique provided a very positive assessment of the impact of the simulation on student learning. The average "grade" on the check on learning was 90.8% (A-). Of course, there are clearly problems associated with using such a subjective measurement to render conclusions about the impact of the simulation on student learning. However, when considered in conjunction with the other qualitative measurements, the check on learning does provide an interesting data point for comparison.

The third and forth measurements consisted of the results of surveys distributed to students in the research group. One survey was administrated half-way through the research. The second survey was administered at the end of the semester. Each survey asked students to consider whether the simulation made class more interesting, whether the simulation increased understanding of class concepts, and whether the simulation facilitated practical examination of topics covered in class. Each survey also included a free- response question asking for additional comments about the simulation. See figure three for a comparison of survey results.

Survey Question	Mid-Course Survey (Mean)	End of Course Survey (Mean)
1. The simulation makes studying international relations more interesting.	4.20	4.33
2. The simulation increased my understanding of class topics.	3.53	3.83
3. The simulation provided me with a practical way to look at class topics.	4.13	4.10

Number	Definition
5	Strongly Agree
4	Agree
3	Neutral
2	Disagree
1	Strongly Disagree

Figure 3 (Survey Results)

The first survey question (the simulation makes class more interesting) had the most positive results -- an observation consistent with the results of observation of the simulation. In the final survey, 26 of the 30 students in the research group strongly agreed (16) or agreed (10) with the statement. Only 2 students made neutral assessment and only 2 students disagreed that the simulation made class more interesting. In combination with the first measurement technique, the results of the two surveys indicate that the simulation did have a positive influence on student motivation during the semester. The free response survey question provided additional evidence of this point. Sample comments expressed by a number of students included feedback such as “nice break from class work” and “makes it fun.”

The second survey question (the simulation increased my understanding of class topics) provides more limited support. While the simulation clearly has a positive impact on student motivation, its impact on student learning is not as clear. Although the mean answer moved in a positive direction from the mid-course survey to the end of course survey, in the final survey only 19 of 30 students strongly agreed (9) or agreed (10) with the statement. Another 8 students were neutral, and 3 disagreed. These results are reflected in the free response survey question in comments such as "I just really don't get much out of it" and "many students did not play the game realistically." That said, there were a number of positive free response questions -- a clear indication that the simulation did have a positive influence on the learning of at least part of the class. This observation is of course consistent with the research on how students learn. In addition to its impact on student motivation and the linkages between motivation and learning, some students clearly benefited from the fact that the simulation was a different teaching technique that presented class topics in a different way.[7]

The third survey question (the simulation provided me with a practical way to look at class topics) provided an interesting comparison to the second question. Both the second and third questions were designed to measure the impact of the simulation on student learning. Yet, while the second question provided limited support, the third question did provide some support for the proposition that the simulation helped students learn about international relations. While students had neutral opinions of the statement that the simulation helped them understand class topics, they were much more willing to agree to the statement that the simulation provided practical examples of class topics. In the final survey, 24 of the 30 students in the research group strongly agreed (11) or agreed (13) with the statement. Only 4 students made neutral assessment and only 2 students disagreed that the simulation provided practical examples. While the mean assessment of this question declined from the mid-course to the end of course survey, the mean answer remained in the "agree" category. Again, this observation is consistent with the research on how students learn. In addition to its impact on student motivation and the linkages between motivation and learning, some students clearly benefited from the fact that the simulation was a different teaching technique that presented class topics in a different way.

Conclusion

While purely quantitative evaluations of the simulation indicated that it had no significant impact on student learning, these results must be measured against the shortcoming of purely quantitative assessment of teaching effectiveness. While test performance is a neat and easily measurable way to evaluate teaching, the debate goes on over whether it is the most appropriate way to evaluate teaching. Qualitative evaluation of the simulation clearly indicated that it had a positive influence on student motivation and provided some support for the proposition that the simulation also had a positive impact on student learning. While every student did not benefit from the simulation, it clearly did help at least a portion of the class by providing an alternate way to present class topics and by making class topics more concrete. Since one common measurement of effective teaching is the ability to use multiple teaching techniques in the classroom in order to reach the largest number of students -- there is evidence to argue that the simulation is a beneficial addition to the large introductory classroom.

The question that remains is whether these gains in motivation and learning outweigh the loss of class time associated with running the simulation and the significant preparation time placed on the instructor. This is a question that will remain highly dependent on the particular dynamics of individual classes and individual instructors. Figure 4 (below) illustrates two dynamics that are of particular interest in determining if a simulation should be implemented: instructor organization / time management and instructor motivation skills.

		Instructor Skill Motivating Students	
		High	**Low**
Instructor Organization And Time Management	**High**	Simulation practical; but not necessary	Best conditions for simulation (practical & necessary)
	Low	Worst conditions for simulation (not practical & not necessary)	Simulation beneficial; but not practical

Figure 4 (When to implement a simulation)

Instructors who are particularly organized or can make the time to prepare the simulation will experience fewer costs associated with its implementation. Instructors who experience difficulty in this area may find the logistics behind implementing a simulation too difficult to overcome. On the other hand, instructors who are highly skilled at motivating their students may not benefit from using a simulation, since their students already tend to be motivated, while instructors who experience difficulty in this areas may find simulations beneficial. It is the intersection of these two conditions that best illustrates the potential benefits of the use of simulations. Given the trend in many universities to tie performance on student evaluations to faculty assessment, trading the loss of preparation time for better student motivation may be in the best interests of some instructors. Yet, other instructors -- especially those who excel at motivating students -- may find the trade-off in preparation time less desirable. The decision on whether to implement a simulation will remain highly dependent on factors unique to individual instructors and classes

-- but the data suggests that there are a number of conditions in which the use of simulations in large introductory classrooms offer positive benefits for student learning and motivation.

Annex A (Quantitative Results)

MODEL #1 -- Comparison of research group (Fall 2007) to control group from the same semester on two exams, paper, final exam, and final grade indicated no significant difference of means. There was no evidence to reject the null hypothesis.

H_0 = No difference between control group (no simulation) and research group (simulation)

EXAM 1

Group	Obs	Mean	Std Err	Std Dev
No Simulation	344	158.4951	0.7832055	14.5263
Simulation	30	157.325	2.095601	11.47808

Ha: diff < 0

t	0.4294
P < t	0.6661

Ha: diff = 0

t	0.4294
P > |t|	0.6678

Ha: diff > 0

t	0.4294
P > t	0.3339

PAPER

Group	Obs	Mean	Std Err	Std Dev
No Simulation	344	161.186	1.191276	22.09489
Simulation	30	161.4333	4.718558	25.84461

Ha: diff < 0

t	-0.058
P < t	0.4769

Ha: diff = 0

t	-0.058
P > |t|	0.9538

Ha: diff > 0

t	-0.058
P > t	0.5231

EXAM 2

Group	Obs	Mean	Std Err	Std Dev
No Simulation	344	161.9578	0.8882636	16.47484
Simulation	30	166.6667	4.601745	25.20479

Ha: diff < 0

t	-1.4286
P < t	0.077

Ha: diff = 0

t	-1.4286
P > |t|	0.154

Ha: diff > 0

t	-1.4286
P > t	0.923

FINAL EXAM

Group	Obs	Mean	Std Err	Std Dev
No Simulation	344	161.9578	0.8882636	16.47484
Simulation	30	166.6667	4.601745	25.20479

Ha: diff < 0

t	-1.4286
P < t	0.077

Ha: diff = 0

t	-1.4286
P > |t|	0.154

Ha: diff > 0

t	-1.4286
P > t	0.923

FINAL GRADE IN COURSE

Group	Obs	Mean	Std Err	Std Dev
No Simulation	344	161.9578	0.8882636	16.47484
Simulation	30	166.6667	4.601745	25.20479

Ha: diff < 0

t	-1.4286
P < t	0.077

Ha: diff = 0

t	-1.4286
P > |t|	0.154

Ha: diff > 0

t	-1.4286
P > t	0.923

MODEL #2 -- Comparison of research group from Fall 2007 to control group consisting of students with the same instructor during the Fall 2006 and Spring 2007 semesters. Comparison of paper, final exam, and final grade indicated no significant difference of means. There was no evidence to reject the null hypothesis.[8]

H_0 = No difference between control group (no simulation) and research group (simulation)

PAPER

Group	Obs	Mean	Std Err	Std Dev
No Simulation	121	410.8760	3.8686	42.5542
Simulation	30	416.9667	11.0572	60.5631

Ha: diff < 0

t	-0.6407
P < t	0.2613

Ha: diff = 0

t	-0.6407
P > |t|	0.5227

Ha: diff > 0

t	-0.6407
P > t	0.7387

FINAL EXAM

Group	Obs	Mean	Std Err	Std Dev
No Simulation	121	406.1694	3.1191	34.3104
Simulation	30	415.5867	6.3399	34.7250

Ha: diff < 0

t	-1.3426
P < t	0.0907

Ha: diff = 0

t	-1.3426
P > |t|	0.1815

Ha: diff > 0

t	-1.3426
P > t	0.9093

FINAL GRADE IN COURSE

Group	Obs	Mean	Std Err	Std Dev
No Simulation	121	1649.0630	10.6996	117.6954
Simulation	30	1674.5120	25.5206	139.7812

Ha: diff < 0

t	-1.0202
P < t	0.1546

Ha: diff = 0

t	-1.0202
P > |t|	0.3093

Ha: diff > 0

t	-1.0202
P > t	0.8454

Notes

[1] The organization of this section (teaching goals, simulation construction, and simulation execution) is based on Smith and Boyer's (1996, 692-693) steps for planning simulations.

[2] For example, calling the great powers France, Britain, Turkey, and Germany creates a parallel with the great powers prior to World War I. This may (or may not) be something the instructor wants to control for during the simulation. States can be named in such a way to force students to "relive" a historical event or to avoid any parallel between history and the simulation. This decision is at the discretion of the instructor.

[3] Student roles are designed to be rotated throughout the exercise to assist in ensuring that all students actively participate in the simulation.

[4] This is a primary way that the instructor is able to shape the game during each round.

[5] The research group consisted of 2 sections (30 students). The control group consisted of 27 sections (344 students).

[6] Only one student in the research group withdrew from the course during the period of the experiment.

[7] Further examination of this point remains a question for future research. During this study, both surveys were anonymous. However, in the future cross-referencing positive comments about learning with individual student learning preferences (such as the Myers-Briggs Type Indicator) might provide a number of interesting observations about more specific impacts of the simulation on student learning.

[8] The two exams were excluded from comparison due to significant changes in the format and weighing of that requirement across semesters.

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