What Creates Engagement? An Analysis of Student Participation in ICONS Simulations

By

Andrew Blum
ICONS Project
University of Maryland
ablum@cidcm.umd.edu

Audrey Scherer
ICONS Project
University of Maryland
ascherer@cidcm.umd.edu

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Introduction

Role-play simulations have become an important pedagogical tool across most of the social science disciplines.[1] Simulations, as with most participatory educational strategies, rely on student engagement. The interdependence created by students interacting with each other in a simulation makes engagement particularly important. If a critical mass of students "check out" during a simulation, the simulation will fail. This paper reports on research designed to explore empirically what creates higher levels of engagement by university students in web-based simulations. The simulations used for the research are the ICONS Project International System Simulation and the ICONS Project European Security Simulation. Each of these simulations ran for three weeks in October-November, 2006.

The research reported on here should be considered exploratory and hypothesis-generating as opposed to hypothesis-testing. However, as an initial step, we identified several potential drivers of student engagement to be explored through the survey. These were:

1) Prior knowledge of and interest in the subject matter.
2) High level of commitment by the instructor.
3) Clear understanding by the participant of his/her roles and responsibilities in the simulation, as well as the process of the simulation.
4) Clear understanding of the pedagogical goals of the simulation.
5) Good relationships with team members in the simulation.
6) High degree of comfort with the technology.

The survey, which is included in this paper as an appendix, was designed to illuminate whether these factors are important in creating engagement. The results of the survey are presented below. The results are then analyzed with the goal of providing suggestions to instructors regarding how simulation exercises should be structured within a course in order to create a higher level of engagement by students.

The Simulations

During fall 2006, the ICONS Project conducted two university-level distributed simulations: International System and European Security. The International System simulation ran from October 23, 2006 through November 13, 2006. This simulation engaged sixteen teams from thirteen universities in negotiations around key issues facing the international community, including terrorism, public health and environmental policy. Each team of students represented a country within the simulation and communicated

[1] Role-play simulations refer to simulations in which multiple students interact with each other while individually or collectively playing a role, e.g. Model United Nations. These can be distinguished from simulations in which students are interacting with a software program that provides a set of consequences for each decision the student makes, e.g. SimCity. Role-play simulations can be conducted in a face-to-face environment or on-line. Hereafter, the term simulation refers to role-play simulation.

with other country teams by sending messages in an online messaging system and participating in nine scheduled online conferences.[2]

The European Security simulation was held from October 30, 2006 through November 20, 2006. Nine teams from four universities participated in this simulation which focused on negotiations over human, economic, and military security issues affecting European Union member states. As in the International System simulation, participant teams represented individual states and communicated through an online messaging system. The European Security simulation also included six scheduled online conferences.

The Survey Process

In total, 480 students participated in the International System and European Security simulations. The ICONS Project simulations, because they are run using an on-line, web-based system, are able to record various indicators of participation. After the simulations concluded, the simulation records were examined to identify a group of highly-participatory students and a group of less-participatory students. For the purposes of this research, we considered participation to be equivalent to engagement.

There are two primary modes of communication in an ICONS simulation. The first is a message in the general simulation; the second is a comment in the real-time conferences that are a part of the simulation. These two modes of communication are roughly analogous to email and to instant messaging respectively. We gave each student a score in which they received one point for a message and one-half point for a comment. We then defined the high participation group as the top-third of students and the low participation group students as the bottom-third based on these scores. The high participation group consisted of 158 total students;[3] the low participation group consisted of 160 total students. We also split the middle-third into two groups. [4]

The survey was implemented using SurveyMonkey (www.surveymonkey.com). Within SurveyMonkey, we created four different surveys with the exact same questions. Each survey was accessed using a unique log-in number. We then emailed different log-in numbers to each of the four groups of students. By structuring the survey process in this way, the surveys were able to be taken anonymously - students did not have to enter any personal information into the survey. They also did not know they were part of a highly-participatory or less-participatory group. And unless they happened to compare their survey number with a classmate, they would not have known the students were divided into groups at all.

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[2] ICONS simulations are run on a dedicated messaging system known as ICONSnet. This system supports both a messaging system which is similar to email and an on-line conferencing system in which all simulation participants are communicating on-line at the same time.

[3] The number of students in each group did not come to exactly one-third due to ties in the students' participation scores.

[4] We divided the middle group into two separate groups so we could use data from this middle group if the response from the high and low participation groups was insufficient. Since response from high and low groups was strong, we did not using the data from the middle groups.

Survey Response

Survey log-in information was sent to a total of 480 students. Of these 158 were in the high participation group, 160 students were in the low participation group. In the high participation group, 88 of 158 students completed surveys (56%). In the low participation group, 68 of 160 students completed surveys (43%). We considered a survey completed and used the data if a student answered more than half of the questions.

Given our concern about getting a sufficient response to the survey request, we were surprised by what we considered was very high rate of response to the survey. The survey was short and easy to fill out, and while this likely contributed to the high response rate, overall it is not clear what created the high level of response from the students.

Data Analysis

The data from the 88 surveys in the high participation group and the 68 surveys in the low participation group was then analyzed. For each question a comparison of means test was conducted to ascertain whether a statistically significant difference ($P < .05$) existed between the responses of the two groups.[5] For the questions in which there was a statistically significant difference, the means for each group were compared to ensure the difference was in the expected direction.[6]

From this analysis, several tentative conclusions can be reached. In this section, results from the questions will be summarized and analyzed. Full information on the questions in the survey and which questions had statistically significant differences in the responses from the high participation group and the low participation group is in the Appendix.

The Course and the Instructor: The overall impression of the course in which the simulation took place and the instructor matter to participation levels. Students who thought more highly of the class and the instructor were more likely to have higher levels of participation in the simulation.

In addition, students were asked whether or not the course was in their major as well as how interested they were in the subject matter of the course. Both were important. If the course was in their major, students were more likely to have higher levels of participation. Higher levels of interest in the subject matter of the course also had a significant relationship with higher levels of participation in the simulation.

Students were asked what their grade was in the course prior to the simulation. Students who had higher grades were more likely to have higher levels of participation in the simulation.

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[5] The full data set is available from the authors upon request.

[6] There was only one unexpected result regarding the direction of the difference in means. It was expected that students who were required to turn in an assignment after the simulation would participate more. In fact, they participated less. This will be discussed further below.

Analysis: This set of results is unsurprising. It is predictable that good students, with good instructors, in good courses that students find interesting, would show higher levels of participation in the simulations. Nonetheless, it is important to confirm that these factors matter as expected. What this means is that broader strategies designed to improve courses, improve student performance, and improve instruction, will also have a positive impact on simulations.

The finding regarding student majors is related to the finding regarding the level of student interest in the subject matter as students are more likely to be interested in the subject matter if a course is in their major. This indicates that instructors should pay some attention to the majors of the students in the course. It may be worthwhile, for instance, to pair majors with non-majors either within teams in the simulation or as part of the preparatory process.

Such mixing of students can have two beneficial effects. First, in our experience with the simulations, students who are engaged are often, but not always, able to self-police a team in ways that elicit participation from other students. Also, such mixing ensures that the team as a whole does not "check out". A non-participatory team, especially a team that is important to the overall simulation, can do damage to the simulation as a whole. Of course, such mixing can also frustrate the more engaged students.

Relationship of the Simulation to Course: Students were asked how much time their instructor devoted to discussing the simulation as well as how important they believed the instructor considered the simulation. Neither of these factors had a significant relationship to participation levels. However, the relevance of the simulation subject material to the subject matter in the rest of the course was important. Students who considered the subject matter of the simulation relevant were more likely to have higher levels of participation.

Students were asked whether they were graded on their participation in the simulation. They were also asked whether they had to turn in an assignment before the simulation and whether they had to turn in an assignment after the simulation.

Surprisingly, there was no significant difference between the two groups on the question of grading. Being required to complete an assignment prior to the simulation did not have a significant relationship to participation levels, nor did the overall amount of time students spent preparing for the simulation.

Completing an assignment after the simulation did have a significant relationship to participation levels, but in what was for us, a counter-intuitive direction. Students that were required to complete an assignment after the simulation were more likely to have lower levels of participation.

Analysis: This is an interesting and somewhat surprising set of results. Perhaps the most surprising finding is that giving a student a grade based on his/her participation did not

appear to have an impact on levels of participation. We went back to double-check the data to ensure that this finding was not caused by very few students reporting that they were graded for participation. This was not the case. In both groups, more than three times as many students received grades as did not receive grades. It is difficult to explain this finding, as grades are often thought to be a fundamental incentive for students. In future surveys, we plan to explore this further by asking additional questions about grading procedures. At the least, this finding indicates that providing a grade does not guarantee a high degree of participation by students.

Our expectation was that discussion of the simulation and giving assignments and/or preparatory work to students would increase participation. Assignments, as well as the overall demeanor of the instructor, signal the importance of the simulation to the overall class. It was expected as well that time spent preparing for the simulation would create a stake in the simulation for the students, as well as increase the confidence of the students, thereby increasing participation. These expectations were not borne out.

According to the data, what is more important than assignments or generic preparation time, is the integration of the subject matter of the simulation into the rest of the course. The key factor appears to be whether the simulation "makes sense" as part of the course or not.

Subject Matter of Simulation: Students were asked how much they knew about the subject matter of the simulation prior to the simulation, as well as how interesting they considered the subject matter of the simulation. Both were important. Students who knew a more about the subject and students who considered the subject matter more interesting were more likely to have higher levels of participation.

Analysis: These are unsurprising results. Students who know more about the subject matter may feel more confident about participating. They also may know more about the subject matter because they find it interesting. And it is unsurprising that students will participate more in a simulation that they find interesting. One implication is that instructors may want to ascertain the level of knowledge about the simulation subject matter. If it is low, instructors may want to devote some time to teaching the subject matter prior to the simulation. A second implication for instructors is that they may want to identify several possible simulations and allow student input into which simulation is chosen.

Previous Participation in Simulations: Students were asked whether they had participated in simulations before in their other classes. They were also asked whether they had participated in ICONS simulations before. Previous participation in a simulation was important. The students who had participated in simulations before were more likely to have higher levels of participation in the simulation. Not enough students had participated in ICONS simulations previously to make the responses to the second question meaningful.

Analysis: This result indicates that a certain degree of comfort with simulations is important in fostering participation. Students who have no experience with simulations, or what it means to play a role, may for instance be scared to participate for fear that they will make a mistake or "do it wrong". To counteract this, instructors who are devoting time to a large simulation, such as the ICONS simulations, may also want to do a smaller less-complex simulation near the beginning of the course. Alternatively, students who have not participated in simulations could be paired with students who have participated in simulations as part of the preparation process or during the simulation.

Simulation Goals and Process: Students were asked whether they were clear on what was expected of them during the simulation and whether the process and procedures of the simulation were clear. Students who were clear on expectations, processes, and procedures were more likely to have higher levels of participation. However, whether or not students were clear on the educational goals of the simulation had no significant relationship to participation.

Analysis: In our experience in both educational and training settings, being clear on the process and procedures of a simulation is extremely important. Frustration at not knowing what is going on in the simulation, what one should be doing, or what's coming next is a very common reason for students to "check-out" of an exercise. This result confirms the importance of a clear description of process and procedures. It has also been our experience that explaining the process and procedures of a simulation should be done in multiple ways. Some students need to hear it, some students want a reference sheet, some students like to have it on the computer as part of the simulation itself.

It is somewhat surprising that being clear on the educational goals of a simulation did not have a similar relationship to participation levels. This is a topic that deserves further scrutiny.

Technology: Students were asked whether they were comfortable with the technology used in the simulation. Comfort level with the ICONS technology had no significant relationship to participation in the simulation. They were also asked whether in general educational technologies such as Blackboard, blogs, and class webpages should be integrated more into classes. How students felt about these technologies did not have a significant relationship to participation.

Analysis: The relationship between students and technology is very complicated and needs to be explored further. Our guess, however, is that students in general are comfortable with various forms of technology in the classroom, including class webpages, Blackboard, list-serves and so on. As a result, the web-based, on-line aspect of an ICONS simulation does not filter the students into groups that are comfortable with technology and those that aren't. Instead, we would guess that virtually all the students are comfortable with the level of technology within the ICONS simulations, which is at the same level as email and instant messaging. This would explain why technological issues do not have a significant impact on participation.

Simulation Teams: In most ICONS simulations, students participate as part of a team. Therefore, students were asked whether they enjoyed team-based projects and how their ICONS simulation team performed. Neither the students' feelings about team-based projects, nor the performance of their team, nor whether or not their team got along with each had a significant relationship to participation.

Analysis: One implication of these results is that instructors should not be overly concerned about how their students feel about team-based projects. Nor should instructors be overly concerned about positive or negative dynamics within teams. According to these data, frustration with teammates doesn't cause students to "check-out" in the same way that, for instance, frustration caused by being unclear about the simulation process does.

In the simulations used here, students could participate as individuals on behalf of their team. The survey may have produced different results if the simulations were structured in a way in which the team could only send messages after a consensus was reached among the team, which would create higher levels of interdependence among the team members.

Conclusion

As noted above, the goal of the research was to identify some of the factors that create higher levels of engagement among university students in web-based simulations. The basic purpose of the research is to provide insights regarding how the simulation exercise can be structured so as to encourage a high degree of participation. The analysis sections above identified steps instructors could take, as well as steps that seem intuitive, but might not be effective, such as grading the students on their participation.

This survey should be considered an initial and primarily exploratory effort. Moreover, a key goal of the process was to examine whether the process itself was a viable way to gather information from university students. The process, particularly the response rate for the surveys, succeeded beyond our expectations. As a result, we will continue to conduct similar surveys in the future.

In addition to continuing to explore some of the surprising results from this survey, there are several additional areas to be explored. We feel the most important in the short-run is to explore the impact of learning styles on engagement in the simulation. The next set of surveys, therefore, will include questions designed to illuminate the impact of learning styles.[7]

It is our belief that simulations will continue to play an important pedagogical role within the social sciences. Simply put, simulations fail if students do not participate. Thus, it is important to investigate what factors create this participation and what this tells us about how simulation exercises should be structured.

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[7] Such questionnaires already exist and could be used as part of an ICONS survey. For an example, see: http://www.engr.ncsu.edu/learningstyles/ilsweb.html.

Appendix 1: Survey Questionnaire with Results

1. If you wish to continue, please click "YES". If you do not wish to participate in the research, click "NO", and then Exit in the top right corner of the screen. YES NO	
Question was asked to indicate individual's consent to participate in the research.	

2. What is your overall impression of the class in which you participated in the ICONS simulation? 1 - Not a Good Course 2 3 4 5 - A Good Course	
Statistically significant difference between high participation group and low participation group ($p<.05$)? **YES**	Direction of statistically significant difference: **High participation group had better overall impression of course.**

3. Overall, how would you rate your instructor in the class? 1 - Not a Good Instructor 2 3 4 5 - A Good Instructor	
Statistically significant difference between high participation group and low participation group ($p<.05$)? **YES**	Direction of statistically significant difference: **High participation group rated instructor higher.**

4. Prior to the simulation, (roughly) what was your grade in the class? A A/B B B/C C C/D D F	
Statistically significant difference between high participation group and low participation group ($p<.05$)? **YES**	Direction of statistically significant difference: **High participation group had higher grades prior to the simulation.**

5. Did you have to turn in an assignment prior to the simulation as part of the preparation for the simulation? Yes No	
Statistically significant difference between high participation group and low participation group ($p<.05$)? **NO**	Direction of statistically significant difference: **n/a**

6. Did you receive a grade based on your participation in the simulation? Yes No	
Statistically significant difference between high participation group and low participation group ($p<.05$)? **NO**	Direction of statistically significant difference: **n/a**

7. Did you have to turn in an assignment about the simulation after the simulation was finished? Yes No	
Statistically significant difference between high participation group and low participation group ($p<.05$)? **YES**	Direction of statistically significant difference: **High participation group was more likely to not have a post-simulation assignment.**[8]

8. How many hours did your instructor devote to discussing the simulation? less than 1 1 - 2 2 - 3 3 - 4 4 - 5 5 or more	
Statistically significant difference between high participation group and low participation group ($p<.05$)? **NO**	Direction of statistically significant difference: **n/a**

[8] This is the one question is which the direction of the difference was surprising.

9. How relevant was the subject matter of the simulation to the rest of the course? 1 - Not Relevant 2 3 4 5 - Very Relevant	
Statistically significant difference between high participation group and low participation group ($p<.05$)? **YES**	Direction of statistically significant difference: **High participation group considered subject matter more relevant.**

10. To the best of your knowledge, how important did your instructor consider the simulation to be within the course? 1 - Not Important 2 3 4 5 - Very Important	
Statistically significant difference between high participation group and low participation group ($p<.05$)? **NO**	Direction of statistically significant difference: **n/a**

11. Is the class in your major? Yes No	
Statistically significant difference between high participation group and low participation group ($p<.05$)? **YES**	Direction of statistically significant difference: **High participation group was more likely to answer yes the class was in their major.**

12. How would you rate your interest in the subject matter of the class? 1 - Not Interested 2 3 4 5 - Very Interested	
Statistically significant difference between high participation group and low participation group ($p<.05$)? **YES**	Direction of statistically significant difference: **High participation group was more interested in the subject matter of the class.**

13. How many hours did you spend directly preparing for the simulation? (drafting opening statements, researching positions, etc.) less than 5 5-10 10-15 15-20 more than 20	
Statistically significant difference between high participation group and low participation group ($p<.05$)? **NO**	Direction of statistically significant difference: **n/a**

14. Have you participated in simulations in any of your classes prior to this? (either face-to-face or online) Yes No	
Statistically significant difference between high participation group and low participation group ($p<.05$)? **YES**	Direction of statistically significant difference: **High participation group was more likely to have participated in simulations.**

15. Have you participated in an ICONS simulation before? Yes No	
Statistically significant difference between high participation group and low participation group ($p<.05$)? **NO**	Direction of statistically significant difference: **n/a**

16. Were you clear on what was expected of you during the simulation? 1 - Not Clear 2 3 4 5 - Very Clear	
Statistically significant difference between high participation group and low participation group ($p<.05$)? **YES**	Direction of statistically significant difference: **High participation group was more clear on what was expected of them.**

17. Were you clear on the process and the procedures for how the simulation would be run? 1 - Not Clear 2 3 4 5 - Very Clear	
Statistically significant difference between high participation group and low participation group ($p<.05$)? **YES**	Direction of statistically significant difference: **High participation group was more clear on the process and procedures of the simulation.**

18. Were you clear on what the educational goals of the simulation were? 1 - Not Clear 2 3 4 5 - Very Clear	
Statistically significant difference between high participation group and low participation group ($p<.05$)? **NO**	Direction of statistically significant difference: **n/a**

19. Were you comfortable with the technology used for the simulation? 1 - Not Comfortable 2 3 4 5 - Very Comfortable	
Statistically significant difference between high participation group and low participation group ($p<.05$)? **NO**	Direction of statistically significant difference: **n/a**

20. How much did you know about the subject matter of the simulation prior to the beginning of the simulation? 1 - Didn't Know Much 2 3 4 5 - Knew A Lot	
Statistically significant difference between high participation group and low participation group ($p<.05$)? **YES**	Direction of statistically significant difference: **High participation group knew more about the subject matter prior to the simulation.**

21. Was the subject matter of the simulation interesting? 1 - Not Interesting 2 3 4 5 - Very Interesting	
Statistically significant difference between high participation group and low participation group ($p<.05$)? **YES**	Direction of statistically significant difference: **High participation group found the subject matter of the simulation more interesting.**

22. What do you think of the following statement? "Classes should integrate more web-based technologies, such as Blackboard, Blogs, Class Webpages, etc." 1 - Strongly Disagree 2 3 4 5 - Strongly Agree	
Statistically significant difference between high participation group and low participation group ($p<.05$)? **NO**	Direction of statistically significant difference: **n/a**

23. Did you participate in the simulation as part of a team? Yes No	
Question was asked to determine whether or not individuals answered questions 24-26.	

24. In general, how do you feel about working on team-based projects? 1 - Dislike It 2 3 4 5 - Like It	
Statistically significant difference between high participation group and low participation group ($p<.05$)? **NO**	Direction of statistically significant difference: **n/a**

25. For this particular simulation, how well did the team members get along? 1 - Not Well 2 3 4 5 - Well	
Statistically significant difference between high participation group and low participation group ($p<.05$)? **NO**	Direction of statistically significant difference: **n/a**

26. How would you rate the overall performance of your team in this simulation? 1 - Not Good 2 3 4 5 - Good	
Statistically significant difference between high participation group and low participation group ($p<.05$)? **NO**	Direction of statistically significant difference: **n/a**