Survivor: A Method for Active Learning in the Classroom that Addresses Student Motivation

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Phil Wankat (1) succinctly states the importance of active learning in the classroom: "Involved students learn!" As a result of the dissemination of the overwhelming evidence supporting active learning, more engineering faculty (including presumably almost all of those who would choose to read this paper) are utilizing active learning in their classrooms. While the benefits of active learning are clear, simply breaking students into small groups to work on problems during class does not automatically address the pervading issue of student motivation. Biggs and Moore (2) classify four primary types of motivation:

1. Intrinsic – learning because of natural curiosity or interest in the activity itself
2. Social – learning to please the professor or their peers
3. Achievement – learning to enhance your position relative to others
4. Instrumental – learning to gain rewards beyond the activity itself (better grades, increased likelihood of getting a high paying job etc.)

As such, an active learning activity that addressed all four of these motivational categories would be useful. Unfortunately, Professors tend to assume that students are motivated by the same things that motivate them. The problem is analogous to the issues with learning styles in engineering education. Professors tend to teach they way that they prefer to learn, which negatively impacts the learning of students with different preferences (3-5). Not all of our

students are inherently thrilled with solving energy balances, even when working in groups with their peers.

Ten years ago when I was teaching my first class, the sophomore-level materials and energy balances course, I was fortunate enough to have dinner with Rich Felder and to talk about pedagogy and learning styles. The next day, I broke my students into small groups and instead of my lecturing on the problem, they solved it in small groups. I was happier. Most of the students were happier and learning more, but too many of the students never really engaged in the activity. Assigning roles for team members helped, but did not fix the problem. The student evaluations were very positive, but the students who did not engage during the active learning exercises were disproportionately represented in the group that did not make it to their junior year. The challenge was to find an activity that would engage the entire class in the group problem solving.

Wankat and Oreovicz (6) proposed using quiz shows such as Jeopardy or Trivial Pursuit as an active learning alternative to lecture, but these games lend themselves better to knowledge-based questions instead of problem solving. I have used Hollywood Squares (7) in a Materials Science class for such questions, but this also did not seem appropriate for a materials and energy balances class. Susan and James Fenton (8) at the University of Connecticut developed a very effective "Green Square Manufacturing" game that came closer to meeting the needs of the class, but did not necessarily address all four motivational factors, nor did it have the pop culture tie-in that I wanted. Finally, the idea of adapting a version of the CBS "reality" game show "Survivor" came to me. With a little preparation, a game that met my needs was developed.

The Game

Students in the materials and energy balances class are broken into "tribes" consisting of 7-8 people per tribe. At Rowan, this results in three tribes, but the number of tribes does not substantially alter the flow of the game. The tribes set together much as they would in any group problem solving exercise. If inadequate space is available, the tribes may self-segregate into smaller subgroups. Each tribe must provide a name for itself. If the fail to do so, I provide one. Usually, I name the first team without a name "the delicate buttercups" and the rest seem to have a name ready by the time I get to them.

The team members are permitted to have their textbook, notes, a calculator, pencil and paper with them, but the book and notes must be closed to start. I write a problem on the board, but they must not look up any values or begin writing until I say begin. Once they begin solving, the first tribe to have an answer to the problem has a member raise his or her hand. The other teams stop and the first team reveals their answer. If they are correct, their tribe has immunity and they do not lose a member. If their answer is wrong, they cannot win immunity and the remaining tribes continue with the problem until one tribe successfully solves the problem or all but one tribe has provided an incorrect answer. To avoid issues of round off or interpolation, I accept any answer within 5% of my answer.

At the end of the first problem, one tribe has earned immunity and every other tribe must lose one member. The method for elimination that seems to work the best is:

1. In the first round, each tribe member votes a member of their own tribe off the team
2. In the second round, the tribe with immunity votes a member off of each of the other tribes.

3. In the third round, one member of each tribe is eliminated randomly by drawing a name. If there are more than three rounds, the list is repeated in order. In the television show, the tribe members always vote a person off their own tribe. Initially, I was reluctant to let them vote at all. I worried that feelings would get hurt and the students who needed the reinforced problem solving the most would be eliminated quickly. The students, however, were unambiguous. They wanted to vote.

As it turns out, the alternating system described above cures many woes. On almost every tribe, there is one player who wants to leave the game (for a variety of reasons). This person is almost always voted off first. Absent students are also assigned to a tribe and they are also voted off quickly. When the victorious tribe votes a member off of another tribe, they uniformly take out the strongest students. The random round is, of course, random. Ultimately, the average students who have enough skills to solve the problems but genuinely benefit from reinforcing the concepts survive the longest.

The students who have been eliminated in any round are given the task of designing and solving a problem to be used in later rounds. Thus, while they are no longer participating in the main activity, they remain actively engaged in team oriented problem solving.

In a typical 75-minute class, there is enough time to get through about six rounds of the game. Speeding up the elimination process would allow for more rounds, but the students seem to thoroughly enjoy that aspect of the game. At the end of the first class, the tribes are dissolved and all of the players who have not been eliminated become part of a single tribe.

The second day of the game involves solving the problems as individuals, but otherwise the flow is the same. A problem is placed on the board, the first person done either receives immunity or fails to solve the problem and the round continues. Players are eliminated by vote

of the tribe in the first round, choice of the player with immunity in the second, and by random draw in the third. The cycle repeats until a single player remains and is crowned as the survivor champion. Groups of eliminated players develop and solve the problems used throughout this round.

The successful students are reward with bonus points on the 200-point final exam. Every player that survives to the second day gets 3 points, every original member of the champions tribe gets 2 points, and the champion gets an additional five. The bonuses are additive, so the champion will wind up with 10 points (5%), while everyone else will get between 0 and 5 points. In three years of playing the game, the bonus points have never altered the final grade in the course of the grand champion, but students will battle ferociously for them all the same.

Sample Questions

1. One mole of a mixture containing 20% ethanol and 80% water at 20°C and one atmosphere is to be cooled to 4°C. How much heat must be removed from the system?
2. Given the following chemical reaction

   Dahmene (g) + 20 IQ (g) → Newellium (g)

   What is the heat of combustion for gaseous Dahmene if the heats of combustion for Newellium and IQ are –4130 kj/mol and –246 kj/mol, respectively?

Student Feedback

On the course evaluations at the end of each semester, the students were specifically asked the question, "Was Survivor helpful in developing an understanding of the subject

matter?". On a five point Likert scale with 5 representing extremely helpful and 1 representing not helpful, the mean responses to that question were 4.70 in 2001, 4.77 in 2002, and 4.80 in 2003. Specific student comments have included:

- The game made the course interesting
- Playing the game helped to stimulate thinking
- Game was fun for a change
- Creating our own problems was especially helpful

Summary

The game show Survivor has been adapted and used for three years as a means of introducing active, team-oriented problem solving into a sophomore-level course on energy balances. The game provides incentive for students from all four motivational forms (intrinsic, social, achievement, and instrumental). By having students who have been eliminated continue to participate through developing new problems that are used in the game, the entire class remains engaged throughout the activity. The game has provided an effective method of reinforcing problem-solving methodologies and has been extremely popular with the students.

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Biographical Information

Jim Newell is an Associate Professor of Chemical Engineering at Rowan University. He currently serves as Secretary/Treasurer of the Chemical Engineering Division of ASEE and has won the Ray Fahien award from ASEE for contributions to engineering education and a Dow Outstanding New Faculty Award. His research interests include high performance polymers, rubric development and forming metacognitive engineering teams.