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## **AC 2012-5309: EXCELLENCE IN ENGINEERING THROUGH A JEOP- ARDY GAME**

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## **Excellence in Engineering through a Jeopardy game**

Interactive teaching has been proven to raise students' interest in learning<sup>1</sup>. Effective learning only happens when students are receptive and involved<sup>2</sup>. In our quest to reach excellence in engineering,<sup>3,4,5,6</sup> new games and techniques have been created to get students more energized in participating actively in their education. One surprising tool is a reverse Jeopardy game where twenty-five questions from basic concepts are used to review key material to be mastered. This study describes the game used and presents the results of a student survey on how the Jeopardy game was perceived in the context of a "Mechanics of Materials" class at the University of St. Thomas. What was the student's appreciation of the game and how they thought it helped them succeed in understanding all the concepts. Students were exposed to a different Jeopardy game for every chapter of the material, ten in all, and had access to the game to prepare for their exams. The game has helped them gain a better understanding of the subject, succeed in their exams and consequently, get better grades.

Students don't always come prepared to class and even though reading assignments are given, textbooks are not always read. The reverse Jeopardy game alleviates this problem by exposing students to the material taught while playing the game. It also incorporates peer teaching by getting them to interact in a group of peers convincing each other of right answers on important concepts.

Peer teaching happens naturally during the course of the game as students need to give their opinion to their peers and try to convince them they know and understand the material and have the right answer. They can go back and forth until they figure out which answer is right. The competition is fun and it allows them to review all the material learned, assuring their learning success.

The Jeopardy game was developed for the Mechanics of Materials class ENGR221<sup>7</sup> after acquiring a template. The Jeopardy game format came from Dr. David Yearwood at a workshop he presented in August 2009 at the University of St. Thomas in St-Paul MN<sup>8</sup>. He developed this great tool for interactive teaching. The principal behind the game is very simple. It is based on a Power Point template of slides with questions showing first and then the answers are revealed at the click of a button. The first master slide contains all the slide options and questions to choose from, covering a whole chapter.

The number of categories as well as the levels of points can be adjusted as needed to create the right amount of detail to adequately cover the subject material. This game applies to any field of study: the subject just needs to be adjusted in the categories and subject matter. From the original Jeopardy game, increasing point values (100-500) are used and five specific categories are selected in this study. The master slide shows a grid of twenty-five icons on a 5 x 5 grid for a chapter, each containing a different question (see Figure 1).

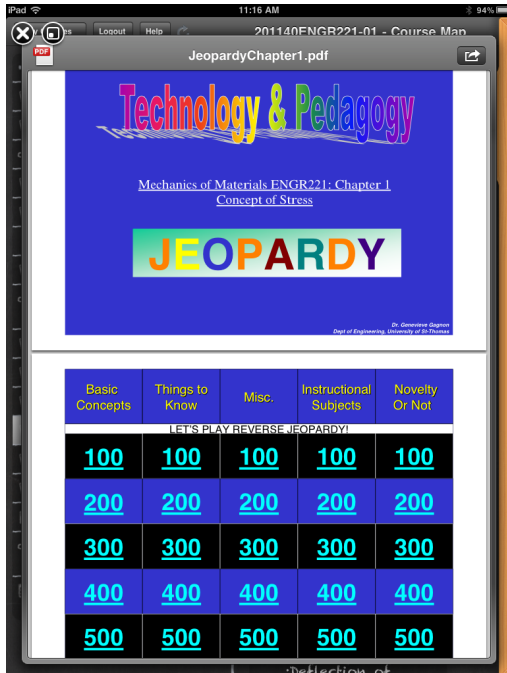


Figure 1: Slide comprising all the selection of questions in a Jeopardy game chapter

Students in the class are divided into two teams and questions are asked successively with each team needing to consult with all their team members before coming to a consensus. Students need to convince each other of the right answer, thus helping them in their learning process. If the response is given is wrong, the other team has a chance to steal the question and try to get the points for the right answer.

The instructor running the game just needs to ask the team of students which category and points level question they want to choose. Then by clicking on the chosen question from the master slide, it takes them directly to the question in that category and point selected. Only the question appears on the Power Point slide at that stage.

It is important to give enough time for the students to exchange their ideas and use peer teaching by interacting. It is one of the main goals behind the game, giving an opportunity for students to evaluate what they know of the subject, reinforcing the material for all, not just the ones giving their opinion on what they think the answer should be. The others must determine if this answer is correct starting a discussion amongst them. The cooperative nature of the game develops and reinforces the concept of teamwork, which is a core skill needed for engineers through their professional careers.

After sufficient time has elapsed, the students must come up with an answer. If the answer is right, the instructor can confirm that and expand on it to confirm everyone understood the material, which allows all the other students in the class to benefit from the revision. If the answer is wrong, the other team gets a chance to try and find the right answer and go through the same peer teaching process. Once the right answer is given

from one of the teams or that both teams had a turn at it unsuccessfully, the push of a button reveals the answer at the bottom of the slide. Furthermore, it's a great opportunity for the teacher to then use the board and provide additional explanations on that specific subject reinforcing the material taught.

The competition makes them desire to prove they are stronger than the other team, motivating the students in a friendly, relaxed atmosphere of Jeopardy game. The students are learning, participating in a team and having fun. It changes from the monotony of a standard lecture. The game is played when all the material has been covered, coinciding with the end of the week in Mechanics of Material. It gives the students a good revision before the weekend and confirms that the material is well known before doing their weekly homework assignment.

The categories in the Mechanics of Materials Jeopardy game follow the Mechanics of Materials textbook<sup>9</sup>. Ten chapters are covered from the book and ten jeopardy games were created to cover all the material taught in ENGR221 at St. Thomas.

Typical questions capture key ideas whether that be a concept or in many cases in engineering, a specific equation. It is important that both questions and responses are brief and yet still capture the main concepts covering all the topics. An example of a Jeopardy question in Mechanics of Materials is shown in figure 2.

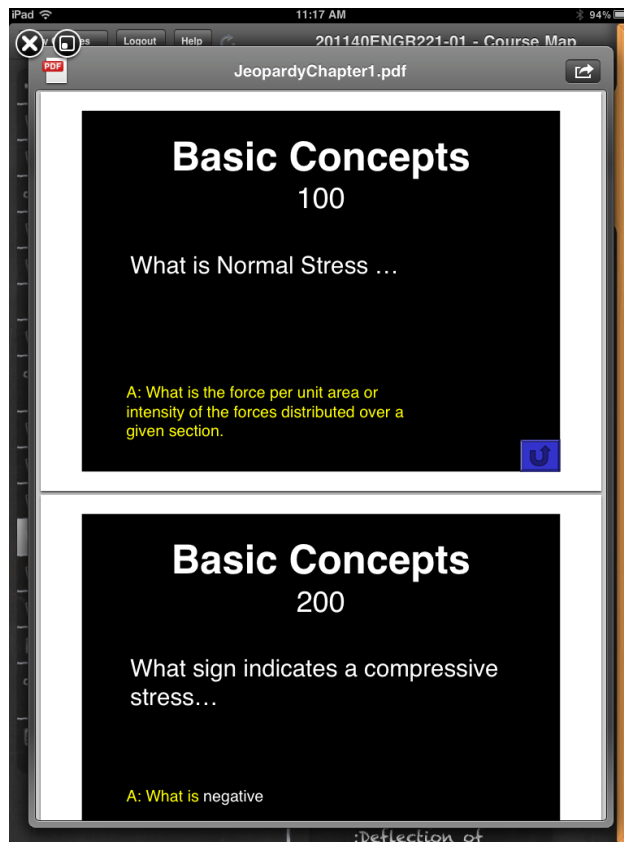


Figure 2: Typical lower point questions from 2 slides in the Jeopardy game.

All Jeopardy game slides are then saved on the Blackboard online application once the game has been played so that all the students can access the material. While they cannot play the game from the PDF version, they can use the slides to study for upcoming exams, giving them a summary of each chapter in only twenty-five core questions.

In order to get a pulse from the students, a survey was distributed that focused on their perceived level of effectiveness of new technologies used within the classroom. The survey included six questions including one that focused directly on the Jeopardy game.

The majority of the students participating in the survey responded very positively (9 out of 15). A few noted concerns with less traditional problem review in class but still generally liked the Jeopardy game (3 of them). Most of them enjoyed the more relaxed Friday class as a change from normal lectures, while pointing out the peer learning benefits of the added review, camaraderie, and competition. They commented on how great it helps them do a complete revision on the subject matter and prepare for problems in the homework and for an exam. The secret is to find a good incentive for the winning team. You can offer points toward their grade, pizza lunch on the teacher or even a trophy. The decision to use incentives is left to the instructor's discretion but can certainly provide additional motivation and drive more peer teaching.

Only three negative comments came from students who would have preferred to forsake the game for more problem-solving during class time. They have a point: students do need time to practice solving engineering problems, often repetitively. But a standard lecture session is already too short for us to walk through the solution of a handful of typical problems especially when involving the participation of all the students. We might succeed in completing only one or two problems.

To counter that, sessions for problem solving with the teacher are suggested and homework help sessions are added so they have extra time to learn how to solve the problems. The students do benefit from peer teaching, reinforcing their comprehension in having to justify their answer in front of others while playing Jeopardy. Working well with a group or a team is another one of the great qualities we aspire for our young engineers that they can develop playing the game.

From a practical perspective, introducing a new technique always makes people uncomfortable as it is different. It might also reduce the time available to spend on other activities in the classroom. Some students may still prefer traditional methods of teaching. The emphasis must be on the new positive aspect the game is bringing to the classroom such as teamwork and peer teaching that were lacking before. Interactive teaching is different from the way they have been learning, where they were spoon fed material and studied last minute before exams. Unfortunately it does not yield significant learning and they forget most of what they learned using those methods. They are reluctant to start owning their learning and getting more involved. Most of them agreed in the end that the interactive learning system is different and it does make them review all their fundamental concepts, which allows them to succeed at solving problems as a result.

It forces them to read the material given to master and in the end they will retain more of what they learned.

The class of Mechanics of Materials covers a lot of material and many new basic concepts are taught and need to be understood. The Jeopardy game is a great addition for the students. Problem solving is a very big part of the class as well. Adding peer mentoring for homework help will allow the space for interactive Jeopardy games in class without taking away time for other important aspects on this engineering class. Students perform a lot of independent work outside of the classroom to complete the assigned homework problems. Unfortunately students don't make use of instructors office hours or try to reach out for appointments with the teacher for directions in their problem solving which is a whole other issue.

This evaluation of the impact of the Jeopardy game on the classroom is still in an early stage as only two semesters have benefited from the new created game. Because classroom contact time is so precious, the Jeopardy game is used sparingly and does not cover the entire set of questions for each chapter. Most of the time, 30-45 minutes is taken at the end of the week to finish on a fun and practical learning note. The most important concepts are described in the higher point questions so that when the game is played, all students go for the big points to win and thus cover most of the more important questions in less than half of a 65 minute class. Depending on the level of the students and how well the material can be covered through the semester, more time can be allocated to the Jeopardy game.

If we compare grades from the last three semesters, the first was taught without the Jeopardy game and the next two were. The average grade in that first semester was 72 % while the average rose in the second and in the third semester to 82 % and 84%, respectively. Obviously this study is just in its infancy so there is still not enough data available to confirm the effect that the Jeopardy game has on long term comprehension and academic performance. However the short term results do show an obvious improvement in overall grades.

The Jeopardy game is a supplement and has to be balanced with problem solving time in class which is also much needed. Team problem solving competitions are also another new aspect of the interactive teaching used in Mechanics of Materials to improve education in engineering.

The balance between lectures, interactive teaching and hands-on work is very important in a classroom so that we make sure our students are well rounded and are actively learning in a significant way. They will retain more of all the information and material they were taught using these new teaching techniques such as the Jeopardy game, helping us reach our goal of excellence in engineering education.

- 1- Mazur, E. Interactive Teaching Video and Book, Pearson Prentice Hall, ISBN: 0-13-158030-2, 2007
- 2- Pomales-Garcia, C., Liu, Y., Journal of Engineering Education (Washington DC) 96 No. 3, pp. 253-262, 2007.
- 3- Engineering accreditation Commission (ABET), "Criteria for Accrediting Engineering Programs: Effective for Evaluations during 2004-2005 Accreditation Cycle," Baltimore MD [www.abet.org](http://www.abet.org) , 2003.
- 4- National Academy of Engineering, Center for the Advancement of Scholarship on Engineering Education (CASEE), <http://www.nae.edu/NAE>, 1999.
- 5- The Millennium Project, Media Union, University of Michigan, Ann Harbor, "High Education in the new Century: Themes, Challenges and Opportunities", Nagoya, Japan, July 2002.
- 6- National Survey of Student Engagement (NSSE), The College Student Report. "The NSSE 2000 Report: National Benchmarks of Effective Educational Practice", 2000.
- 7- Jeopardy game classroom material in Mechanics of Materials developed by Dr. Genevieve Gagnon August 2009.
- 8- Yearwood, D., from North Dakota University, Lecture at the University of St-Thomas, August 2009
- 9- Beer, Johnston Mazurek, Mechanics of Materials, 6<sup>th</sup> edition, McGraw Hill 2012