

## **Jeopardy in Structural Analysis**

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## **Work in Progress: Jeopardy in Structural Analysis**

### **Abstract**

In the era of COVID-19, keeping students engaged with each other and the technical content of the course in an interactive, fun, and creative yet safe way was very crucial. To accomplish this goal as well as to allow students to review materials for the exams, a Jeopardy-style game was created in a junior-level structural analysis course. The current paper discusses the details of the creation of the game and its relation to the KEEN objectives on curiosity, connections, communications, and collaboration. Curiosity was assessed through problem selection, connections based on the style of the questions, communication from the written report, and collaboration per students' reflection on teamwork and whether they were able to teach and learn from their peers. Such games can be played again and again and provide the students with a unique experience to review the course content within the course.

### **Introduction**

During the COVID-19 pandemic, higher education institutions across the U.S. offered three types of classes in the fall semester of 2020: traditional in-person learning by taking the preventive measures suggested by the U.S. Centers for Disease Control and Prevention (CDC) and local health departments [1], fully online, and hybrid (in-person and online instruction on a rotating basis for students). Ohio Northern University took CDC and local health department preventive measures, such as mask-wearing and social distancing to adjust the number of students in each course and the size of the classrooms, to hold most of the classes in-person, depending on the health-risk level for professors and students. While traditional in-person classes help students to learn the material in a less distracting environment and develop a student-professor relationship by interaction with the professor, less interaction with other students due to social-distancing measures could reduce the efficacy of in-person instruction.

Student response systems (SRS) are powerful tools that provide real-time feedback from students to the instructor [2]. Game-based student response systems (GSRS) stimulate the students' motivation and engagement through graphics, animation, and audio, as well as the use of scores. The gamification of SRS can be done by transforming the classroom into a game show where the instructor plays the role of a game show host and the students are competitors [3]. Research has indicated that games can be integrated into traditional classroom lectures to improve the learning, motivation, and engagement of the students [4, 5]. To promote the interaction of students with classmates and establish a learning environment outside of class, a project in the form of a Jeopardy-style game was introduced to a Structural Analysis course. The current paper aims to discuss the implementation of the project, objectives, and assessment criteria.

### **Project Description**

Structural Analysis is a required course for junior civil engineering students at Ohio Northern University. The course covers the following topics: loading, stability and determinacy, trusses, internal forces and shear and bending moment diagrams, cables and arches, influence line, deflection, and analysis of indeterminate structures. The course consists of two midterm exams and a final comprehensive exam. Since only three topics were evaluated on each midterm exam,

conducting a Jeopardy game did not seem reasonable. Therefore, a Kahoot game was conducted to review the materials for each midterm exam. Research has shown that Kahoot increases engagement, motivation, and perceived learning [6, 7]. Kahoot 1 covered the material for Exam 1 and Kahoot 2 targeted the material for Exam 2. The class consisted of 20 students. The students were asked to form groups of two or three members and create short-answer questions as well as problems for each Kahoot game. This was done outside of class. The following procedure was shared with the class for question creation and teamwork for Kahoot games:

For Exam 1<sup>1</sup>, the topics are loading, stability and determinacy, and trusses. Follow the rules to create questions for the first Kahoot game:

- 1- Each member of the team must create two close-ended multiple-choice questions on each topic. One question must take 20, 30, or 60 seconds while the other must take 90, 120, or 240 seconds to complete. Besides, the person must determine the amount of the reward for that specific problem: \$100, \$200, \$400, \$600, or \$800. Questions with higher dollar amounts will take more time to solve.
- 2- Having an estimation of the required time to answer each question, share the problems with your group members. Do not share the required time to complete each problem.
- 3- The other team members must measure the time required to answer each question. If a team member cannot solve the problem within 240 seconds, they can select an answer arbitrarily and report the completion time as greater than 240 seconds. Each team member must fill out the table below:

Question #	Created by	Teammate Name	Estimated Completion Time	Actual Completion Time

- 4- Upon completion by all team members, each group must select the best questions to submit for the Kahoot game. The number of questions must be 6 x (the number of group members -1). The questions cannot be duplicated. For each question, include the required time (20, 30, 60, 90, 120, or 240 seconds) to solve and the dollar amount. The total required time must not exceed 10 minutes.
- 5- Each student may receive up to 10 bonus points, depending on their score on the Kahoot game.

The instructor and the TA will select questions from the submitted questions by each group to conduct the Kahoot game. Each member of the team must submit a written report that contains their questions, the solution to each question, the estimated time and actual time taken by other team members to solve each problem using the table above, the dollar amount for each question, and the overall selected questions by the team. The report must include a reflection on your teamwork, selection of the final questions, challenges, and possible values the assignment created for you .

Each student had to create two questions on each topic: a short version to be completed within 60 seconds and a longer problem to be solved within four minutes. Additionally, the student had to

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<sup>1</sup> The only difference between Kahoot 1 and 2 are the topics and the targeted exam. Kahoot 2 covers the topics for Exam 2, which are: internal forces and shear and bending moment diagram, cables and arches, and influence line.

estimate the required time to answer questions and assign the dollar-amount prize per the level of difficulty. The teammates had to complete the questions and give feedback to the creator of the questions by reporting the required completion time and whether the questions were valid or not. Then, students within a group had to eliminate some questions and select the best ones that met the requirements to submit for the Kahoot game. The instructor and TA chose the questions for each Kahoot. At the end of the semester, all the questions and problems used in the Kahoot games were narrowed down and put into one Jeopardy game. Also, the instructor made additional questions to cover the topics that were not targeted by Kahoot games. The rules for the Jeopardy game were as follows:

- 1- Choose a captain for your team. The captain goes to [www.playfactile.com/join](http://www.playfactile.com/join) and types in the pin number to join the game as “Captain”. The captain chooses the mascot that represents the team. Once the captain joins the game, team members follow the same procedure to join as “Team Member”. The team members select the mascot that represents their team.
- 2- Questions are to be answered starting with “what is...”.
- 3- The winner of the Kahoot game will start the game. The team that buzzes in first gets the first chance to answer the question. Note that everyone can buzz and answer the questions.
- 4- If they provide an incorrect answer, then the next team who has buzzed in sequential order has the opportunity to provide their answer for scoring.
- 5- If no team gets the answer correct, then the answer is revealed and no one scores for the question, and the team/person who chose the previous question gets to choose again.
- 6- The procedure is repeated until the game is over.
- 7- After completing all of the tiles of the game, the game moves on to the final jeopardy, which is the last question of the game. The captain of each team wagers points from 0 to the max points the team has. Only one team member can type in the answer from their device.

## **Assessment**

Over the past decade, the Kern Entrepreneurial Engineering Network (KEEN) has been central to integrating an Entrepreneurial Mindset (EM) in the classroom. According to KEEN, the six core values of EM are Curiosity, Connections, Creating Value, Collaboration, Communication, and Character [8]. Using the KEEN framework and Expanded KEEN Student Outcomes (eKSO) developed by educators at Ohio Northern University [9], the learning objectives of the project were as follows:

- Curiosity: Take ownership of, and express interest in the topic
- Connections: Connect life experiences with class content
- Communication: Produce effective written reports
- Collaboration: Recognize their own strengths, skills, and weaknesses, as well as those of others. Be able to teach and learn from peers.

The following rubric was used for grading:

Table 1. Evaluation Rubric

Learning Objective & Description of Full Achievement		Achievement				Comments
[Curiosity] Take ownership of, and express interest in the topic	Problem selection demonstrates a depth of curiosity about course material.	N	P	M	F	
		0	3	7	10	
[Communication] Produce effective written reports	The report is well written, contains minimal spelling/grammar mistakes, and sufficiently communicates the requested information.	N	P	M	F	
		0	7	14	20	
[Connections] Connect life experiences with class content	The questions match Jeopardy's style.	N	P	M	F	
		0	3	7	10	
[Collaboration] Be able to teach and learn from peers	The reflection clearly describes the teamwork, challenges, selection of questions, and possible values created by completing the assignment.	N	P	M	F	
		0	3	7	10	

N: No Evidence, P: Partially Achieved, M: Mostly Achieved, F: Fully Achieved

## Discussion

An anonymous survey of the project was created and conducted by the instructor. Appendix 1 displays the survey. The survey asked students to rate each question on a scale of 1 (strongly disagree) to 5 (strongly agree). All the students enrolled in the course participated in the survey and submitted their responses. Table 2 shows the average of the results from the survey.

Table 2. Survey Results

	Survey Question	Average Rating	Standard Deviation
1	The project allowed me to dig into the course material and gain insight	4.0	0.6
2	The project increased my curiosity about course material	3.8	0.9
3	I was able to teach and learn from my peers	4.1	0.6
4	The project helped me identify my weak points and muddy areas of the course	4.1	0.6
5	The project helped me develop a propensity to ask more questions	3.8	0.7
6	The project helped me recognize and explore knowledge gaps	3.9	0.5
7	The project guided my study efforts	3.7	0.9
8	The project helped me review course material and get better prepared for the exams	3.9	0.9
9	The project was an effective study tool	3.5	0.8
10	The real-world connection of the project motivated me to do my best	3.6	1.1
11	The project allowed me to connect life experience with class content	3.0	1.1
12	The project allowed me to explore a contrarian view of accepted (typical) solution	3.5	0.8
13	The project allowed me to modify an idea/question based on feedback	4.1	0.7

14	The project helped me improve my communication skills	3.4	0.9
15	The project allowed me to provide and accept constructive criticism, including self-evaluation	4.1	0.6
16	It helped me recognize my own strengths, skills, and weaknesses, as well as those of others	4.1	0.8
17	During the project, I identified and organized information in a format suited to the audience	3.9	0.7
18	During the project, I managed informal communications (meetings, networking, etc.)	3.8	0.9
19	The project allowed me to consider a problem from multiple viewpoints	4.1	0.8

Questions 1, 2, 5, 6, 12 are related to Curiosity, questions 10, 11, and 19 target Connections, questions 1, 4, 7, 8, 9, and 13 are related to Creating Value, questions 3 and 16 are related to Collaboration, and 14, 15, 17, and 18 target Communication. Figure 1 displays the relative frequency for each survey question. As seen in the table and figure, the project was successful in targeting the entrepreneurial skills of students and was well received by them. Question 11 has the lowest average rating since it assumes a life experience and the students were possibly confused by creating questions applicable to two different game styles.

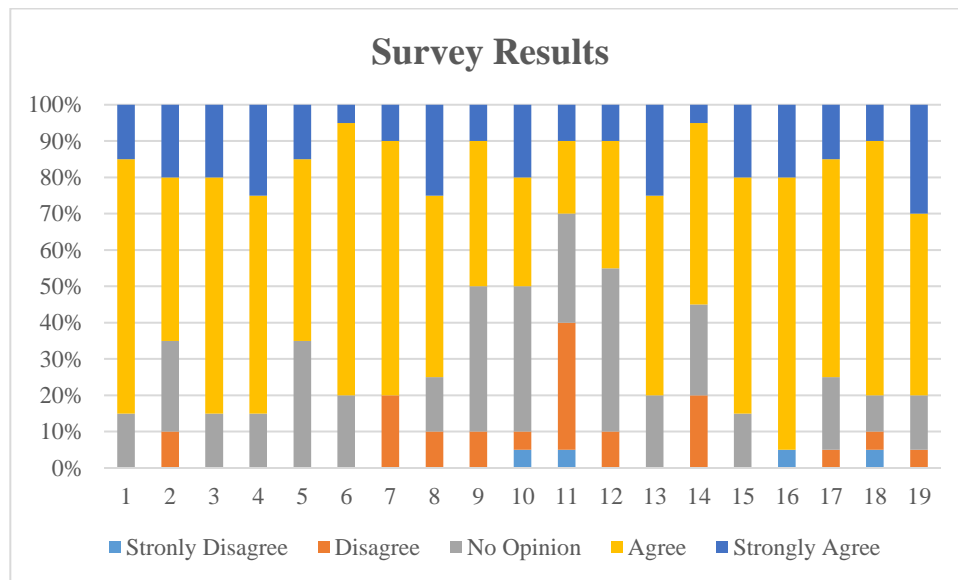


Figure 1. Relative Frequency for Each Survey Question

Based on the results of the open-ended feedback portion of the survey, students found the project as a helpful review and study tool that gave them a better understanding of the course material. Additionally, it forced them to start studying sooner. The students appreciated the variety of questions, which allowed them to find their weak points. Some student comments were:

*“I liked that the project gave a unique way for students to prepare for the exam with some fun elements.”*

*“It forced me to look back through the material earlier than I would have otherwise.”*

*“Forced us to review all materials. Required deeper understanding of each concept by making problems and incorrect answers.”*

*“I liked the fact that mostly everyone had different questions. It helped me see what I should study more based on the questions provided. I liked that it was bonus points, that was nice.”*

*“Was a great study tool.”*

*“Forces one to work backwards to make sure the problem will work out. I have a better understanding of the difficulty it takes to design/come up w/ problems for class.”*

*“The jeopardy was fun to play in class.”*

The suggested changes by students were adjusting the required time limit to allow for more complex questions, having teams work together to come up with a certain number of problems, posting solutions to the problems, and switching the groups each time. They liked the open-ended and simple, yet challenging nature of the project. Some other comments were:

*“Do smaller jeopardy games instead of kahoot games leading up to the big jeopardy game.”*

*“I think that more of the questions should be created by the professor so students don't just remember their own questions and ruin the point of the game.”*

*“Personally I am not sure if a "speed-type" jeopardy game is the best review since it is a different dynamic than slowly working through each problem and ensuring a correct answer.”*

*“I think that everyone's questions should be able to be viewed so there are more examples to study.”*

### **Instructor Observations**

The benefits of the project include establishing a safe learning environment outside of the class and providing students with an effective study tool that forces them to go through the material, design and solve questions, recognize their weak points, teach and learn from peers through collaboration, and gain a better understanding of the course content. This was advantageous during the COVID-19 pandemic since the interaction of students with their classmates during class was minimal due to social distancing measures. While the questions were designed for a Jeopardy game, it is easy to incorporate them into a Kahoot game.

The due date for submitting Kahoot questions was on Friday and the Kahoot game had to be played on Monday before the test on Tuesday. Therefore, there was little time to select questions from groups. Also, not all questions designed by students were correct and the allocated time to solve problems was not always reasonable. While the time limit for each question was adjustable in Kahoot, the website that was utilized for Jeopardy did not allow such time adjustment. For future implementation, it is suggested to post all the questions to the Learning Management System (LMS) so that students have access to more problems to practice. It is also recommended to switch teams from one game to another. This allows students to interact with more peers, which helps them learn further about their capabilities, become better communicators, and distribute the knowledge.

## References

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## Appendix 1- Project (Jeopardy) Evaluation

Please complete the following survey. The goal of the survey is to assess the project. It will remain confidential and will not contribute to your grade. Please answer the statements as honestly and fairly as you can. There are no right or wrong answers, only honest ones.

Circle your response for each statement.

The project allowed me to dig into the course material and gain insight.

strongly disagree	disagree	no opinion	agree	strongly agree
1	2	3	4	5

The project increased my curiosity about course material.

strongly disagree	disagree	no opinion	agree	strongly agree
1	2	3	4	5

I was able to teach and learn from my peers.

strongly disagree	disagree	no opinion	agree	strongly agree
1	2	3	4	5

The project helped me identify my weak points and muddy areas of the course.

strongly disagree	disagree	no opinion	agree	strongly agree
1	2	3	4	5

The project helped me develop a propensity to ask more questions.

strongly disagree	disagree	no opinion	agree	strongly agree
1	2	3	4	5

The project helped me recognize and explore knowledge gaps.

strongly disagree	disagree	no opinion	agree	strongly agree
1	2	3	4	5

The project guided my study efforts.

strongly disagree	disagree	no opinion	agree	strongly agree
1	2	3	4	5

The project helped me review course material and get better prepared for the exams.

strongly disagree	disagree	no opinion	agree	strongly agree
1	2	3	4	5

The project was an effective study tool.

strongly disagree	disagree	no opinion	agree	strongly agree
1	2	3	4	5

The real-world connection of the project motivated me to do my best.

strongly disagree	disagree	no opinion	agree	strongly agree
1	2	3	4	5

The project allowed me to connect life experience with class content.

strongly disagree	disagree	no opinion	agree	strongly agree
1	2	3	4	5

The project allowed me to explore a contrarian view of accepted (typical) solution.

strongly disagree	disagree	no opinion	agree	strongly agree
1	2	3	4	5

The project allowed me to modify an idea/question based on feedback.

strongly disagree	disagree	no opinion	agree	strongly agree
1	2	3	4	5

The project helped me improve my communication skills.

strongly disagree	disagree	no opinion	agree	strongly agree
1	2	3	4	5

The project allowed me to provide and accept constructive criticism, including self-evaluation.

strongly disagree	disagree	no opinion	agree	strongly agree
1	2	3	4	5

It helped me recognize my own strengths, skills, and weaknesses, as well as those of others.

strongly disagree	disagree	no opinion	agree	strongly agree
1	2	3	4	5

During the project, I identified and organized information in a format suited to the audience.

strongly disagree	disagree	no opinion	agree	strongly agree
1	2	3	4	5

During the project, I managed informal communications (meetings, networking, etc.).

strongly disagree	disagree	no opinion	agree	strongly agree
1	2	3	4	5

The project allowed me to consider a problem from multiple viewpoints.

strongly disagree	disagree	no opinion	agree	strongly agree
1	2	3	4	5

What did you like or appreciate about the project?

What should be changed?

Additional comments/observations: