Teaming Tribulations: A Design Course Simulation Game

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Abstract:

This work-in-progress paper discusses the development and implementation of a board game intended to simulate conversations that may occur in design-based projects. One of the challenging tasks for a design group is learning how to collaborate and argue in a constructive and productive way. This paper provides an overview of simulations and games used to assist pedagogy as well as efforts at improving teamwork in design courses and utilizes this information to discuss the development and initial implementation of a pedagogical board game, "Teaming Tribulations." This game is intended to simulate the arguments that might occur within a design team discussion in a lighthearted and friendly atmosphere. In Teaming Tribulations, students are asked to create a quick design in response to a simple prompt. They then share their designs during the judgment-free "Concept Generation Phase." In the next phase of the game, "Concept Selection and Debate," they must argue with their teammates to select the best design to submit for their fictional group project. The twist of the game is that the initial bias of students –which design they would like the team to submit– as well as their personality –the method that they use to argue– are both determined by randomly dealt cards. This causes the students to step outside of their comfort zone and internally reflect on how they argue their opinions normally versus how others might make a similar argument. In the "Grading" phase of the game, the team receives a score based on if they were able to receive a majority or total consensus. The objective of implementing this game within a classroom environment is to start the discussion on teaming, as well as provide a low-fidelity simulation of the design process for comparison during the semester. Later in the semester, concept selection methods are taught with the reminder that it is not ideal to simply argue based on initial biases and gut feelings. The game was introduced in both a first-year and capstone engineering design course. The first-year students were asked to reflect on the experience and determine what personalities hinder a discussion and which combinations are beneficial to a group's experience and success.

Introduction

Teaming is one of the most challenging aspects of an engineering design project, especially in the college setting. Due to the complex and multidisciplinary nature of their projects, engineering students must learn how to work effectively on a team, as the majority will be expected to work as part of a team after graduation. The projects that they will face during both their academic and post-academic careers will involve problem-solving and critical thinking, and the unique skills and perspectives of each team member are necessary to arrive at effective solutions. This paper introduces a pedagogical boardgame aimed at simulating arguments within an engineering exercise, as well as the study planned to track the changes.

A diverse team has people with different backgrounds, experience, and ways of thinking. This can lead to a wider range of perspectives and ideas that can improve problem-solving and decision-making. The wider pool of knowledge and experience of a diverse team can result in more creative and innovative ideas. Finally, a range of backgrounds can increase the team’s ability to understand and empathize with different customers and stakeholders. Allowing for a culture of inclusion strengthens the output of a group and maximizes the benefits of a diverse team [1-2]. It is therefore critical for engineers to understand how to work with others and give

and accept criticism in a way that is respectful and builds up the team rather than alienating members.

During the 2020 Covid-19 pandemic, many teachers switched to online education, and the methods that faculty use now in and in the future will and should change as a result of this experience [3]. The lessons learned in online education cannot be understated, and while it is critical that while faculty work on improving their online, they must also focus on the benefits of in-person learning for when they are in the classroom. In-person learning has many benefits: improved learning outcomes, equity in learning, personalized attention, and easier access to resources. One of the largest benefits of in-person learning is the opportunity of social interaction. The impact of this pandemic is expected to affect social skills of those who were students during that time [4]. In-person learning provides opportunities for students to socialize with their peers and build relationships. It is important that, rather than taking these features for granted, faculty take advantage of utilizing this resource to its greatest advantage. Post-Covid education should not simply return to lectures and typical learning but instead focus on maximizing the benefits of the in-person experience by maximizing active learning opportunities.

Pedagogical Boardgames

Many boardgames are adaptable to a virtual environment, but a 2018 study found that when given the option, many players will opt for a physical board game over a virtual equivalent [5]. The idea of gamifying learning, or pedagogical boardgames has been used in many fields in K-12 and higher education [6-8]. A study on the use of medical boardgames for undergraduate and postgraduate students found that boardgames could either help student enjoyment of a given topic, or also have an impact on knowledge retention of a given topic. Roleplaying games, in which the students take on a role of a patient or physician were a common feature in medical games [9]. Boardgames can be a fun way to build motivation in a class and introduce students to a topic. Having a set of rules with flexibility of strategy and methods takes students out of the mindset of having an action be "right or wrong," –as opposed to how they might feel when taking a quiz or answering a question in class– and puts them into a play mindset. This mindset is critical within a design course; having fun and playing with humor can lead to more creative behaviors [10].

Teamwork in Design Courses at Penn State Erie

The design courses taken by Mechanical Engineering students at Penn State Erie, the Behrend College include a semester long first year introduction to engineering program (EDSGN 100) as well as a yearlong capstone program (ME 448). In EDSGN 100 students are assigned to teams of up to 5 students either randomly or based on their schedule availability. In ME 448 students are given the option to self-select teams, but some teams are formed by the faculty running the course for students who do not have a team. The technical expectations of the EDSGN 100 project are light enough that any student can complete any task, while the ME 448 course requires each individual student to take on tasks of their own within the group while also managing the team progress together.

In order to help the students work together in teams, both classes require students to write a Team Contract at the start of the project. The document is created so the groups may set their expectations, norms, and consequences for a lack of participation. The ME 448 students also use

CATME [11] to evaluate their work and their teammates work at 3 checkpoints throughout the year and are encouraged to revisit their Team Contract in the event that there is dissatisfaction between teammates. Students in EDSGN 100 are given paper feedback sheets to rank their teammates at the end of the project but are not required to revise their team contract during the project.

In both courses there are challenges when working with a team. Students may struggle with communicating their expectations, which can lead to misunderstandings and miscommunications. Collaboration can be challenging when students have different opinions or goals. Other challenges can occur due to differences in behavior or personality. These include those who do not participate at the same level of their teammates, those who are overly critical with their teammates, those whose personal relationships outside of class affect their behavior within the team, and the over/underrepresentation of extraverted and introverted students respectively. These challenges can impact the group performance and the student satisfaction.

Teaming Tribulations

Teaming Tribulations was designed as an in-class exercise aimed at simulating an argument within the design process. This game was inspired as part of a workshop at Capstone Design Conference in 2022. The goal of the workshop was to create a game that could simulate all or part of the Capstone design process. The game takes place over three main phases: Concept Generation, Concept Selection or Debate, and Peer Review. The three phases mimic components of a typical design project, although in a highly simplified manner.

Concept Generation

During concept generation the players draw one “Design Prompt.” These design prompts are lighthearted and meant to generate quick, silly, ideas. Examples include “Fancy Snowshoes,” “Invisible Coat,” “Dog hotel,” etc. The players are then given 2 minutes to draw and name their design. The players then share their design with each other in a judgement-free environment.

Concept Selection/Debate

In this section students argue to come up with the design that their team will present to be graded. However, both the design that they argue for as well as the personality status are determined by two cards that they draw between the Concept Generation and Debate rounds. The “Personality Card” determines how they will argue during the debate, while the “Initial Bias” card determines which card they will start off arguing for. The initial bias cards will have an option of a player number, the player’s own design, any design but the players, or an odd or even design. The Personality Card types can be seen in Table 1.

During the debate stage players have four minutes to come to some sort of consensus. At the end of the four minutes, the players must all simultaneously point to a design that they vote for.

Table 1: Personality Card Types

Personality Card	Description/Rules
Coach	Try to make sure every other player talks
Wallflower	Can only speak if directly asked to talk
Chipper	Can only compliment designs and is unable to critique
Doom and Gloom	Can only critique designs and is unable to say something positive
Slacker	Participate as little as possible, do not try to help
Besties	Roll a die to select a player to agree with as much as possible
Nemeses	Roll a die to select a player to disagree with as much as possible

Peer Review and Grading

The game ends as a type of prisoner's dilemma, they get points for selecting their initial bias, but the team will "fail" if there is no majority vote. During this round the team earns points for each player that met their initial bias card, that stayed true to their personality card, and the team earns points if they had a majority or unanimous agreement on which design they selected. The points are added up and the students are given a mock final grade based on their points. The students are informed that the in-game points are simply for fun and do not affect their course grade at all.

Class Implementation

The game was implemented in both the ME 448 and EDSGN 100 to work as a jumping off point prior to students writing their team contracts. Groups of 4-5 students received a box set of the game, as shown in Figure 1. Students play two rounds of the game, receive their "team grades" and then discussed how they felt playing the different roles. They also shared their final design selection with the class, most of which had humorous designs.

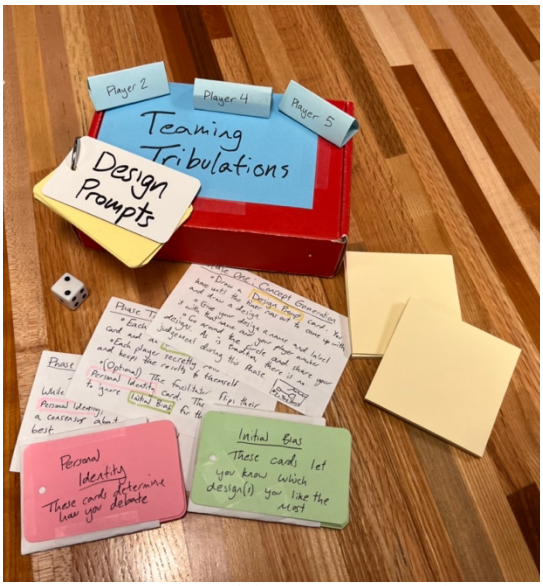

Figure 1: A copy of the game as received in class

Spring 2023 Study

The game was implemented in fall 2022 in both the ME 448 and EDSGN 100 classes. Students appeared to enjoy playing the game, and it worked as a quick ice breaker activity. Several students in ME 448 course stated that while they enjoyed the game, they did think it was more fitting for the EDSGN 100.

Several EDSGN 100 students were informally interviewed after the conclusion of the fall 2022 semester. These students were asked what they thought of the game, and whether they found it as a useful option for teaming. Their reactions were positive. “It was a different take on learning about teams, and it was really fun to see how people played different personality cards.” “I really liked it because I think it was a good way to introduce students to the concepts.” A student did note that some EDSGN 100 students would benefit from a lesson on critique (helpful details that could improve a project) vs criticism (only stating if they liked or disliked an idea without follow up.)

In spring 2023 the game implemented in EDSGN 100 was followed by an in-class survey which will be repeated at the end of the semester. Students who opt into the study will also have their team adjustment grades analyzed at the end of the semester to see if there is any correlation between a student’s belief about teams and how they perform on a team, as well as to see their insights-based teamwork before and after the class project. A copy of the survey can be seen in Appendix B. In future semesters the author plans to have the boardgame utilized in some sections of EDSGN 100, while only using a standard lesson on teaming in others. This will allow a comparison on the effectiveness of the boardgame in terms of how they write their team contract, and how they feel they performed as a team.

Discussion

Teamwork is an essential component of engineering due to the complex and multidisciplinary nature of the field. Engineering projects typically involve problem-solving and critical thinking, and the unique skills and perspectives of each team member are necessary to arrive at effective solutions. A successful team can lead to a more enjoyable and fulfilling work environment. When team members work together towards a common goal, they can learn from one another, share ideas, and support each other through challenges. This can help foster a sense of camaraderie and create a positive work culture.

While this game serves as an entertaining ice breaker for new teams, there are several hidden goals built into the process. Although the game is extremely simplified in how the design process is explored, it can be used later in the semester as an example as why different techniques are needed. For example, during concept generation discussions in class this exercise is brought up to show the need for quantity of ideas rather than simply going for the first option. The method of “no-judgement” during concept generation is continued to be upheld as a policy throughout the class. During concept selection these arguments and initial biases are used as justification for objective tools and methods used to limit bias and focus on customer needs.

The other goals of the game are intended to help students as they navigate the challenges of teamwork. In the game, the players select ideas not based on the quality of the work but based on their own hidden agendas. However, this sets the practice of separating the idea from the creator and allows the designer to practice removing a sense of ownership and seeing it more as a part of

a larger project. More importantly, this game might start to allow students to develop more empathy for their teammates. A student might realize how challenging it is to have only one person play the coach and start to ask others for their opinion more often. An extroverted student might be given the “wallflower” card and realize that a person who is less comfortable speaking up may still have ideas that they wish to share.

In future work the authors would like to expand the complexity of the game by introducing conflict management styles of avoid, accommodate, compromise, compete, and collaborate as either part of the game play or as a post grading discussion to determine how to work through different expectations. A detailed discussion on how to give a proper critique will be added at minimum to the accompanying lesson, and possibly as part of the grading portion of the game.

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Appendix A: Rules of the Game

Teaming Tribulations

Objective: Agree on a design as a team, despite your difference of personalities and opinions

Materials:

- Pad of paper (sticky notes or index cards)
- Initial Bias Cards (Green)
- Personal Identity Cards (Red)
- 6-sided die
- Design Prompt cards (yellow, may not be included in student decks)
- Grading Sheet

In this game you will simulate the concept generation and concept selection component of the engineering design process. During your engineering design class, you will learn several methods to ensure that your concept selection is as objective as possible, while limiting any personal biases. Here, you will instead rely solely on a personal bias and will argue based on an assigned personality type.

Game Procedure:

Part 1: Concept Generation:

In this section you will draw a design based off a prompt. No worries if you don't feel inspired for a brilliant design, you will find out that how it is judged has nothing to do with what you've written down.

1. On a note card, write your player/design number (1-5)
2. Draw a design based off your prompt, you will have 2 minutes
3. Name your design, and share your design with your team: no judgements, just description

Part 2: Secret Judgement:

Identify what drawing you like the most and find out your personality. Although as engineers we'd like to imagine we are completely objective when selecting the "best" design, there is often other factors at play. (Note: Every card is kept secret until the end of the game.)

1. Personality Card: This card will determine *how* you debate with your teammates
2. Initial Bias Card: This card says which design you initially like the best.
3. Roll a die until you find out what you need to know. (This is needed for some cards, you can ignore the result of the die if you don't need to know it.)

Part 3: Debate

Your team has 4 minutes to argue which design is the best. At the end you must vote on the "best" design. While you may get points for sticking with your initial bias, you may also doom the group project to non-consensus. Reminder: Don't take anything too personally, people are arguing and are not behaving as themselves.

- You have 4 minutes to discuss the designs while staying true to your personality
- You will get a warning at two minutes
- At the end of the round everyone has to put a hand in the air and, when the game leader says "vote", point to a design of their choice

Part 4: Peer Review and Presentations

You will be graded based on if your team reached consensus, if you stayed true to your personality, and if the team voted for your initial bias.

1. On your score sheet, mark if your team had a unanimous decision,

2. Share your secret personality and initial bias cards. Give a check for each Initial Bias met by the winner and for each personality card that players were true to.

3. You will learn the scoring method from the game leader.

Example Scoring Sheet

Scoring Sheet Example: The team voted for Player 3's design with majority vote. Player 3 did not stay true to personality but everyone else did. X's added for each bias or personality card not met, ✔'s for each card met.

Player	Name	Personality Card	Initial Bias	Points Scored
1	xxxxx	Coach ✔	Design 2 ✘	
2	yyyyy	Wallflower ✘	Even number ✘	
3	zzzzz	Chipper ✔	Your design ✔	
4	jjjjjjj	Slacker ✔	Any design but your own ✔	
5	kkkkk	Gloom and Doom ✔	Design 3 ✔	

Voting:

Results	Score
Unanimous (All players vote for same design), Majority vote, or Zero consensus	
Total Score (Player points + Team score)	
Grade	

Appendix B: Survey Questions for the start and end of the class project

1. Did you complete the teaming boardgame in recitation (if not, skip to question 9)
2. What personality cards were you assigned for the recitation game activity?
3. Which personality cards do you think were easier or harder to play in general? Which would be more challenging for you to play? Why?
4. If you could build your ideal team for a school project, which personality types would you include on your team?
5. If you could build your ideal team for a school project, which personality types would you exclude on your team?
6. How did you find the teaming boardgame in terms of identifying traits you like in a team?
7. Rate the helpfulness of the teaming boardgame in identifying an ideal project team.
   Not helpful at all Not very helpful Neutral Helpful Very helpful
8. How did you find the teaming boardgame in terms of enjoyment
   Not Enjoyable at all Not Very Enjoyable Neutral Enjoyable Very Enjoyable
9. In general, what aspects of working on a team (especially for a class project) considering a team project) do you like the best?
10. In general, what aspects of working on a team (especially for a class project) do you find most challenging? List your top #3 challenges for working on a team.
11. What is your preference when working on a school project?
    Strongly prefer working alone Slightly prefer working alone Neutral
    Slightly prefer teamwork Strongly prefer teamwork