

Work in Progress: A Delphi Study to Investigate the Value of Board Games to Teach Teamwork Skills

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Abstract

Board games may serve as the vehicle for students to experience teamwork skills in a low-stakes environment, facilitating discussion of the value of good teamwork practices. This work has evolved to a point where “refresher” activities for higher level students are the next logical step. Our research question asks: which games are most appropriate for developing specific skills, especially associated with teamwork?

A Delphi Study is underway to allow for a panel of experts to facilitate the aspect of connecting teamwork to game elements. The panel of experts consists of game designers, game reviewers, game publishers, game store owners, and prominent game collectors. The panel will go through multiple cycles to identify the above characteristics. The panel will be guided through the lexicon of teamwork to better equip them on how to decide the most appropriate alignment between game mechanics and teamwork skills.

From this analysis, the research team will be equipped to catalog which games are best aligned with the skills educators wish to develop or reinforce for their engineering students. Some skills beyond teamwork the games will be targeted towards are communication, effort coordination, adaptability, and risk assessment for decision making.

Introduction

The value of games in education has been established through educational games [1], games designed to teach a topic [2-9], gamification [10], and commercial games adapted to the classroom [11-14]. Games are defined by Juul as having rules, goals, and options or choices [15]. Barab’s group demonstrated the value of games by designing an avatar-based environment to teach its students the basics of environmental science [2-9]. Their avatars must investigate, take measurements, and propose solutions to solve environmental problems like a deficient fish population [5]. They found the “investment” by the students and the experiential nature of the game enhanced their understanding. Similar impacts can be found for gamification [10].

Regarding commercial board games, alignment between game features and educational objectives is a key requirement [16]. Specifically, our earlier work highlighted the importance of this by using the commercial board game, Pandemic, to teach engineers how to effectively work in teams [11, 12]. Pandemic is a cooperative game where players are members of a Center for Disease Prevention and control team tasked with treating and curing four global diseases. As a cooperative game, players only win against the game instead of against each other. In that study, we found, through reflection and experiential learning, the students were able to not only extract proper teamwork but also put it into practice [11, 12].

However, we recognize the Pandemic game does not cover all teamwork skills and may only simulate the use of other skills at a mediocre level. As such, the goal of this work in progress is to identify other commercial games capable to address the shortcomings of Pandemic for upper-level students.

Teamwork is an important skill to teach to engineers, especially to facilitate appropriate designs [17-19]. However, many intervention activities are limited [20], inappropriate for a specific setting [21-24], or require a large amount of financial resources or faculty time [25-27]. In the study on Pandemic, intellectual diversity, goal setting, task planning, equal contribution, communication, group decision making, and team cohesion were identified as important skills [11, 12]. These will be defined in a later section along with other teamwork skill we believe could be addressed through games.

While the team is very familiar with a number of commercial board games, we decided to gather “expert” opinion on which games would be best to augment (versus replace) Pandemic for upper level refreshment activities.

Rather than relying on intuition to choose appropriate games for those refresher activities, the research team will rely upon expert opinion to guide the decision of what games to use. We will gain insight into the following through the use of a Delphi Study:

- Teamwork skills to be gained from cooperative games
- Which games best address those skills
- The difficulty to learn the mechanics of specific games
- The challenge level of specific games

We will show how we recruited experts, the content and results from both the preliminary stage survey and the primary stage survey. As a work in progress, the intention of this work is to identify which skills are deficient in Pandemic and which other games could supplement these deficiencies. The ultimate goal is to implement the games identified through the study at upper levels to reinforce teamwork skills and address skills insufficiently addressed by Pandemic.

Delphi Method

The Delphi technique is ideal to gather information from and strive for consensus among a panel of experts in cooperative games. This procedure is a technique used to gather opinions from all participants, allowing consensus to be reached, without requiring face-to-face meetings from participants [27-35].

The Delphi procedure required participants to be surveyed through (typically) three rounds when consensus is reached. The first round asks participants to answer a series of broad questions or give suggested solutions to a broad issue. Answers are gathered and a broad definition or extensive solution is developed. A second round asks participants to assess the model / solution;

to judge the current iteration and comment on changes to be made. The third round is similar to the second: the existing solution is critiqued. If consensus has not been reached, further rounds can commence; this is not necessary in most cases [31-32].

One advantage of the Delphi procedure is the equal weight to all participants. In workshops in which participants engage in discussion on location, consensus may be inhibited if a participant is judged to have a higher expertise or is a speaker that can take command of the discussion; this ‘groupthink’ can result in a false consensus.

Selection of Delphi Panel

In order to properly select “experts” in cooperative games, defining characteristics of cooperative game experts was determined. Experts needed to be familiar with many different types of games as reflected by their frequency of play, number and variety of games owned, and their respective knowledge regarding a large number of games.

Game publishers, designers, playtesters, and reviewers require broad knowledge of games and game mechanics as part of their job description. A number of each was contacted directly through email describing the study and the aims of the Delphi panel. In the end, we recruited three publishers, two designers, and three reviewer/playtesters. According to Clayton, a panel of at least fifteen is desirable [36]. As such, we recruited the rest through the board game site, www.boardgamegeek.com [37]. We described the basics of the study, but required the volunteers to identify information about themselves, but also information regarding the board game “expertise”. This was ascertained through the number of games owned (general and cooperative), number played, and frequency of play. At the end, a total of sixteen members were officially recruited to participate. Coincidentally, a number of the extra members were professionals in education.

Preliminary Stage

The goal of the preliminary stage survey was designed to ascertain two pieces of information. First, a list of common games we presented to see how well the panel agreed on which games were considered cooperative or not. This was also a means to prompt the panel on which games could be considered for the second section. The second section listed fifteen separate teamwork skills identified by the authors. These skills along with the definition we presented to our panel can be found in Table 1 below. This list was generated from review of a number of effective teamwork models[43]. For each skill, we asked the panel to identify as many games as they could think which invoked the skill mentioned.

Table 1: Teamwork skills and their definitions used in each survey

Skill	Definition provided to panel
intra-team communication	the players have to effectively communicate to progress or win game. Game may require creative uses of communication.
skill diversity	players in the game have different skills or abilities to give them individual advantages/disadvantages.
interdependence / equal contribution	players cannot win the game without the aid or equal involvement of other players
task planning	planning out the moves of different players for the next turn or so
keeping the team on track	is it easy to get distracted in the game by side goals to prevent accomplishing the main goal/goals
grace under pressure	the game has a time element built in
problem solving / critical thinking	the players have many choices on how to move forward
sacrifice	players must make sacrifices (loss of turn, damage, etc...) for the sake of the team
resource management	the players have so much resources and must manage them to succeed
adaptability	the game changes frequently and the players must adapt
team cohesiveness	the players must get along to finish the game
group decision making	decisions must be made by the group, not just individuals
goal setting	setting minor goals to achieve the major goals of the game
conflict resolution	the game has components that provoke inter-player conflict and players must resolve that conflict to win
adversity	the game has competition even if it stems from the game itself

Panelists had high agreement regarding which games were cooperative and which would be inappropriate for a teamwork activity. No game had larger than a one point interquartile range; 50% of the respondents formed a consensus within one “point.” Also, no game scored as “inappropriate” was included in the cooperative games in the second section.

The purpose of the second section was to collect a list of games conducive to teaching students teamwork skills. As expected, Pandemic was listed multiple times (approximately 50 times between the 15 skills). From this preliminary stage, we could, possibly, assess which games exhibited a skill better than Pandemic based on frequency of inclusion, but that is the purpose of the later stages of the study.

After compiling the lists of games mentioned, 74 separate games were mentioned as games possibly conducive to teaching teamwork skills. Stage 1 was designed to see which skills were involved in which games and which games could augment Pandemic. As such, including all 74 games for 15 different skills would make the length of the stage 1 survey prohibitively long. As such, we chose games to be included in stage 1 based on the number of times a game was mentioned in the preliminary stage. The cutoff was at least eight separate mentions of game leading to 25 games to be included in stage 1. They can be found in Table 2 along with the frequency of identification.

Table 2: Games Identified in Preliminary Stage with Number of Mentions in Parentheses

Escape	(8)	Spectre Ops	(11)	Shadows over Camelot	(14)	Flash Point: Fire Rescue	(18)
Captain Sonar	(9)	Keep Talking and Nobody Explodes	(12)	Hanabi	(15)	Legendary	(18)
New Angeles	(10)	Space Cadets	(13)	Lord of the Rings	(16)	Freedom	(19)
Sentinels of the Multiverse	(10)	Battlestar Gallatica	(14)	Forbidden Desert	(17)	Space Alert	(19)
The Grizzled	(10)	Defenders of the Realm	(14)	T.I.M.E Stories	(17)	Dead of Winter	(23)
Ghost Stories	(11)	Mice & Mystics	(14)	Eldritch Horror	(18)	Robinson Crusoe	(25)
						Pandemic	(50)

Primary Stage

While 100% (n=16) of the panel responded to the first round of the Delphi survey, only 63% (n=10) responded to the second round. We believe this was due to the length and extent of the survey. In the second round, we asked the panel to allocate two scores for each skill for each game, as well as some expected attrition of volunteers. The first score was to rate how frequent a skill was used in a game. In order to reinforce a specific teamwork skill, the constructive

experience must continually reinforce the skill and remind the user of its importance and utility. The second score was to rate how critical the skill was to winning or progressing the game. By definition of a game, the choices must have impact on the game. If choices associated with implementation of a skill are not available or have not impact, they will not be utilized or developed.

The other part of this survey was to assess appropriateness from a logistical perspective. First, the activity will likely be administered as a take-home assignment and the students will need to learn the rules of the game without the input from a professor, so we assessed how difficult the game is to learn. Second, we needed to assess the difficulty level of a game and how long it takes to finish. Other studies have found if an activity is too challenging or too easy, students do not learn what is intended [38-41]. When success is guaranteed, students become overconfident and falsely believe they have learned the intended skill. Conversely, if the activity is too challenging, students are frustrated. With regards to time, similar issues could happen; students become bored if a game is not engaging enough for the time required to play.

Finally, the survey asked how similar a game was to Pandemic's mechanics. The goal of this study is to find "new" games to augment the Pandemic activity. If a game is too similar to Pandemic, the students may try to anticipate the desire of the instructor, or "game" the game, failing to learn anything new. In other words, students would strategize based on their experience with Pandemic instead of strategizing based on the new teamwork skills they require to accomplish victory [34].

First, the median and mean were tracked for each game in each skill. To identify which skills Pandemic did not address well, we next applied two criteria to the scores: the number of games with a higher score was 11 or more and if the median score for either frequency or criticality were 3.5 or below. They included the following:

- Keeping Team on Track
- Grace Under Pressure
- Problem-solving/critical thinking
- Sacrifice
- Resource management
- Adaptability
- Conflict Resolution
- Adversity

As mentioned, previously, this stage was prohibitively long. To motivate the panel to have a higher response rate, we assured them stage two would be significantly shorter; a desirable feature of the Delphi procedure. Regarding the structure of stage 2, very little is different. However, the number of games to be assessed needed to be drastically lowered. If any game scored a median of five on criticality or frequency, it was included as a possible candidate for the stage 2 survey. We also looked at the top three games in for each skill. For the skills listed

above, they were also included into the list. Considering both criticality and frequency were important, each game was plotted on a graph like Figure 1 below. Those in the upper right-hand quadrant represent games with high frequency and critical need in the game.

From Figure 1, three games are clearly the three best for adaptability, as identified by the panel.

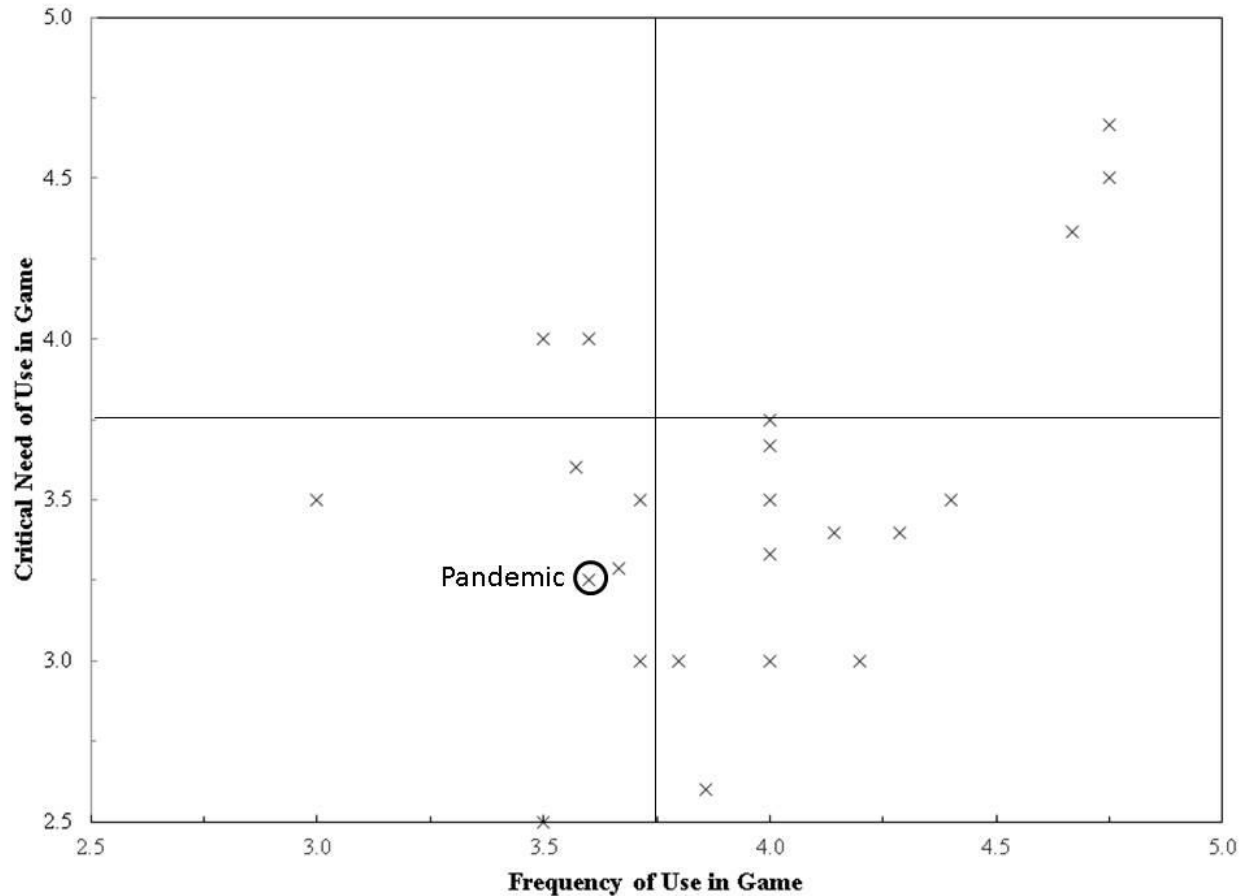


Figure 1 – Games’ critical use of the skill *Adaptability*, plotted versus the frequency of use.

There were problems with some of the games which made the list. Some games were judged to be too similar to Pandemic, others were too difficult to learn or achieve a sense of victory, took too long to finish, were too obscure and the panel lacked familiarity with them, or were based in an undesirable setting. With regards to the last criteria, we identified ‘theme’ as a major decision factor when choosing Pandemic [11]. Certain themes could be construed as unappealing or even offensive, so games based on zombies/undead or fantasy settings were eliminated. From that, the following games were chosen as games to be included in the second stage of the study:

- Space Cadets
- Captain Sonar
- Keep Talking and Nobody Explodes
- Hanabi
- Freedom: the Underground Railroad
- Space Alert
- Robinson Crusoe
- Pandemic

Space Cadets has team members manning different stations of a space ship in search of valuable artifacts in the galaxy. *Captain Sonar* pits two teams of submarine personnel against each other. While *Keep Talking and Nobody Explodes* is actually a computer game, its features were important enough to include in the list. In this game, one person is disarming a bomb, while the rest of team conveys instructions on how to disarm the bomb. *Hanabi* requires players to coordinate a fireworks launch, but they are limited with respect to how they communicate, requiring the use of body language and other clever means of communication. *Freedom: the Underground Railroad* requires players to coordinate the Underground Railroad to transport as many slaves as possible from the South to Canada. *Space Alert* is a real-time game where random scenarios (e.g., incoming meteors) on a space station occur as chosen by an online app. Finally, *Robinson Crusoe* requires players to handle a number of different scenarios related to crash-landing on a deserted island.

The Future of this Work

The stage two survey has been delivered to the panel and we are waiting for its results. The games above were re-listed with the same fifteen skills. The participants were asked to rate these games again for each skill. The difference is each skill includes the median score along with the interquartile range for each game from stage 1. They are asked to comment why they allocate a score outside of this range; information which will anonymously be fed back to the panel in stage 3. The purpose of this is two-fold. First, this is the mechanism for facilitating feedback between panel members while maintaining anonymity. Second, by reporting scores, the median and interquartile range can be tracked to identify a convergence of opinion. We hypothesize this may not happen in stage 2 because of the low response rate in stage 1. Rather, we predict the range will grow in stage 2, but will get smaller in stage 3.

In the end, we will identify which three games address the skills not address well by Pandemic. In addition, from the feedback of the panel, the games will be chosen for appropriate difficulty and targeted skill development. In other words, adaptability may not need to be addressed at the sophomore level, but rather at the senior level in conjunction with a capstone design course. Similarly, conflict resolution may be a skill that needs to be “nipped in the bud” as early as possible.

Summary

This work in progress utilized the Delphi process to identify games to augment a teamwork development activity centered on the cooperative board game, Pandemic. The expert panel was made up of avid gamers and people directly involved in the gaming industry. They identified over 70 games which engaged important teamwork skills. From this, the first two stages of the study have identified seven possible candidates to be implemented in upper level courses for advanced teamwork training. We have also have found, on a preliminary basis, the skills Pandemic does not address well or could be addressed better by a different game.

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