

What's in an (Educational) Game? Ub3r Mechanics and L337 Motifs!

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Abstract

In this study we explore the role that mechanics, themes, and genres may play in making an educational game engaging for players. Data for this study comes from two different databases that provide player ratings on hundreds of different digital and non-digital games. We found that non-digital games were most often associated with mechanics; in contrast, digital games were most often associated with themes. We also found that educational games were likely to employ mechanics, themes, and genres that are easily associated with education and children, such as *Puzzle*, a digital theme or genre that emphasizes problem solving, or *Roll / Spin and Move*, a non-digital mechanic that is commonly found in children's games. However, game elements associated most directly with education and children tended to result in lower-rated games. Finally, we also found that specific game elements (themes, mechanics, genres) were more likely to be associated with highly-rated games than others, suggesting that not all games are created equal. We discuss the implications of these findings for future research, for practitioners interested in employing educational games, and for designers of educational games.

What's in an (Educational) Game? Ub3r Mechanics and 1337 Motifs!

What makes an educational game effective, playable, and engaging over time is a multifaceted and complex issue. Although engagement should not be the only concern of those who design and use educational games, it is a critical issue since so many of these games have been dismissed as “chocolate-covered broccoli” (Bruckman, 1999). That is, while games may seem more palatable than other means of teaching and learning, they aren't as fun (or even as educational!) as they seem to promise (Charsky, 2010; Van Eck, 2006). However, there remains much to be understood about what makes games (including those used for teaching and learning) engaging or, too often, unengaging (Van Eck, 2006). Scholars have begun to explore the role of aesthetic appeal (Schell, 2008), the balance between strategy and luck (Mayer & Harris, 2010), the context and setting provided by the game world (Van Eck, 2006), and the novelty of features and challenges (Koster, 2010) as they contribute to developing an understanding of what makes games engaging. It is likely that all of these play a role in engaging players, and designers of educational games would benefit from a better understanding of each of these features.

Of the many facets that potentially make an educational game engaging over time, we have chosen to focus on *themes* and *mechanics* as well as on the related game element of *genre*. These elements are of particular importance for educational games because of their theorized role in teaching and learning. Scholars have pointed to the importance of *themes* in providing a game's setting and story, which relates to the suitability of a game for educational purposes (Mayer & Harris, 2010; Sicart, 2009). For example, it is no coincidence that research on the history-themed game *Civilization III* generally takes place in history classrooms (Squire, 2006; Squire & Barab, 2004; additional information on this game and other games mentioned in this paper can be found in Appendix B). However, many scholars have also argued that the

mechanics of a game do the teaching. Mechanics present a particular model of the world (Bogost, 2007; Koster, 2010; Sicart, 2009) and invite players to learn the behaviors that the model associates with success. Other accounts have described how mechanics and theme might either contradict each other, undermining the message of a game, or reinforce each other, strengthening that message (Mayer & Harris, 2010). This is more than a theoretical conversation: The effectiveness of any pedagogical tool depends in part on teachers' understanding of its features, affordances, and constraints, especially if that tool was not explicitly designed for education (Mishra & Koehler, 2006).

A better understanding of the mechanics, themes, and other features of educational games therefore has the potential to better inform research, practice, and design. This study collected and analyzed data from the non-digital (i.e. board and card game) database BoardGameGeek and the digital (i.e. console and computer game) database VideoGameGeek to contribute to this better understanding. This paper first explores theme, mechanics, and related concepts. It then outlines our study, explaining its methods, sharing its results, and discussing the trends that emerged from the data.

Literature Review

The field of game studies has long struggled to establish an authoritative vocabulary: For example, the game design textbook *Rules of Play* (Salen & Zimmerman, 2003) spends an entire chapter examining nine different definitions of what constitutes a game. We therefore feel that it is important to describe what we mean by each of our key concepts by summarizing prior discussions. We define the terms *theme*, *mechanic*, and *genre* and discuss the potential impact

each has on engagement based on theoretical and (where available) empirical research. Finally, we discuss the interaction between these game elements.

Theme

Theme, in simple terms, is what a game is about—it is an encompassing concept (usually involving the setting, characters, and game fiction) that ties the game together and establishes a purpose for playing. In this study, we use the definition of theme provided by the websites BoardGameGeek and VideoGameGeek: “the topic or subject matter of a game,” (“BoardGameGeek Glossary,” n.d.) or “the setting, story, or ideas within a game” (“VGG FAQ,” n.d.). For example, *Star Trek: Fleet Captains* is a board game with a science fiction theme. Other games have animal, military, or historical themes.

Theme is powerful in its ability to attract players and educators. A game is often marketed (and even packaged) based on its theme. In the case of a truly thematic game, the setting can immerse a player in a richly detailed simulation or connect a game to real-world issues that have personal relevance (Harris & Mayer, 2010; Koster, 2010). Conceptually, scholars have linked theme-related game attributes like fantasy, narrative, sensation, and representation with engagement (Charsky, 2010; Prensky, 2001; Schell, 2008). Emerging empirical research on game-based learning suggests that higher levels of student engagement are reported when games feature immersive, narratively-rich videogames (Barab, Pettyjohn, Gresalfi, Volk, & Solomou, 2012).

Yet a compelling theme is no guarantee of an engaging game; conversely, many abstract games (e.g., *Tetris*, Tic Tac Toe) can stand alone on the playability of their mechanics (Harris & Mayer, 2010). An initially attractive theme can fail to engage when it is perceived by players to

have been hastily or thoughtlessly applied after the fact; for example, *Doctor Who: The Card Game* was criticized by some reviewers for having little to do with *Doctor Who* other than the language and artwork of the game. Squire (2011) argues that “the difference between good and bad games is more in the polished game experience than in the content” (p. 5), and illustrates this point by comparing two videogames with very different themes. *Sid Meier's Pirates!* is a game that immerses players in a simulation of the Caribbean during the seventeenth century, engaging players to learn about history and geography through the exhilarating perspective of a pirate. Many games are released each year with similarly exciting themes; yet few are equally engaging. On the other hand, *Diner Dash*, a game about being a waitress, is an example of a well-crafted, fun game that arises from an arguably mundane theme.

Theme alone, then, is not enough to engage players. It has been argued that games train players to focus most intensely on their underlying patterns and rule systems, with the result that players largely ignore the fiction in which it is wrapped (Koster, 2010; Johnson, 2012). According to this view, theme is a ‘dressing’ that may be essential for selling copies and attracting audiences, but well-designed mechanics aligned with that theme are necessary to keep players engaged and to create meaning through their interactions.

Mechanics

If theme is what a game is about, mechanics are how it is played. Mechanics allow players to interact with the game and are generally related to its functional operation. Schell (2008) describes mechanics as “the interactions and relationships that remain when all of the aesthetics, technology, and story are stripped away” (p. 130). In *Rules of Play*, Salen & Zimmerman (2003) focus on the core mechanic—a pattern of behavior repeated again and again

during the course of the game that involves a player's choices, their decisions, the system through which inputs and outputs are shaped, and the activities that constitute the experience of play. Examples include jumping in *Super Mario Bros.*, rolling dice in *Yahtzee*, or making bets in poker. A core mechanic is an activity that involves a player's ability to interact with the game: the ability to make input, receive output, and engage in the psychological and cognitive processes that guide in-game decisions.

Most definitions reflect an appreciation—one that is recognized in both scholarly literature and gaming communities alike—for the strong relationship between mechanics (which involve interaction with the game state) and rules that regulate the space that makes interaction possible (Sicart, 2008). The BoardGameGeek/VideoGameGeek glossary follows suit by defining a mechanic as a “part of a game's rule system that covers one general or specific aspect of the game...A gameplay mechanism (or often mechanic) is a metaphorical term referring to a functional aspect of a game” (“BoardGameGeek Glossary,” n.d.). This definition, which is provided to visitors interested in submitting game reviews, respects the relationship between rules and mechanics without prescribing a strict framework for interpretation.

Game attributes associated with mechanics—like competition, rules, challenges, level of player control, and feedback—are frequently linked with engagement (Charsky, 2010; Prensky, 2001). Indeed, mechanics tend to serve as a pivot point between challenge and frustration, which explains why games often use common mechanics (with which players are already familiar) to scaffold players as they learn how to play. A familiar mechanic is not always an engaging one, however. Empirical evidence has shown that mechanics that are too easy or do not give the player a sense of control over the game world (like rolling dice in a board game) are not engaging in the long run; on the other end of the continuum, mechanics that are too difficult can

result in disengagement through repeated failures and increasing frustration (Harris & Mayer, 2010; Squire, 2011; Trepte & Reinecke, 2011).

Genre

A genre is a category of games defined by common conventions, traditions, and mechanics; Kurt Squire describes genre as “family resemblances among media that use similar techniques to achieve similar goals” (2011, p. 105). VideoGameGeek’s FAQ defines genre as the “type of game and the style of gameplay it best fits” (“VGG FAQ,” n.d.). Common examples of genres include role-playing, strategy, and adventure. Scholars have noted that genre plays an especially important role in educational videogames since each genre tends to follow conventions establishing the length of game play, openness of goals, and opportunities for creative expression and, in short, reflects particular affordances and constraints (Squire, 2011). Genres offer useful descriptions for the nature of a game’s interaction as well as predictions for its practical, cognitive, social, and motivational affordances (Foster & Mishra, 2009). Because genres tend to employ particular mechanics and themes, they can exert a strong influence on a player’s level of engagement.

Koster (2010) provides a helpful exploration of the mechanics common to certain genres. Action-based fighting games involve visceral challenges and often require a player to perform the same task repeatedly (perhaps increasing the speed at which an action must be completed as the player progresses through the game). Other genres—like strategy—rarely involve such rapid reflexes and instead encourage the player to adapt to unexpected challenges. Adventure and exploration games teach players to be thorough and patient, requiring players to discover secrets, master complex puzzles, or explore an area completely.

Genre, therefore, might be thought of as a filter through which different combinations of commonly associated mechanics and themes may be viewed or categorized. Although there is some evidence for age and gender-based inclinations for particular genres, what a player finds engaging is largely determined by personal preferences and psychographic factors shaped by personality, interests, and values (Schell, 2008).

Relationships between Theme, Mechanics, and Genre

There is general consensus that theme and mechanics must work in concert to create engaging player experiences. The theme of a well-designed game frames its mechanics in a rich context; likewise, appropriate mechanics can reinforce a resonant theme. An engaging game requires an appropriate synthesis of the two. Theme may initially attract players to a game, and well-designed mechanics engage them with challenging gameplay. Proper thematic support for rules and mechanics continues to maintain player interest to make a game engaging over time (Harris & Mayer, 2010).

Considering this reciprocal relationship between mechanics and theme, it may be helpful to examine mechanics not as an abstract, formal system standing alone but instead as an “intrinsically interesting rule set into which content can be poured” (Koster, 2010, p. 120). Koster explores this “pouring” of content with a hypothetical re-theming of *Tetris* as a game about dropping people into a gas chamber. This relationship is also illustrated by the *Commands & Colors* series of light wargames, which uses a common set of mechanics but has been adapted to themes as varied as the American Civil War, the Second World War, the Napoleonic Wars, and fantasy battles. These examples demonstrate quite effectively that “the bare mechanics of the game do not determine its semantic freight” (2010, p. 168).

It therefore seems unwise to dismiss theme as nothing but empty aesthetic trappings or a story grafted onto a set of rules and mechanics. Players discuss games in terms of the overall experience—in which visual representation and metaphor play an important role—and not just as abstract, formal systems (Koster, 2010). Bogost (2007) argues that the surface representation or skin of a game is not a mere dressing or side dish. He then quotes Jesper Juul's assertion that "the relation between rules and fiction... is not arbitrary. Both are based on a background of some existing antagonism—and that is why they work, because the rules fit the representation—in an allegorical way" (2005, p. 15). If a game's mechanics are in conflict with its theme, the misalignment can create a sense of dissonance for the player that actually undermines the intended meaning and the level to which he or she will feel engaged (Johnson, 2012).

Similarly, genre sets expectations for a player's game experience and can be an important factor in the decision to choose (and potentially be engaged by) a particular game. Players frequently buy games for the theme, but if the conventions and mechanics of the genre are at odds with expectations, many players won't find them engaging. *Halo Wars* is a telling example: Fans of previous *Halo* games expected an action-based, first person shooter, and many were surprised to find *Halo Wars* to be a strategy game. The conventions and standard mechanics of these genres differ dramatically: The first-person shooter genre involves quick reflexes and close combat, while the strategy genre usually employs a third-person omniscient perspective and moves at a slower pace. As a result, many players were disappointed in a game that differed from their expectations and preferences (Johnson, 2012).

Summary

The literature suggests that theme can play an important role in the selection of games and can provide support and context for mechanics. Mechanics, in turn, can supply a player with challenging gameplay and are a crucial element of what makes a game engaging over time. Theme and mechanics ideally support each other, creating an immersive and interesting game experience that sustains player interest. Genre, particularly in digital games, sets expectations for the types of themes and mechanics a game will contain. Engagement can be negatively affected when a game's theme and mechanics are misaligned; by the same token, a game risks disappointing players when genre expectations are not met.

While these guidelines provide a helpful framework for understanding relationships between theme, mechanics, and genre in theory and design, it is not entirely clear how they contribute to a game that is engaging and enjoyable in practice. To inform our understandings of the relative importance (and interplay) between mechanics and theme in educational games from the perspective of players themselves, we answer the call to action to “look for games that gamers play” (Mayer & Harris, 2010, p. 74).

Purpose and Research Questions

The purpose of this study is to explore trends in educational games' mechanics, themes, and genres and examine their relationship with player engagement. To carry out this exploration, we turned to the game websites BoardGameGeek (<http://boardgamegeek.com>), which focuses on *non-digital games*, and VideoGameGeek (<http://videogamegeek.com>), which focuses on *digital games*. BoardGameGeek and VideoGameGeek (hereafter BGG and VGG) have features common to wikis, social networking sites, and databases. Included among these features are two

that allowed us to examine the trends and relationships of interest in this study. First, BGG and VGG users rate the games that appear on each site on a 1-10 scale; these user ratings indicate the quality of the game as perceived by players. We assume that players consider more engaging games to be higher quality games and therefore use user ratings as a representation of perceived engagement. Second, the BGG and VGG databases allow players to collectively provide information about features of these games, including the *Mechanic* and *Category* entries on BGG and the *Genre* and *Theme* entries on VGG. With a few modifications, these database elements allow us to represent the game elements we focus on in this study.

We use the BGG and VGG data to answer the following questions:

1. What is the average number of mechanics, themes, and genres associated with each game in these databases? Comparing the answers to this question will suggest which of these types of game element players find most salient in educational games, better informing theories on how students learn from games and telling designers, researchers, and educators what game elements to focus on.
2. Which mechanics, themes, and genres are most often associated with educational games? Answering this question will give some indications as to current trends of game elements in educational games.
3. Is there a difference between highly- and poorly- rated games in terms of the mechanics, themes, and genres they employ? While the popularity of a game element may not have any relationship to its effectiveness for learning and teaching, answering this question will still let educators and designers know what kinds of games are likely to be well-received.

Methods

In this section, we identify the data we used to answer our research questions and the measures we used to analyze that data.

Data Collection

Although the BoardGameGeek (non-digital games) and VideoGameGeek (digital games) databases contain information on games of all kinds, we narrowed our scope to an analysis of educational games, operationalized as those games that were associated with the *Educational* Category on BGG or with the *Educational* Genre on VGG. We further narrowed our data collection by excluding games that had no user ratings: This yielded 252 non-digital educational games from the BGG database and 159 digital educational games from the VGG database. For each of these games, we collected the following data: number of user ratings, average user rating, Bayesian average of the user ratings, standard deviation of the user ratings, all Mechanics and Categories associated with each BGG game, and all Genres and Themes associated with each VGG game.

Measures

Although the VGG and BGG data largely correspond with the concepts we address in this study, they do not match perfectly. For example, the BGG Categories represent a mix of mechanics, themes, and genres that we reclassified as such when analyzing this data. We ultimately transformed the raw VGG and BGG data into the following measures:

- **Bayesian average:** The Bayesian average represents the average user rating for a game corrected for outliers. We used the Bayesian average for each game as calculated by and retrieved from BGG and VGG.
- **Weighted average:** The weighted average is an approximation of the average user rating corrected for outliers; although it is not as accurate as the Bayesian average, we use it in instances where games do not have enough individual ratings to calculate a Bayesian average. We calculated the weighted average for each game by multiplying the number of user ratings by the average user rating, both of which were retrieved from BGG and VGG.
- **Composite average:** The composite average is an average of multiple games' user ratings that counts individual ratings as the unit of analysis rather than individual games. We calculated the composite average for groups of games by dividing the sum of their weighted averages by the sum of their numbers of user ratings.
- **Mechanic:** We defined a game mechanic for non-digital games as any Mechanic entry in the BGG database or any Category in the BGG database that we reclassified as a Mechanic. Because the VGG database does not include Mechanic entries, we did not consider individual mechanics for digital games. Although we regret this omission, we feel that it is consistent with the nature of digital games, whose computing power automates and moves to the background individual mechanics (Salen & Zimmerman, 2004; Sicart, 2009).
- **Theme:** We defined a game theme for non-digital games as any Category entry in the BGG database that we reclassified as a theme and for digital games as any Theme entry in the VGG database.

- **Genre:** We defined a game genre for non-digital games as any Category entry in the BGG database that we reclassified as a genre and for digital games as any Genre entry in the VGG database.

Results

In this section, we report on the results of the data collection and analysis described in the previous section. We report on each research question individually and distinguish within each research question the results from the BGG database and the results from the VGG database. Throughout this and the following sections, we refer to a number of game mechanics and genres, all of which we have briefly defined in Appendix A.

Research Question #1: Average Number of Mechanics, Themes, and Genres per Game

Table 1 indicates the average number of mechanics per game, genres per game, and themes per game for both non-digital and digital educational games. To calculate these numbers, we counted the number of times non-digital games were associated with a mechanic, with a genre, or with a theme; we then divided each number by the number of games being considered. In doing so, we left out the *Educational* genre, since we expected it to appear for each game. We repeated this process for digital games except that we left out the number of mechanics for the reasons described earlier.

Research Question #2: Frequently Appearing Mechanics, Themes, and Genres.

Table 2 indicates the three mechanics, themes, and genres that are most often associated with non-digital and digital educational games. Like in the previous section, we excluded the *Educational* genre from consideration here.

Research Question #3: Relationship of Game Elements to Game Ratings

This research question asked about the relationship of mechanics, themes, and genres to highly- and poorly-rated games. We examined this relationship in two ways. First, we divided each of our data sets into a highly-rated half and a poorly-rated half. For the BGG data, we sorted the games in descending order by Bayesian average; this yielded 174 games, the first 87 of which were classified as “highly-rated,” and the second 87 of which were classified as “poorly-rated.” In the VGG data, only 11 games had a Bayesian average. We therefore sorted all 159 of the games in descending order by weighted average and divided them into two “halves” of 79 games apiece. We then compared the proportion of games having each mechanic, theme, and genre in the highly-rated half with the proportion of games having that element in the poorly-rated half. Table 3 indicates which mechanics, themes, and genres had the greatest differences in these proportions. We list two mechanics, two themes, and two genres for non-digital games; however, because of ties for second place, we list three themes and three genres for digital games.

Our second method of answering this question was to calculate the composite average rating of all educational games associated with each mechanic, theme, and genre in the BGG and VGG databases. Table 4 indicates the three highest- and three lowest-rated game elements for digital and non-digital educational games.

Discussion

In this section, we examine and interpret the results presented in the previous section; we also discuss some limitations of this study.

Research Question #1: Average Number of Mechanics, Themes, and Genres per Game

The results of this study seem to indicate that players find different game elements salient in non-digital games than they do in digital games. Games in the digital game database had the highest average number of mechanics, the second highest average number of genres, and the lowest average number of themes. On the other hand, games in the non-digital game database had a higher average number of themes and a lower average number of genres. This seems to correspond with the general nature of non-digital and digital games: Mechanics are central to the way that board and card games are learned and played (Mayer & Harris, 2010) whereas themes play an important supporting role that is nonetheless optional. On the other hand, the computing power associated with digital games minimizes the importance of individual mechanics while making themes and game worlds increasingly immersive (Salen & Zimmerman, 2004; Sicart, 2009). Those evaluating or designing educational games may wish to use these data to know what game elements to focus most on. Researchers, on the other hand, should explore whether this trend is true generally of games (or even an effect of the structure of the BGG/VGG databases) or if it is unique to educational games.

Research Question #2: Frequently Appearing Mechanics, Themes, and Genres.

Two things are remarkable about the game elements that appear frequently in this data: their nature and their ratings. First, the data seem to indicate that educational games frequently

include game elements that can be easily associated with education and learning. For example, since education is often associated with younger ages, it is not surprising that the *Children's* digital theme and the *Children's Game* non-digital genre both showed up as common game elements. Likewise, the non-digital game data identifies *Trivia* as a common genre; this element is easily associated with a vision of education as a means by which people memorize facts about “reading, ‘riting, and ‘rithmetic.” In the digital game data, common genres include *Puzzle* (which is also a common theme) and *Simulation*, which might be considered more cerebral or intellectual than other digital game genres (although *Adventure* also makes the list). It may be the case that educational game designers try to include game elements that wouldn't seem out of place in a classroom so as to better justify their existence.

However, these game elements are also noteworthy for how they are rated. With a composite average rating of 5.15, the *Children's* theme is the fourth poorest-rated of the digital themes; furthermore, the *Children's Game* non-digital genre is present in a much higher proportion of low-ranking games than of high-ranking games, representing one of the highest such differences in proportions. The *Cartoon* and *Cute Fantasy* digital themes, which could be considered means of appealing to children, rate even poorer than *Children's*. *Roll / Spin and Move*, the second most common mechanic in the non-digital data, is an easy-to-learn mechanic associated with many children's games (Mayer & Harris, 2010), but is also the poorest-rated mechanic. Higher-rated (and therefore presumably more engaging) game elements (e.g. *Adventure*) also appear frequently in educational games, but the frequency with which these poorly-rated elements appear recalls Prensky's (2003) criticism of edutainment as sufficiently engaging for young children but as ultimately failing to take advantage of the true potential of modern games. While some game elements may be more obviously fit for educational games

than others, educational game designers should also ensure that they are also fit for engaging gameplay before adopting them (Van Eck, 2006).

Research Question #3: Relationship of Game Elements to Game Ratings

Our discussion of the second research question has already indicated some important interactions between game elements and game ratings, but there are other results worth highlighting. The *Religious* and *Novel-based* themes are among the least popular in the non-digital game data, reinforcing the idea that having an obvious tie to education does not necessarily mean that a game element is a good choice for an educational game. Bogost (2007) points out that many religious games are concerned mostly with thematic elements and have comparatively less focus on issues of mechanics and genre; we suspect that this is also the case for games based on novels. As previously discussed, however, mechanics and genres play an important role in all non-digital games; it may be the case that religious and novel-based games are over-attentive to questions of theme and fail to include the necessary mechanics to truly engage players. Likewise, since theme is seemingly the most salient aspect of digital educational games, it is perhaps no surprise that *Zombie* and *Horror*, themes that are common in pop culture if not in traditional educational media, are the highest-rated themes in the digital game database. Taken as a whole, these trends suggest that good educational games follow the rules of what makes good games in general. If their goal is engagement, educators and game designers may wish to take some cues from popular entertainment games when choosing or creating educational games.

This idea is reinforced by one of the apparent differences between our two data sets. Two of the three games with the highest Bayesian averages in the non-digital game database are *1775*:

Rebellion and *1812: The Invasion of Canada*, two wargames that were designed as both entertainment and educational games. Other highly rated non-digital games in our data include games that were not designed with teaching and learning in mind, but are considered by the BGG community to have educational properties. However, *1775* and *1812* are notable because as a result of their inclusion, not only is *Wargame* the most popular genre in the non-digital game data, but at least two of the most popular themes (*American Revolutionary War* and *American Indian Wars*) and the two most popular mechanics (*Campaign / Battle Card Driven* and *Area Movement*) are also chiefly associated with wargames. On the other hand, although digital games such as *SimCity* and *Minecraft* are also considered both entertainment and educational games, and although entertainment games such as *Civilization III* have notably been repurposed for educational purposes, these titles have all been excluded from the *Educational* genre on VideoGameGeek. Given contemporary arguments for the value in using commercial games in educational settings (e.g. Charsky & Mims, 2008; Mayer & Harris, 2010), their inclusion would have contributed to our ability to evaluate those arguments. Although we cannot yet establish a clear causal connection, the inclusion of repurposed educational games and “hybrid” entertainment/education games in the non-digital game data and their exclusion from the digital game data may be part of the reason that *Educational* is one of the poorest ranked genres in the digital game data but is, with a composite average rating of 6.43, the fifth highest-ranked genre in the non-digital data.

Limitations

Many of the limitations and challenges in this study are related to the data we chose to use. BoardGameGeek and VideoGameGeek were chosen because they provide a large existing data set, offer a publicly available API for accessing data, share comparable rating systems, and

are affiliated with an established gaming community. However, other game review websites may provide more helpful information for answering our research questions; this is especially true for digital games, as VideoGameGeek does not enjoy the same status in the videogame community that BoardGameGeek does in the board game community. We also concentrated on only a small number of the features in the BGG and VGG databases and may have benefited from also analyzing game descriptions and written game reviews: A content or keyword analysis of game reviews could be instructive in identifying commonalities that emerge in reviews of educational games. Such an analysis could potentially shed light on players' interpretations of key terms like theme, mechanics, and genre as well as the value they place on each.

Another major challenge encountered in this study (and in studies of games in general) is the absence of agreed-upon definitions and categorization schemes for game mechanics, themes, and genres. Indeed, the difficulty of disentangling mechanics and theme is a common point of discussion in game design (Schell, 2008). We cannot be certain how familiar registered users of BoardGameGeek and VideoGameGeek may be with game terminology, and relying on these communities' understanding of educational games, mechanics, genres, and themes has created a number of peculiarities. For example, not only do these communities differ on what qualifies as an educational game (as described above), but BoardGameGeek recognizes *Memory* as both a Mechanic and a Category and VideoGameGeek recognizes *Puzzle* as both a Genre and a Theme. This all seems to suggest a lack of clarity and consistency in their thinking that impedes the interpretation of our results. Furthermore, even if these definitions were consistent, it is possible that they differ from those of game designers and scholars. Game genres also overlap and can even change and evolve over time (Foster & Mishra, 2009). Yet these challenges are not unique to this study, and we remain hopeful that our results will contribute to a better understanding of

the ways in which these terms are understood in game communities, especially as they relate to educational games.

Furthermore, our study is limited by the constraints of a descriptive study design. While this approach is sufficient for indicating some important trends in how game elements are used in educational games, it does not yet indicate whether these trends are statistically significant. In future work, we intend to identify and apply appropriate statistical analyses in order to strengthen our conclusions. In addition, our analysis does not break down videogame ratings by platform. Console, mobile, and PC games have been consolidated under the designation “videogames” due in no small part to the fact that VGG’s database is considerably smaller than that of BGG. However, further insights about the affordances and constraints of different game media could be gained through a breakdown of VGG educational videogame ratings by platform. In the same vein, the scope of this work is limited by a content-neutral approach (Foster & Mishra, 2009). That is, the data as it is currently organized does not allow us to examine whether trends in science education games differ from those in history education games. Future studies might evaluate results by specific content area and learning outcomes.

Conclusion

In this study, we examine data from the game databases BoardGameGeek and VideoGameGeek to explore the role of mechanics, themes, and genres in educational games. In answering our research questions, we first determined that mechanics are the most salient game element in non-digital educational games while themes are the most salient game element in digital educational games. We further found that many of the game elements that appeared frequently in educational games were those that seemed to have an obvious connection to

education; however, other findings suggested that many of these same elements were not considered engaging by the players, suggesting that the easy route to educational game design is not always the best. We also found that some players (notably in the BGG community) considered a good educational game to be an engaging game that could be repurposed for education. Together, these trends seem to reinforce the oft-repeated idea that an engaging game for education follows many of the same principles as an engaging game for entertainment. Although educators and educational game designers should also be concerned with the effects of games on teaching and learning, they should not hesitate to take cues from entertainment games when considering issues of student engagement.

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Table 1

Average Number of Game Elements (per Game) for Digital and Non-Digital Games

<u>Type of Game Element</u>	<u>Non-digital games</u>	<u>Digital games</u>
Mechanics	2.55	n/a
Themes	0.92	1.47
Genres	1.42	0.79
Total	4.90	2.26

Table 2

Game Elements (by Percentage) Most Often Associated with Educational Games

Non-Digital Games					
Mechanic	%	Theme	%	Genre	%
Dice Rolling	16.67	Animals	8.73	Card Game	33.73
Roll / Spin and Move	15.08	Travel	7.94	Children's Game	26.19
Hand Management	15.08	Environmental	7.54	Trivia	19.84
Digital Games					
Mechanic	%	Theme	%	Genre	%
		Children's	23.27	Puzzle	11.95
		Puzzle	10.06	Adventure	10.69
		Abstract	8.18	Simulation	10.06

Table 3

Largest Differences Between Highly- and Poorly- Rated Games by Game Elements

	proportion in “highly-rated”	proportion in “poorly-rated”	difference in proportions
<u>Mechanics (Non-Digital Games)</u>			
Roll / Spin and Move	.0000	.2644	-.2644
Card Drafting	.2184	.0575	.1609
<u>Themes (Non-Digital Games)</u>			
Movies / TV / Radio	.0115	.1264	-.1149
Humor	.1034	.0345	.0690
<u>Genres (Non-Digital Games)</u>			
Children’s Game	.1724	.3218	-.1494
Card Game	.4483	.3333	.1149
<u>Themes (Digital Games)</u>			
Children’s	.1139	.3544	-.2405
Historical	.1139	.0253	.0886
Board Game	.0886	..0000	.0886
<u>Genres (Digital Games)</u>			
Strategy	.1139	.0253	.0886
Adventure	.1392	.0633	.0759
Simulation	.1392	.0633	.0759

Table 4

Average Game Rating of Highest- and Lowest-Rated Educational Game Elements

Non-Digital Games					
Mechanic	Rating	Theme	Rating	Genre	Rating
Campaign / Battle Card Driven	7.58	American Revolutionary War	8.05	Wargame	7.56
Area Movement	7.49	Age of Reason	7.83	Party Game	6.61
Variable Player Powers	7.43	American Indian Wars	7.70	Trivia	6.58
<i>(42 other mechanics)</i>		<i>(37 other themes)</i>		<i>(12 other genres)</i>	
Storytelling	4.90	Music	4.63	Action / Dexterity	5.25
Memory	4.89	Novel-based	4.57	Racing	4.99
Roll / Spin and Move	4.72	Religious	4.07	Print & Play	4.44
Digital Games					
Mechanic	Rating	Theme	Rating	Genre	Rating
		Horror	7.31	Strategy	7.32
		Zombies	7.31	Light Gun Shooter	7.31
		Ocean / Sea	7.11	Adventure	6.91
		<i>(6 other themes)</i>		<i>(5 other genres)</i>	
		Jungle	4.33	Educational	6.10
		Cartoon	4.62	Platform	5.68
		Cute Fantasy	4.73	Life Simulation	5.58

Appendix A

Glossary of Selected Game Mechanics and Genres

BoardGameGeek and VideoGameGeek have both developed a comprehensive jargon to describe different game elements. Although themes are typically straightforward and easy to understand, mechanics and genres can be more technical. For this reason, we include here a brief definition of all of the mechanics and genres referred to in this paper:

- *Action*, a genre of digital games that emphasizes quick gameplay and precise coordination
- *Action/Dexterity*, a genre of non-digital games in which players must physically manipulate game components in tests of skill in order to advance the game
- *Adventure*, a genre of digital games that center around a story and put the player in the role of a hero or protagonist
- *Area Movement*, where a game board is divided into distinct areas (e.g. *Risk*) and players move pieces between those areas;
- *Campaign / Battle Card Driven*, a wargame mechanic where players are limited to the actions described on the cards in their hand
- *Card Drafting*, a mechanic where players choose cards from a collection common to all players
- *Card Game*, a genre of games in which cards play a central role
- *Children's Game*, a genre of games designed with children in mind and typically having child-appropriate themes or simpler mechanics
- *Dice Rolling*, a mechanic where rolling one or more dice plays an important role in the game

- *Hand Management*, a mechanic where players try to play cards in a certain order or in certain combinations
- *Life Simulation*, a genre of games in which the player controls one or more persons or animals
- *Light Gun Shooter*, a genre of games that uses a gun-shaped controller (e.g., the NES game *Duck Hunt*)
- *Memory*, a mechanic where players must recall information to do well in the game
- *Party Game*, a genre of game that can be played with large groups of people and that often emphasizes interaction and humor over strategy and winning
- *Platform*, a genre of games in which the player controls a character who jumps between platforms and over obstacles
- *Print & Play*, a genre of games in which players download and print out all of the game components
- *Puzzle*, a genre of games in which puzzle- or problem-solving is a large part of the gameplay
- *Racing*, a genre of games that emphasizes moving to certain places on the board as quickly as possible
- *Roll / Spin and Move*, a mechanic where players roll a die or spin a spinner and move that many spaces on a board
- *Set Collection*, a mechanic where players try to collect items having a certain characteristic in common
- *Simulation*, a genre of games that attempts to model real-world events with varying degrees of fidelity

- *Storytelling*, where players collectively tell a story that drives the game
- *Strategy*, a genre of games that emphasizes strategic and tactical thinking but, in the VGG database, may be distinct from the *4x Strategy* and *Real Time Strategy* genres
- *Trivia*, a genre of game where players ask questions to advance in the game
- *Variable Player Powers*, a mechanic where each player plays according to slightly different rules
- *Wargame*, a genre of games focused on direct combat and requiring tactical and strategic thinking

Appendix B

Game References

In this appendix, we provide information on all of the games that have been referenced in this paper:

- Academy Games (2013). *1775: Rebellion* [board game]
- Academy Games (2012). *1812: The Invasion of Canada* [board game]
- Cubicle 7 Entertainment (2012). *Dr. Who: The Card Game* [card game]
- Electronic Arts (2013). *SimCity* [PC and Mac game]
- Infrogrames/Atari (2001). *Sid Meier's Civilization III* [PC and Mac game]
- MicroProse (1987). *Sid Meier's Pirates!* [Apple II, Apple IIGS, and PC game]
- Microsoft Game Studios (2009). *Halo Wars* [Xbox 360 game]
- Microsoft Studios (2001). *Halo* [Xbox and PC game]
- Milton Bradley/Hasbro (1956). *Yahtzee* [dice game]
- Mojang (2009). *Minecraft* [PC and Mac game]
- Nintendo (1984). *Duck Hunt*. [NES game]
- Nintendo (1985). *Super Mario Bros.* [NES game]
- Nintendo (1988). *Tetris* [NES game]
- PlayFirst (2004). *Diner Dash* [PC and Mac game]
- Wizkids Games (2011). *Star Trek: Fleet Captains* [board game]