Tug-of-War 2.0: A Digital Card Game

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Introduction

Tug-of-War is a networked card game designed to help youth develop fluency with fractions. One of the challenges of describing an educational game is to distinguish among the many aspects of learning that are important to learning designers. We will use the Seven Circumstances of Game-Base Learning framework (Arena, 2011) to communicate the learning aims of *Tug-of-War 2.0*. After applying the framework, we will discuss *Tug-of-War* in more detail, describing its history and the new features in this digital version.

The Seven Circumstances

The seven-circumstances framework is a rhetorical device from ancient Greece. In this context, it can be used to help designers explicate the learning that occurs in and around an educational game.

Who is the learner? *Tug-of-War* is designed for upper-elementary students who have had lessons about fractions but have not achieved full fluency with the concepts.
What is being learned? Our game teaches and reinforces techniques for developing a "rational-number sense" (e.g., deciding whether 7/15 is bigger or smaller than .5) and performing fractional operations on whole numbers ("What is 3/4 of 8?"). To measure what was being learned, we used a paper assessment as a pre-/post-test containing questions directly relating to the aforementioned questions. We also recorded videos of students as they progress in the game, as well as observed help-seeking behaviors that children displayed while playing the game.
When does the learning occur? Students are introduced to and practice these techniques before and during gameplay.
Where does the learning occur? *A*lthough there are introductory videos to teach about game mechanics and basic fractions concepts, the learning occurs primarily in-game and in players' conversations with their partners and opponents (gameplay is 2 vs. 2) about effective strategies.
Why is the learner playing? While our research was conducted mostly in classroom studies where gameplay was compulsory, students routinely asked whether they would get to play again next week, suggesting that they found the game to be fun. We hope for the game eventually to be voluntary and extracurricular.
How does the learning occur? The introductory videos present game mechanics and basic fractions concepts through direct instruction. Gameplay learning occurs primarily through situated exposure to fractional operations on whole numbers and comparisons among different representations of rational numbers: players have to solve such problems to arrange their teams for the tugs-of-war that end each round of play. These repeated opportunities to practice and build fluency come with corrective feedback from both peers and the computer, and they are supported by the use of virtual manipulatives to offset cognitive load (Martin, 2008). We used a paper assessment as a pre-/post-test containing questions directly relating to what we were hoping to measure, including items such as "What is 1/4 of 12?". We also recorded videos of students as they progress in their learning of the game, as well as observed help-seeking behaviors that students displayed while playing the game. Lastly, we kept logs of the student's activity as they play the game to track their progress with understanding the material.
With what does the learning occur? The digital version of *Tug-of-War*, a networked card game written in Java, was built by one of the authors over the span of a few months, based on a successful physical version of the game. For an more in-depth review of our measures and experimental design, see our earlier paper (Jiménez, Arena, and Acholonu, 2011).

The *Tug-of-War* Game

Having explained how the learning fits into *Tug-Of-War*, we would like to now explain the game itself and its construction. Using an iterative design approach that started with paper prototypes, we have created a game that is relatively easy for children to learn, that they find enjoyable, and that has demonstrated success in helping them learn how to perform fractional operations on whole numbers.

The game is based on a series of fictional tug-of-war battles, in which students strategically play cards to increase their own strength or diminish their opponents' strength. The goal in each round of play is to choose cards that will create the biggest disparity in strength. To maximize disparities, students must compare fractional values and decide how best to play their cards. This digital version (see Figure 1) was based on an earlier paper version. Students who played the paper version demonstrated significant learning differences when compared to their counterparts on a statewide standardized test (Jiménez et al., 2011). The current digital version of *Tug-of-War* was developed as the successor to the earlier version; it, too, has been shown to help students build fluency with fractions (Acholonu et al., 2012).

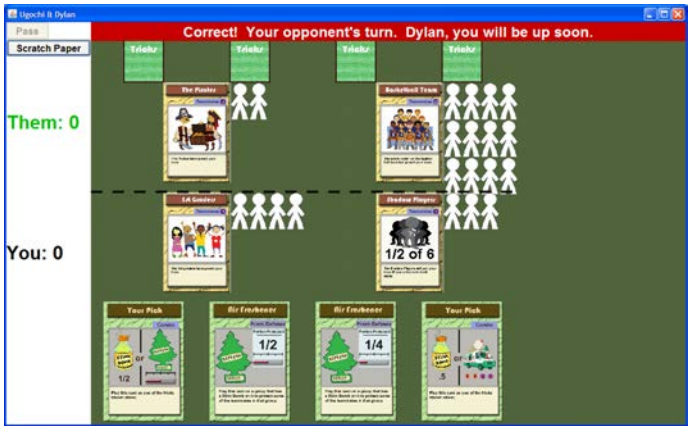

Figure 1: **A screenshot of the digital version of Tug-Of-War.**

The digital version of *Tug-of-War* was implemented as a networked Java application, where players and their partners take turns choosing which cards to play against an opposing pair of students. The digital version takes much of the game management away from the students and serves as a moderator for rules that are logistically but not conceptually important. Rather than immediately disallowing incorrect moves, the game provides the students with opportunities to make mistakes and learn from those mistakes. The computer version also has a *Show-me-how* button, which plays animation that reviews the strategy they should take to perform a fraction and walks them through all the steps. What *Tug-of-War* lacks in animations, flashy graphics, and 3D realism, it compensates for with measurable learning outcomes and design decisions that may foster discussion in the educational game landscape.

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Creative Play and Social Impact

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YourTurn! The Video-Game

"YourTurn! The Video-Game" (http://yourturn.fm) is a social network game about creating YouTube video mash-ups with other players made to foster social interaction, communication and the reflection of cultural identity among juveniles, primarily in Vienna, Austria, but the game has also been released internationally. YourTurn! is accessible on Facebook where players engage in ›versus‹ battles. Taking turns, they select short snippets of Youtube (music) videos, which they append to a mutual video mix. Playing against each other leads to a shared and creative result; a video mix made by two players who previously did not know each other. Thus YourTurn! brings together youth of different ethnicity, gender and place of residence who normally would not be in contact with one another. Thereby, music acts as identity-related tie (Solomon 2009). The sustained yield of the forming relationships is supported by a series of events and workshops.

Figure 1: The start page of YourTurn!, which shows the most popular video mixes and opportunities to contribute.

A pre-study in Vienna, Austria and insights on media use and everyday social interaction shaped the design of the game. YourTurn! builds on core mechanics which enable it to become a playful means of communication, transform competitive play into cooperative play, facilitate a shared reflection of culture and identity and train media literacy.

Background Information

Preceding studies show that youth in Vienna tend to segregate into closed ethnic groups (Weiss, 2007; Götzenbrucker & Franz, 2010; Thomas & Crul, 2007). To answer the central research question

›*Can an online social music game allow Viennese teenagers to change their understanding of cultural diversity in order to overcome cultural and ethnical boundaries?*‹ a game is designed, developed and evaluated within a multidisciplinary academic setting (Kayali et al. 2011) involving partners from social and political sciences, informatics, game research and game industry. The game builds on 51 personal interviews conducted between March and June 2011 with 27 male and 24 female teenagers living in Vienna. The results of this research helped identify touch points for the game intervention and provided starting points for drafting the game's design. The interviews showed that an overwhelming majority uses Facebook and Youtube on a regular basis. It also became clear that these web services are not only used daily but that they have become an essential means for social interaction and media consumption. Hence we decided to use communication through media especially through music videos to be the core of our design.

The study led us to use the following core mechanics, which shall foster social impact through creative play:

- The back and forth of cutting and appending videos becomes a playful means of communication, fosters togetherness and helps expand social boundaries.

- Players engage in a VS battle but in the end they create something together. The transformation of competitive play into cooperative play is a crucial step towards bringing participating youth closer to one another and supporting inter-ethnicity in their social networks.

- Videos are created based on a topic and for example allow players to reflect their place of residence together. Taking turns players negotiate meaning by submitting adequate video responses. The free association style of play enables shared cultural reflection and furthers the process of acculturation (Berry, 2001).

- Other topics allow players to express their identity. Doing this together fosters intercultural understanding. Striving for game goals together ideally overrides the cultural restrictions present in everyday life.

- Players gain media literacy. Finding a matching clip means learning to reflect communication, aesthetics and context.

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