

Learning Math through Competition, Design and Social Play

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Abstract *+Plus Out* is a card game where players practice math skills by battling with high numbers to win the game. It is a competitive, 2-4 player short-form game, designed to increase fluency in addition, subtraction, division and multiplication. Students, parents and teachers can design new rules to create their own games and modify the deck to fit different knowledge levels. The principles of player control, exploration and interaction keep players engaged in practice at home and school while easy customization helps meet a range of teacher needs in the classroom.

Way to Play: A Game of Strategy in High Numbers

A full 72-card deck holds 48 Number Cards and 24 Power Cards, which range through 1-12 for all four types: (+, -, x and ÷) (see Figure 1). Each turn, everyone draws three new cards. Players combine two Number Cards from their hand to build a high number. Whoever has the highest number wins the battle, and first to win six battles wins the game. After everyone has played their Number Cards, they can counter-attack with rare Power Cards, such as adding +10 to boost their score and win the battle.

Following is a short player scenario between Tsai and Nala who are playing at school.

Nala has two Number Cards: a Red-5 to add and a Blue-3 to multiply. She can build a combo for 8 points ($5 + 3$), by choosing the addition sign, or build a combo for 15 points by multiplying (5×3). She plays her combo for 15 points and Tsai plays a combo for 24 points! Next, they can counter-attack. Nala uses two Power Cards: a (plus) +10 to boost her score to 25 and a (minus) -10 bring Tai's score down to 14. Now the score is 25 versus 14! Tsai can also counter-attack but Nala's quick strategy reversed the battle!



Figure 1: Numbers Cards are on the top row and Power Cards on the bottom row. The 48 Number Cards range through 1-12 for all four types: (+, -, x and ÷).

Informed Design: Learning Principles and Practice Spaces

Solving and creating number problems are core mechanics of gameplay. Players are empowered to have control over what they solve; they can take risks on the interactions between numbers and, unlike a quiz, the game allows players be social, competitive, and collaborative in their problem solving. Challenge, exploration, risk taking, agency and interaction are a few key learning principles that informed the mechanics design (Gee 2004, 2006).

Game designer and researcher Kurt Squire calls this setting a “*social practice space*”---a motivational safe zone where learners can socialize, compete, compare and help one another while practicing through gameplay, using the same skills they rely on for homework or in the classroom (Squire 2010). Used as a fun practice tool, teachers can engage with students while refining their skills. There is also room for independent playful learning among

groups to focus on their strengths or tackle weaknesses.

Versatility: Building Ways to Play and Learn

Customization is a core principle that helps accommodate differences between learners (De Freitas 2008). Teachers can build decks for specific goals, like a deck of only addition and subtraction Number Cards, geared toward first and second graders. Or switch all positive numbers in a deck with negative numbers to gear toward fifth and sixth grade. Gradually introducing higher cards lets students to grow at their own pace (see Figure 2). Special education teachers may be interested in sharing collections of rules to fit the learning and playstyles of their students. Following is scenario in a 3rd grade classroom.

Mrs. Ella sees most of her students are enjoying the game while four students seem to be struggling. Later in the day, she creates two new simple winning goals and a multiplication-only deck for them to focus their skills. Mrs. Ella saves the deck style and the new rules so she can later build an addition-and-subtraction-only deck for her husband's second graders to play and create their own games too.

Conclusion: Opportunity to Design Their Own Learning

Like teachers, players can be co-creators of their practice spaces too: building new decks, creating their own rules, sharing their strategies and making self-paced challenges (De Freitas 2008). What if students designed games for one another? What if homework involved playing or designing with mom, dad or siblings at home? What if players also become designers of their own learning? *+Plus Out* provides players and educators a high level of flexibility for custom experiences and a foundation for fun learning.



Figure 2: Teachers might introduce high card numbers gradually (like 15 to 30). Or create a deck of negative numbers to fit fifth and sixth grade concepts (-1 to -12).

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