

Using Catan as a Vehicle for Engaging Students in Mathematical Sense-Making

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Catan is an increasingly popular board game which is rich with opportunities for mathematical applications. The research presented in this poster demonstrates how Catan served as an effective vehicle for engaging students enrolled in a freshman learning community. Students engaged with various mathematical concepts involving probability, combinatorics, and game theory.

Keywords: student engagement, motivation, mathematical reasoning, combinatorics, games

Games provide unique opportunities for students to engage in mathematical reasoning (Canada and Goering, 2008; Capaldi and Kolba, 2017). Using games in teaching applies to all four components of Keller's ARCS model of Motivation Design Theory (1987). Catan is a property development and trading-based game with a board which is set-up differently every time you play. This dynamic board and other aspects of the game provide several opportunities for students to engage in mathematical reasoning to improve their chances of winning (Austin and Molitoris-Miller, 2015). Players place settlements and roll dice to collect resources from resource tiles adjacent to their settlements. Resources are used to build more structures which increase card production or score points. In this study we explored the ways in which using Catan in a general education course for freshmen affected their engagement and motivation.

Participants were freshman students from a variety of majors enrolled in a freshman seminar course which was part of a learning community coupled with a section of pre-calculus. The course consisted of general college skills as well as opportunities to play Catan and discuss the related mathematics. Data were collected throughout the course of a semester in the form of written class work, homework, projects, exam items, and two online surveys.

Preliminary analysis of the data indicates that the game supported students' engagement in mathematical reasoning around a variety of ideas. The use of two different color dice in the game helped clarify justification behind the probability of rolling 2 through 12 using two standard six-sided dice. Determining which player to rob one resource card from in order to maximize the chance of obtaining a desired resource supported reasoning about probability and fraction comparison. Evaluating which locations to choose for initial settlements invoked various considerations of expected value including: the value of each resource based on production costs, the value of each resource based on rarity on a particular board, the probability of a settlement location producing a card, and the probability of a settlement location producing a rare resource. They also deduced results related to Bayes' Theorem by exploring if a particular resource is produced, what is the probability it came from a certain location. Survey results indicate that students saw value in learning mathematics in the context of Catan. 70% of students either agreed or strongly agreed that they enjoy using Catan to learn about mathematics. 75% of students either agreed or strongly agreed to "I understand mathematics best when I use an example or tool to figure it out."

These findings are aligned with other work which highlights the important links between games and mathematical reasoning. By utilizing Catan in this setting with freshman non-mathematics majors we have identified a creative way to make mathematics fun, engaging and accessible to students with a variety of mathematical backgrounds.

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