Research Question
How do students think about variation and expectation before, during, and after a game?

In our research, we drew upon teaching strategies documented in existing literature to help students develop more robust probabilistic reasoning. Nisbet and Williams (2009) expressed how creating a positive learning environment can help improve students’ attitudes towards mathematics. Using games in the lessons can provide a social aspect to the classroom that also leads to an increase in interest overall. McCoy, Buckner, and Munley (2007) expressed that using games, especially multicultural games, provides a rich and interesting context for applying important probability concepts. Turan (2016) outlined the importance of probability in education, focusing on experimental and theoretical probability and using a “guess-check-restate-check” method when conducting simulations.

References

We repeated the instructional design cycle above each week to understand students’ reasoning and refined each subsequent lesson based on the analysis (Ricks, 2011). Our process started with the experimental event, via our pre-interviews with the students. From there, we ran the interventions to relations based on their current understanding, and refined the lesson with our peers and faculty members.

Empirical Teaching and Learning Trajectory:

Each interview and lesson was video recorded. Transcripts were coded qualitatively and inductively in collaboration with faculty mentors. While coding, we focused on identifying normative and non-normative student reasoning. We also carried out axi coding to continuously group and re-code to produce a comprehensive portrait of the reasoning students exhibited.

Post-Assessment Results
Compared to the first interview, Violet did show some slight improvements. However, contextual details still confused her in many of the questions. Both Kari and Buddy showed much more improvement, using strong proportional reasoning in many of their answers. In many of the problems, Kari used a general understanding of the areas of spinners to expected values. For example, one problem had a spinner split up into three parts, with a 2:1:1 ratio. She recognized that the smaller parts were quarters and was able to correctly estimate how many would land in a quarter portion out of 300. Compound events still posed trouble for the students, something we did not have much time to address. Only Buddy was successfully able to state that the carnival game had a 25% chance to win (key item #3). He listed out the four different outcomes and determined how many would result in a win. Unfortunately, Robert did not attempt the final post-assessment due to responsibilities elsewhere.

Reflection and discussion: Many challenges surfaced as we designed and taught lessons. Students had difficulty understanding sampling with replacement; they tended to not trust this sampling method. Students also generally wanted the sample size to be a large percentage of what we would gather and be worried about pulling the same cube twice in a single sample. The seventh grade learning progression guiding our study involved compound events. Our experience suggests that several more lessons would be needed to prepare students to this topic; moving from a basic understanding of probability to understanding compound events is not a trivial matter. Although probability is not addressed until Grade 7 in the Common Core, it would be helpful for teachers in earlier grade levels to develop children’s understanding of beginning probability concepts so that the seventh grade curriculum is not overwhelming. Our study provides examples of how such understanding can be developed through games and other concrete activities.