Developing Students' Proficiency in 7th Grade Common Core Statistics

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Introduction

- **Background:** Research indicates that students in elementary and middle school often have difficulty understanding statistics and probability (Watson, 2005).

- **Purpose:** The purpose of this study is to examine how students think about and approach probability and statistics prescribed in the 7th Grade Common Core State Standards.

- **Research Question:** How can students' mathematical proficiency be developed for the language of probability, theoretical and experimental probability, and simple and compound events?

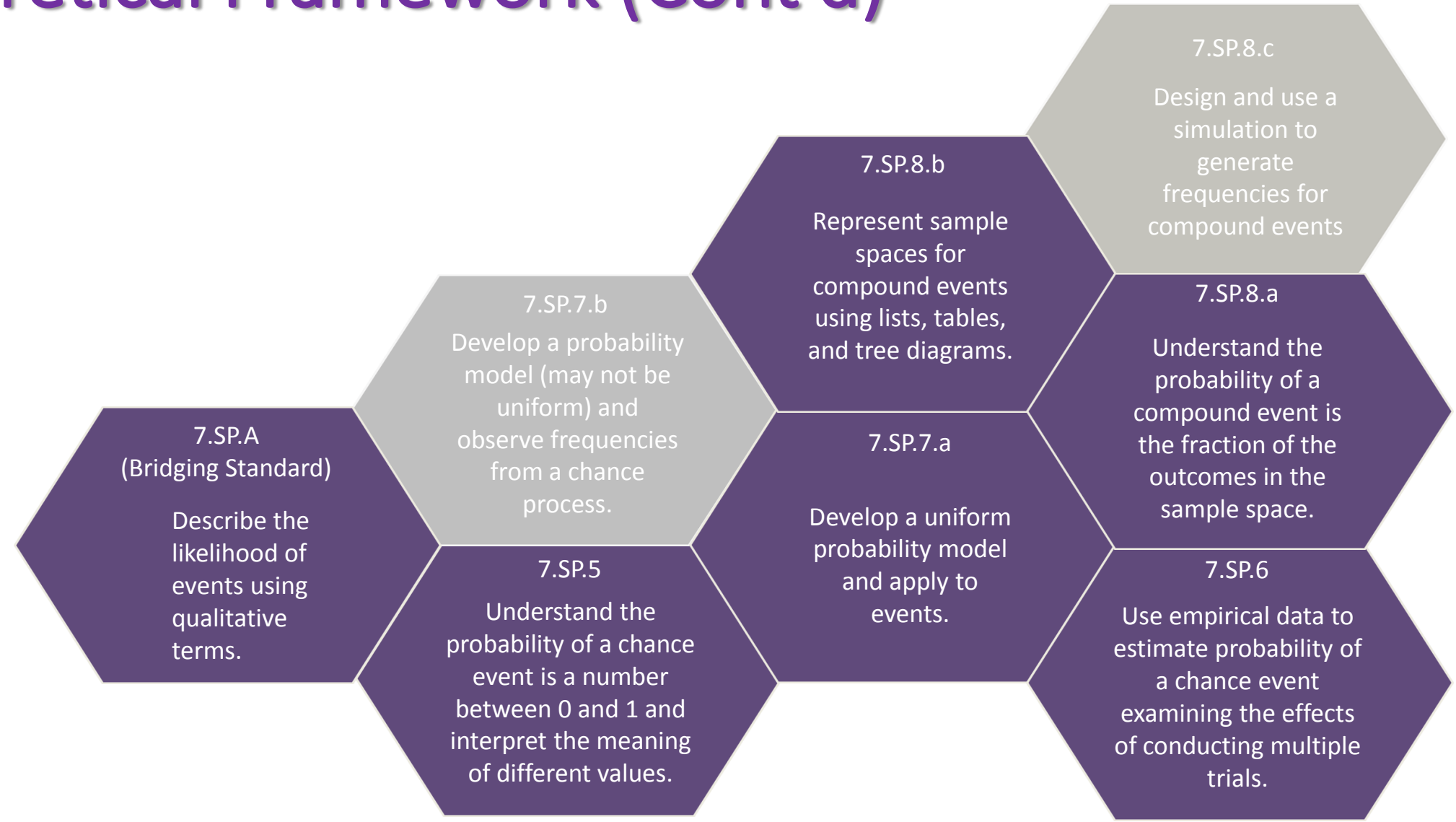
Theoretical Framework

Five Strands of Mathematical Proficiency

(Kilpatrick, Swafford, & Findell, 2001, p. 164)

Conceptual Understanding	• Comprehension and functional grasp of mathematical ideas and concepts which enables students to learn new ideas.
Procedural Fluency	• Skill in carrying out procedures flexibly, accurately, efficiently, and appropriately
Strategic Competence	• The ability to analyze and solve mathematical problems
Adaptive Reasoning	• Ability to logically explain and justify thought
Productive Disposition	• The habitual inclination to see mathematics as sensible, useful, and worthwhile

Theoretical Framework (Cont'd)



(Maloney, Confrey, Ng, & Nickell, 2014)

Methodology – Participants and procedure

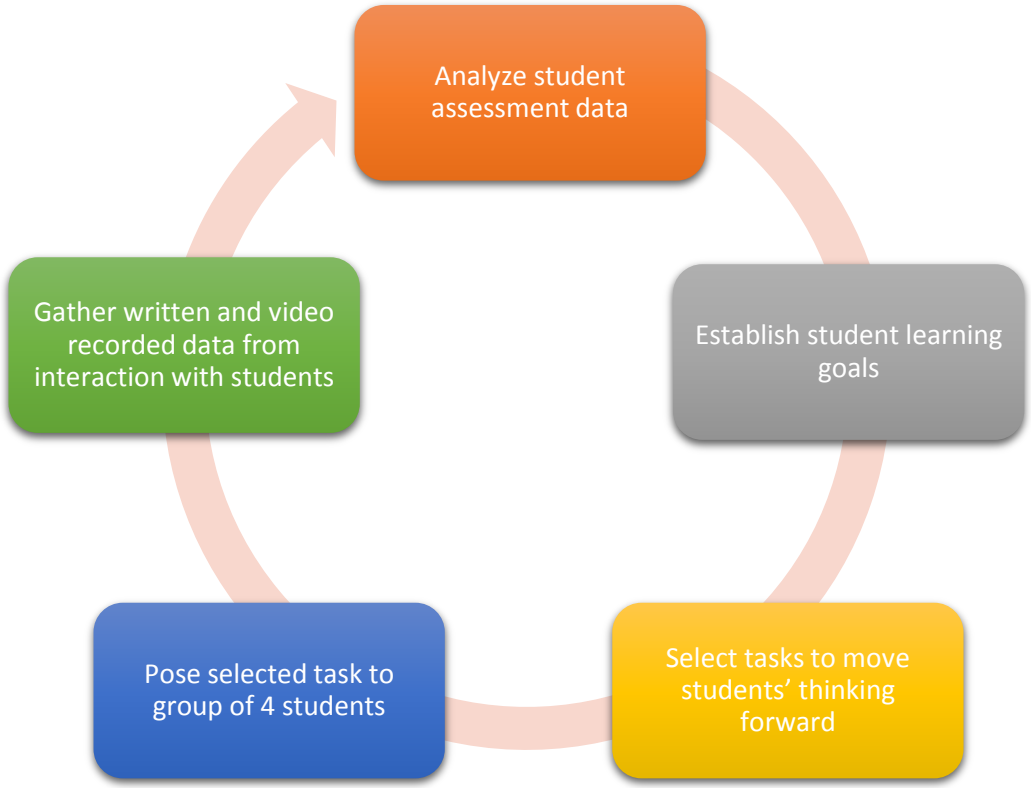
Participants: Four students, two male and two female, moving from 6th grade into 7th.

Time Frame: Seven one hour sessions plus a pre and post assessment interview

Participation Rate: One student missed one of the one hour sessions

Pseudonyms: Thomas, Nathan, Natalia, and Katherine

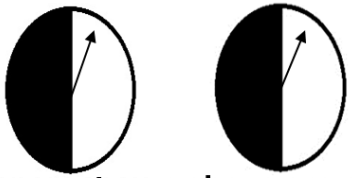
Pathways Instructional Cycle



Methodology – Data gathering and analysis

Interview Script:

- 30-minute clinical interviews with students.
- All questions were aligned with our targeted Common Core State Standards and sequenced according to the learning progression.
- We asked students to explain their answers and to think aloud as they answered the questions.



The two fair spinners shown above are part of a carnival game. A player wins a prize only when both arrows land on black after each has been spun once.

James thinks he has a 50-50 chance of winning. Do you agree?

(Zawojewski & Shaughnessy, 2000, p. 263)

Sample Question 2

Choose words from the word bank to describe how likely each event is. Explain your thinking for each item.

Word Bank	
Certain	Possible
Likely	Impossible
Unlikely	Rare
Evenly Likely	Almost Certain

(Romberg et al., 2003, p. 11)

1. You will have a test in math sometime this year.
2. It will rain in your town sometime in the next month.
3. You will meet the President of the United States sometime during your life.
4. You will roll a "7" on a normal number cube
5. In a room of 367 people, two people will have the same birthday

Match 'Em Up (Romberg et al., 2003, p. 13)

Dan is doing an experiment. He is holding pieces of paper of equal size, numbered 1-20. He is going to pick a number from the bag. Here are some of the possible outcomes for the number he will pick:

a. It will be even.
b. It will be divisible by five.
c. It will be a 1 or a 2.
d. The digits in the number will add up to 12.
e. It will be smaller than 16.

*Put the five statements on a ladder like the one to the right and explain why you put them where you did.

Sample Question 4

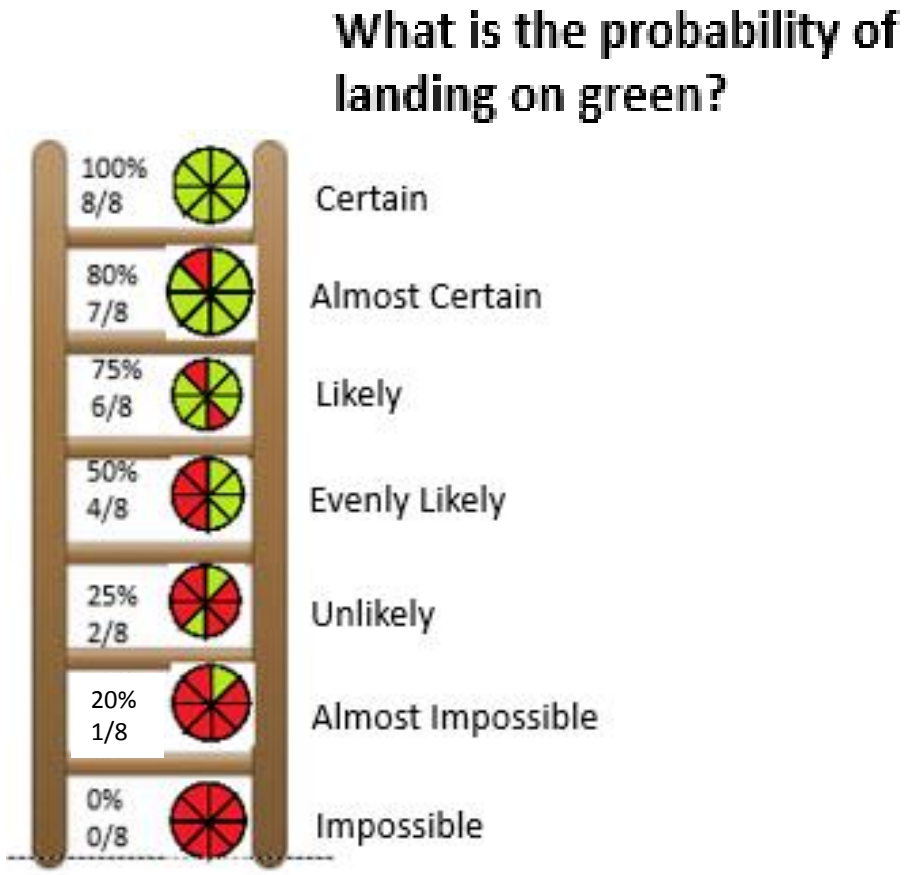
What is the probability of rolling a sum of 7 with two fair dice? What is the probability of rolling a 2 with two fair dice? Explain how you know.

Initial Assessment Results

- **Language of Probability:** The students were asked to pick the best qualitative term (e.g. certain, likely, impossible, etc.) from a word bank to describe a given scenario. When students were asked to determine the probability of the event “it will rain in your town sometime in the next month” their answers varied from certain, to likely, to rare.
- **Theoretical vs. Experimental Probability:** Three of the four students could accurately determine that when a coin is tossed 100 times it is not guaranteed the results will be exactly 50 heads and 50 tails.
- **Simple and Compound Events:** Each of the four students could accurately determine theoretical probabilities for simple events (e.g. the probability of rolling a 3 on a single fair die is 1/6). However, none of the students could determine accurate theoretical probabilities for a compound event.

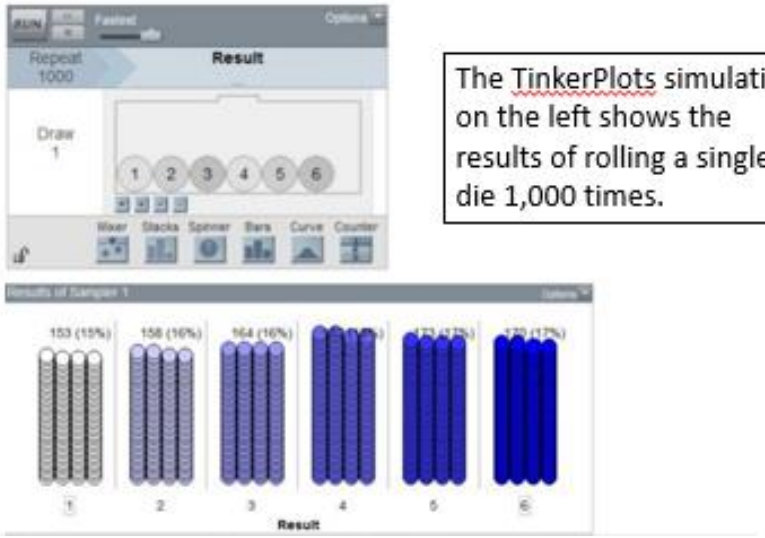
Qualitative Terms – Cluster 1

- These lessons asked students to describe probabilities using the qualitative terms: certain, almost certain, likely, evenly likely, unlikely, almost impossible, and impossible. They used these qualitative terms in conjunction with quantitative probabilities to help them complete the task shown to the right.



Theoretical and Experimental Probabilities – Cluster 2

- These lessons focused on having students identify and describe differences between theoretical and experimental probability.



The TinkerPlots simulation on the left shows the results of rolling a single die 1,000 times.

- After the conclusion of these lessons students were able to accurately identify scenarios as theoretical or experimental probabilities.

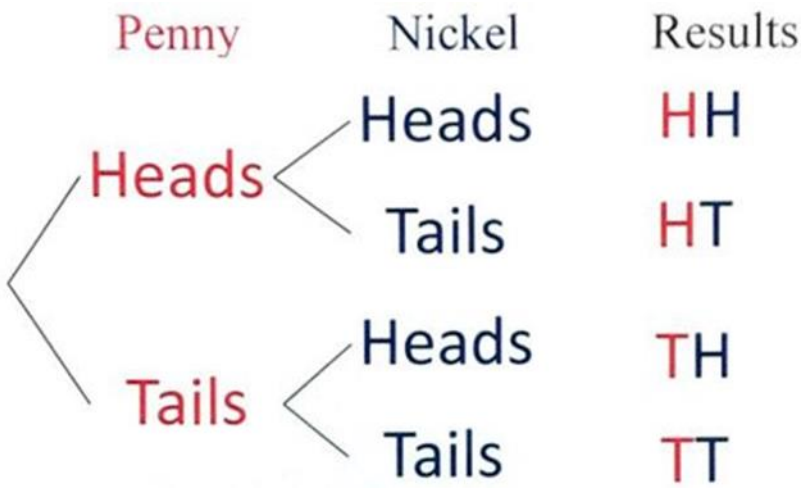
Sample Scenario:

Malik looks at a spinner that is divided into 6 equal sections; red, yellow, blue, green, purple, and orange. He says that the probability of landing on the green section is 1/6

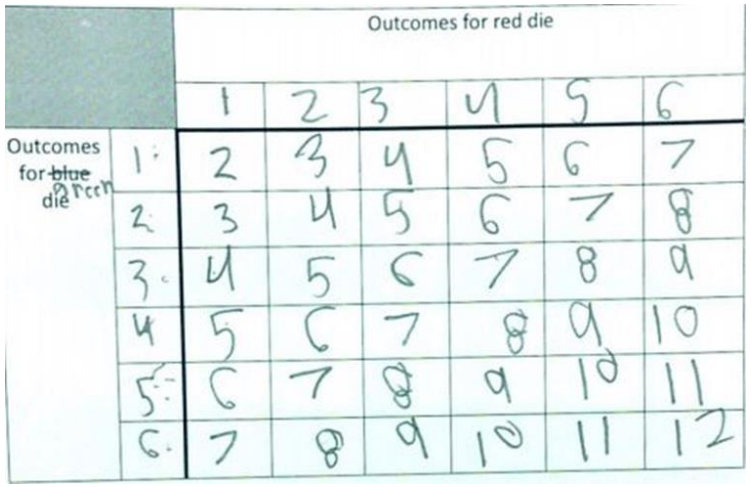
Compound Events – Cluster 3

- These lessons focused on having students analyze compound events and create probabilities for these events.

- During these lessons students were prompted to use probability models to assist them in determining theoretical probability



- After completing these lessons students were able to complete both tree diagrams and tables for multiple compound events (such as the one shown below). However, most students still struggled to accurately determine the theoretical probability of compound events.



Post Assessment Results

- **Language of Probability:** The students were asked to pick the best qualitative term (e.g. certain, likely, impossible, etc.) from a word bank to describe a given scenario. When the students were now asked to determine the probability for the question “it will rain in your town sometime in the next month”, three of the four students were now able to reason that this event is likely to happen.
- **Theoretical vs. Experimental Probability:** Four out of four students could now accurately determine that when a coin is tossed 100 times that it is not guaranteed that the results will be exactly 50 heads and 50 tails.
- **Simple and Compound Events:** Two of the four students could now construct a table/diagrams to help them determine the probability for a compound event.

Reflection and Discussion

Initial Difficulties: Students struggled the most with standard 7.SP.A and standard 7.SP.8.B.

7.SP.A

- Students found it challenging to use qualitative terms (e.g. unlikely, evenly likely, rare, etc.) when describing probabilistic events.
- **Suggestion:** Allow students time to gain a deep understanding of these terms even though they are included in a "bridging standard" not explicitly written into the CCSSM.

7.SP.8.B

- The problems that students faced with this standard stemmed from the fact that they struggled to understand when tables and tree diagrams should be used to determine probabilities.
- **Suggestion:** Encourage students to first list out the sample space prior to determining any theoretical probability.

References

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