EXPLORING FOURTH GRADE STUDENTS' PROBABILISTIC REASONING IN A GAME SITUATION BASED ON BINOMIAL TRIALS

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Previous studies of children's probabilistic reasoning often have focused on misconceptions children have or mistakes made in analyzing random experiments. Studies often do not involve instruction. The reason for children's mistakes could be due to inability to reason probabilistically, to a misunderstanding of the language used in probability, or to a simple lack of content knowledge. The purpose of the study reported here was to investigate children's ability to learn probability concepts associated with the negative binomial probability distribution. An intact class of fourth grade students (N = 21) served as participants. For two years these students had been playing a game called Skunk that involves repeated tosses of two dice. The students had little or no previous formal exposure to concepts in probability. In a series of eleven one-hour instructional sessions conducted by the investigator, the class was asked to explore the probabilistic aspects of the game. These sessions consisted primarily of oral and written questions presented to the group before, after, and during game playing.

Instructional sessions were held during normal "math" time in the regular classroom. In addition students in groups of three were interviewed five times, including right after the first session and one week after the last session. All instructional sessions and interviews were videotaped. Students were presented with the ideas of experiment, number of possible outcomes, equally likely outcomes, composite events, combinations (by use of Pascal's triangle) and probability of an event. Formal terms were avoided and instruction was focused on two questions: "How many ways can something occur?" or "What are the chances that something occurs?"

The game requires players to decide when to "pass" on another toss of the dice. Students frequently were asked to analyze their decisions. These decisions involved two types of concepts, game theory concepts and probability concepts. However, instructional sessions focused solely on probability concepts. By the last session most students exhibited some understanding of binomial trials and were able to calculate the probability of various types of outcomes. Lack of ability to multiply fractions was the major hindrance to students' success on standard questions. Students occasionally made decisions based on hunches (which might not be the wise probability move), but usually indicated they were aware they were going against the "odds." Students were using terms such as "odds" prior to the instructional sessions, but clearly meant something different from the formal mathematical definition. Results suggest that many students at this level are able to learn rather sophisticated probability concepts, but may have alternate meanings for mathematical terms typically used to discuss these concepts. The success of the students in answering typical probability questions seems to depend primarily on their ability to function with rational number algorithms.