THE ROLE OF SIMULATION IN SOLVING PROBABILITY TASKS

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One of the key components of probabilistic thinking is attention to outcomes within a sample space (Chernoff & Zazkis, 2011). Researchers are also interested in the notion of computational thinking, including the use of simulation and programming (Weintrop et al., 2016). According to Lockwood and De Chenne (2020), coding can "facilitate mathematical learning" in combinatorics, an area with close connections to the concept of sample space. In addition, simulations can lead to solutions which are very close numerically to those found using theory. This study investigates how learners interpret these two solution types within a probability task.

Methods

Using a clinical interview methodology (Clement, 2000), a preservice secondary mathematics teacher engaged with a probability task. Greg (a pseudonym), was asked to determine the likelihood of obtaining 3 blue marbles in a situation where 10 marbles are drawn without replacement from a bag containing 50 green, 20 yellow, and 30 blue marbles (theoretical solution using hypergeometric distribution approximately 0.2812). The interview was video recorded and transcribed, and analysis focused on Greg's two solution strategies.

Preliminary Findings

Greg's first strategy was to think about different "possibilities", referencing the task's sample space. He listed different "configurations" that would be possible, saying, "I could go through and do this systematically by hand." Greg stated that it would take a long time to list all of these out and seemed perplexed about how he would actually get to some sort of numerical solution, but that it might involve permutations or combinations. He then stated that his next step "would probably be to run some sort of simulation," going on to describe how he would "code" the situation using random numbers, conditionals, and loops, and run 10,000 trials in Excel to get an idea of what the likelihood might be. According to Greg, "What that would do is it would give me some sort of framework to judge my work." His results from the simulation would allow him to check whether his theoretical approach was going "in the right direction". The researcher then asked whether he would consider giving the results of his program as his answer to the task. He said, "Yes and no." While he would give the answer as an approximation, he believed that to answer the question "fully" he would need to go back to his theoretical method which involved enumerating all the possibilities. It appeared that he viewed the simulation approach as a way to verify a potential theoretical solution, not as a true solution in its own right.

Discussion

This research suggests that learners may view experimental or simulated solutions to probabilistic tasks differently than those they arrive at using theoretical methods involving concepts like sample space. In this case, it appeared that a theoretical solution was valued more highly by Greg than one which utilized programming, and that his simulation was primarily useful as an approximation or verification tool. This brings up questions about what it means to "solve" a problem involving likelihood. However, these conclusions are extremely preliminary, based on one individual's responses. More research needs to be done to see if others respond similarly to solutions found using theory versus those obtained using simulation.

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