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Seek First to Understand

 Intimidating. Frustrating. Time-consuming. Impossible. These are just a sample of the adjectives I used to describe complex puzzles a mere six weeks ago. When I began Mathematical Puzzles, I was interested in the idea of solving puzzles but was reluctant to accept the challenge they posed. It is possible that just the exposure to more puzzles increased my familiarity towards and therefore tolerance of these challenges. This reasoning, however, is far too passive, as I no longer simply tolerate puzzles: I have come to enjoy solving them. My change in attitude was brought about by an active pursuit to better my puzzle solving ability. I sought out methods that would allow me to tackle problems successfully; by making puzzles seem more reasonable, I have altered my perspective on challenges. I began my inquiry by examining problems in a non-academic context, but the scope of my search was too wide. I then found the advice in G. Polya’s novel *How to Solve It,* which breaks down the process of completing an intellectual challenge. These sources began my journey to find a successful problem solving method, and eventually I had a small epiphany. I had deduced a methodology that was both simple, yet profoundly impactful. The best approach when seeking a solution is to first examine the question; by seeking to understand the problem at hand one can more easily determine how to solve it.

 Not all puzzles involve geometric shapes, probability, or combinatorics. Life is full of situations that require problem solving skills and logical thinking. Common to all scenarios, though, was the necessity of understanding the problem truly in order to best determine how to tackle it. It appeared logical to first look at how one approaches day-to-day challenges in order to deduce a methodology that could be applied in the classroom. I found an article written by Tina Hutton in the Alternative Methods for Horsemanship forum. Her story caught my attention, as it speaks to the difference between solely seeking a solution, and gathering information about the problem in order to find the most logical approach. Hutton notes changes in teaching style by Jeff A. Moore, a man known in the equestrian world as a successful dressage instructor (Hutton). He has attained his most recent success by completely altering his teaching style. Hutton admires that this man moved from a “goal achieving, Get It Done” approach to one which “focuses the rider to observe what information the horse is conveying in both physical and behavioral ways” (Hutton). Jeff Moore had found success in his equestrian career in the past, but his methods overlooked the feedback from his horses and the riders. Eventually, in tuning his focus to solutions alone, he began to find barriers in his careers that could not be overcome. This successful dressage instructor now benefits from instead focusing his attention on all the information available. Diagnosis of the problem and understanding the cause lead him to find applicable solutions.

 Tina Hutton’s observation was a single example of how understanding the problem assists one’s ability to find a solution. One example is not sufficient, however, to draw the conclusion that this method is applicable to all situations. I then furthered my search to other realms of everyday life. If a deeper understanding of the problem could help with horses, could it possibly be useful for something else? An entirely different setting led to the same conclusion. This time, the problem arose in the computer gaming world. Conor Murphy, who is associated with the gaming company Big Fish, advises his consumers on how to best approach the various challenges of his games. He presents his advice as a list of ten items, the first of which is to “make a plan” (Murphy). His reasoning is simple: “think through the problem first, you’re bound to do well” (Murphy). This single piece of advice does not inconclusively demonstrate that understanding a puzzle is the best method to solve it, as only a single item on a list of ten is devoted to this topic. While glancing through Murphy’s advice, I picked up on a pattern. There were actually four more items devoted to gathering and understanding information about the problem at hand. These items were: #3 Look for Patterns, #4 Group Items, #5 Check your Inventory, and #7 Take Notes (Murphy). A top gaming executive made a list of ten items, half of which are devoted to focusing the consumer’s attention back to the information presented in the puzzle. Murphy asserts that carefully dealing with the information at hand is the most successful way to seek out a solution.

 Life provided examples across the entire spectrum of experience in which the information presented in the problem was the best foundation for finding a solution. From horses to computer games, a solid understanding of *what* one is dealing with is the basis to determine *how* to deal with it. This principle is portrayed in a more academic context in G. Polya’s *How to Solve It.* Polya details the best way to teach others in the art of solving puzzles, and breaks down the process into manageable pieces of advice. One reoccurring theme throughout the book is consistent with the principle deduced from the earlier examples: a puzzle is the starting point to its own solution. Polya even asserts that it is “foolish to answer a question which you do not understand” (Polya, 6). It is essential that the student understands the problem on both a “verbal” and “conceptual” level if he or she has any chance to solve the proposed problem (7). Three essential questions to ask are, “What is the unknown?”, “What are the data?”, and “What is the condition?” (2). Polya narrowed down the intimidating nature of every puzzle into three concise questions. Luckily for students everywhere, these three questions are answered in the puzzle itself. The “unknown” is the part of the puzzle that is going to be solved. Determining this entity is the objective of the puzzle. The “data” are all information pertaining to the unknown. Extracting relevant data from the wording of the puzzle and disregarding extraneous words simplifies the verbiage and makes the problem more manageable. Listing what you already know will help the student see the tools available to find a solution. The third question looks at the problem and how its parts relate. Are there certain solutions that are not plausible due to this condition? Are certain combinations not permitted in this puzzle? Must the solution have some element that satisfies this condition while still solving the puzzle as a whole? If a student can obtain a level of understanding great enough to satisfy Polya’s three questions, then he or she may finally embark on his or her journey to a solution.

 It is interesting that this simple method is applicable in everyday scenarios and in the world of academia. When I reflect on my experience in this course, one devoted to examining and solving mathematical puzzles, I realized the puzzles I was able to solve were when I had a solid understanding of the information presented in the problem. One example that stands out in my mind was a problem involving the hypothetical basketball player “Shaneal O’Kiel.” The problem was handed out on a slip of paper and contained the following information. Shaneal, at the beginning of her season, had a free throw percentage below 80%. By the end of the season, her percentage had risen above 80%. The puzzle then asked the reader if it was possible that Shaneal’s free throw percentage went from under 80% to above 80% without ever being equal to exactly that percentage.

 I looked at this problem and immediately got to work. I thought I could find the solution by doing some simple math in order to provide a single example that proved she did not, in fact, need to be at exactly 80%. I started with a simple example of 79 “makes” out of 100 total shots. This fraction indicates that Shaneal’s free throw percentage was under 80% at this point in the season. If she made the next shot, she would have made 80 of 101 total shots, or 79.2%. Upon the next made shot, 81 of 102, her free throw percentage is 79.4%. I continued this progression, increasing by increments of one, until I got to 84 of 105 total shots. This percentage is equal to exactly 80%. I was surprised, but also thought that I had simply found one possible solution but had not discovered a rule. I was still set on disproving the notion that that it was impossible to bypass exactly 80%. On my next attempt, I used more “unusual” numbers. I started with 75 made shots out of 94 total shots, approximately 79.8%. I thought starting at less “obvious” numbers would show that it is possible to skip 80%. I followed the same process as before, only to find that the very next completed shot, 76 of 95, equaled exactly 0.8. I was surprised, and faced with the realization that my method to disprove the problem was not successful. I began to question if it was, in fact, necessary to be exactly 80% at some point. I then looked back to the problem and started once more.

 I broke down all of the information presented in the problem in an effort to gain a new perspective. The objective was to evaluate the idea that Shaneal’s free throw percentage would hit exactly 80% no matter what the initial numbers were. I stated that each made shot would increase both the numerator, the number of made free throws, and the denominator, the total number of shots. The total number of shots was the sum of made shots and missed shots. With each made shot, the number of misses would not be affected. From this simple realization, I was able to evaluate the problem in a new way. The free throw percentage could be examined as “makes” divided by “misses.” I set up a new fraction where Shaneal had 7 makes and 3 misses. This fraction indicates a 70% free throw rate. I increased the number of makes successively by one and held the number of misses constant. The fraction changed to 8 over 3, 9 over 3, and so on, until I reached the fraction of 12 makes and 3 misses. There are then 15 total shots, and a free throw percentage of 80%. This process led to the conclusion that no matter what integer was in the denominator, it was inevitable that the fraction would reach a 4:1 ratio. The total number of shots is the sum of the numerator and denominator, making the total to miss ratio 5:1. If one rearranges theses fractions, it is clear that at some point in the season, Shaneal’s makes will be 4:5, which is exactly 80%.

 In the puzzle from class, simply reorganizing the information provided led straight to the solution. Mathematics is not my strongest subject and, therefore, I could see how actually understanding the problem would help lead to a solution. The methodology of understanding the question, however, made other types of problems easier as well; even in subjects much simpler than puzzles involving math. A clever puzzle in *The Colossal Book of Short Puzzles and Problems* illustrated this fact. Martin Gardner wrote the short logic puzzle, “Many years ago, on a sultry July night in Omaha, it was raining heavily at midnight. Is it possible that 72 hours later the weather in Omaha was sunny?” (Gardner 367). I answered “yes” immediately. Omaha, Nebraska is not a location known for extended periods of time without sunlight. I thought that under almost any circumstance, there would still be the “possibility” of the sun shining later. Satisfied with my conclusion, I checked the answer in the book. The solution stated that it was not possible. This is an example of seeking a solution without first fully understanding the problem. I had previous knowledge of weather and recalled that rainstorms tend to pass. I did not really grapple with the information any deeper than that thought. If I had sorted out the unnecessary description, the puzzle boils down to one important fact: it is midnight. The condition is that the puzzle is solved for a time 72 hours later, the equivalent of three full days. Three full days later would mean one must evaluate the weather in the same location at midnight. This means it is impossible for the sun to be shining at this time.

 From the context of equestrian training to weather patterns in Omaha, one can solve all problems by first dealing with the information at hand. The intimidation I used to feel when approaching puzzles came from trying to tackle all the possibilities at once. If one solely looks for a solution, it is like stabbing in the dark in order to find success. It is reassuring to know that the puzzle is presented with all the tools necessary to solve it. Diagnosing the problem, then, is the only plausible way to fix it.

Works Cited

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