Continuous Improvement on the Free-Throw Line

A father and son successfully use the PDSA cycle to improve basketball shooting percentage.

by
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In 1924, Walter Shewhart developed a problem-solving method to continually improve quality by reducing variation (the difference between the ideal outcome and the actual situation). To help guide improvement efforts, Shewhart outlined a process referred to as the plan-do-study-act (PDSA) cycle. The PDSA cycle combined with the traditional concepts of decision making and problem solving are what my son and I used to continuously improve his basketball free-throw shooting.

Recognizing the problem

Identify the facts. I had observed over a three-year period from 1991 to 1993 that in basketball games, my son Andrew's free-throw shooting percentage averaged between 45% and 50%.

Identify and define the process. Andrew's process for shooting free throws was simple: Go to the free-throw line, bounce the ball four times, aim, and shoot.

The desired outcome was a higher free-throw shooting percentage. An ideal outcome, or perfection, would be one in which 100% of the shots fall through the middle of the rim, land at the same spot on the floor every time, and roll straight back in the shooter's direction after landing.

Plot the points. To confirm my observations on the results of the current process, we went to the YMCA and Andrew shot five sets of 10 free throws for a total of 50 shots. His average was 42%. Results were recorded on a run chart (see Figure 1). Based on this information as well as on past observations, I estimated the process was stable.

Decision making

Identify the causes. Causes of variation in any process can be identified through the general categories of people, equipment, materials, methods, environment, and measurement. A cause-and-effect diagram is used to graphically illustrate the relationship between the effect—a low free-throw shooting percentage—and the principal causes (see Figure 2).

In analyzing my son's process, I noticed that he did not stand at the same place on the free-throw line every time. I believed his inconsistent shooting position affected the direction of the shot. If the shot goes left or right, there is a smaller probability that the ball will have a lucky bounce and go in. I also noticed that he didn't seem to have a consistent focal point.

Develop, analyze, and select alternatives. The alternatives selected for Andrew, a right-handed shooter, were for him to line up his right foot on the middle of the free-throw line, focus on the middle of the front part of the rim, and visualize the perfect shot before he released the ball. The modified process is:

1. Stand at the center of the free-throw line.
2. Bounce the ball four times.
3. Focus on the middle of the front part of the rim, and visualize a perfect shot.
4. Shoot.

Develop an action plan. The course of action at this point was for Andrew to shoot five more sets of 10 free throws to test the effectiveness of the changes.

Figure 1. Free-Throw Shooting Run Chart

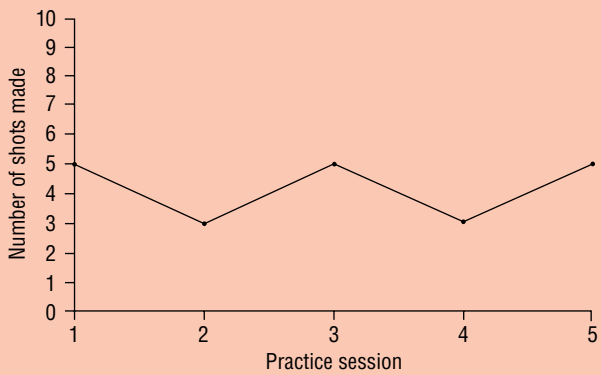
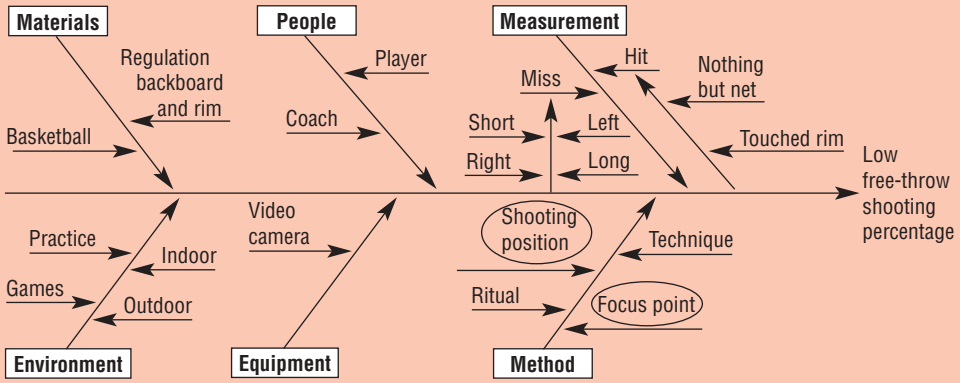


Figure 2. Free-Throw Shooting Cause-and-Effect Diagram



Problem solving

Implement the selected alternative and compare actual with expected results. The new process resulted in a 36% improvement in Andrew's average free-throw percentage at basketball practice, which raised his average to 57% (see Figure 3). The new process was first implemented in games toward the end of the 1994 season, and in the last three games, Andrew hit nine of his 13 free throws for a free-throw shooting average of 69%.

Figure 3. Free-Throw Shots Made Before and After Implementing the PDSA Cycle (March 17, 1994, to Nov. 23, 1994)

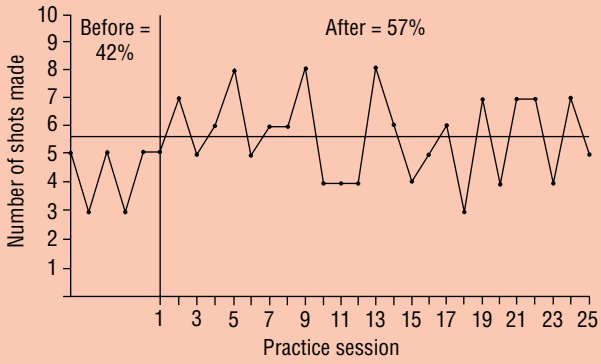
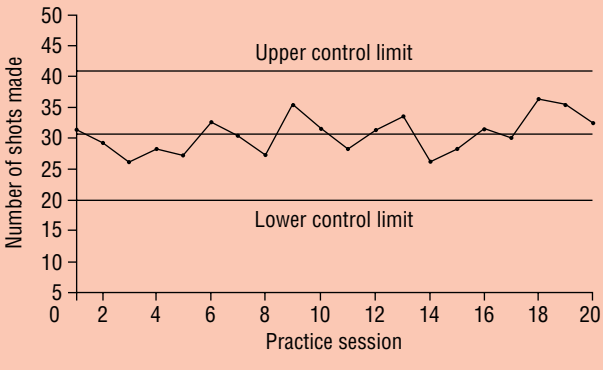


Figure 4. Determining Whether the Free-Throw Process Is Stable (March 17, 1994, to Jan. 18, 1996)



During the 1995 season, Andrew made 37 of his 52 free throws in games for an average of 71%. In one extremely close game where the other team was forced to foul Andrew's team in an effort to get the ball back, Andrew hit seven of his seven shots, which helped his team win the game. In team practices, the coaches had the players shoot two free throws and then rotate. For the entire season, Andrew hit 101 of 169 of his team practice free throws for an average of 60%.

As we monitored Andrew's process from March 17, 1994, to Jan. 18, 1996, we plotted the total number of practice shots made out of 50, using Shewhart's number-of-affected-units control chart (see Figure 4). A control chart is a trend chart with upper and lower control limits. If all of the data points fall within the control limits, the variation in the process is due to normal or common causes of variation, and the conclusion can be made that the process is stable or predictable. In other words, if you always do what you always did, on average, you will usually get what you always got.

If any points fall outside the limits, the variation is due to a special cause that makes the process unstable or unpredictable. A special cause might represent a temporary or fleeting event and might require little or no action to resolve. Variation due to a common cause requires a permanent change in the process. In this case, the process is stable, which will make it easier to validate future improvement efforts.

In the late summer of 1995, Andrew went to a basketball camp where he was advised to change his shooting technique. This change to his process reduced his shooting percentage during the 1996 season to 50%. This caused him to lose confidence in his shooting ability, and consequently, he took fewer shots. We then reinstalled his old process, and his shooting percentage returned to its former level. In one series of 50 practice free throws, he hit 35 of 50 shots for an average of 70% and in another set, he hit 32 of 50 for an average of 64%. During the remaining team practices, Andrew hit 14 of 20 of his practice free throws for an average of 70%. During the final three games, he hit two of three free throws for an average of 67%.

During the 1996 and 1997 seasons, Andrew was a point guard and was responsible for controlling and distributing the ball. In this position, he had fewer opportunities to shoot free throws. Therefore, during the 1997 season, he had the opportunity to shoot only 12 free throws, but he made nine of them for an average of 75%.

Overall benefits. In addition to the tangible results, such as improved free-throw shooting, the intangible benefits were also significant. For example, Andrew's confidence improved, and he learned how to determine when changes to his shooting technique resulted in improvement. W. Edwards Deming referred to this type of knowledge as profound.

Continuous improvement

Take appropriate action based on study results. In preparation for the 1998 season, Andrew's priorities for improvement are to continue to monitor his free-throw shooting to ensure it remains stable and to work on improving the shooting percentage of his two- and three-point shots.

Knowledge changes how people look at the world

Shewhart's methodology represents a problem-solving or decision-making process that requires a fundamental change in thinking. Traditionally, people are trained to make decisions based on gut feelings or on relatively few facts. The PDSA process requires people to first determine if the process outcome is due to a common cause or a special cause. This knowledge becomes the foundation for making decisions, which can only be developed by plotting points. Developing a knowledge and understanding of variation will change the way you look at the world forever and can lead to unprecedented levels of quality.

Bibliography

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