Stocking Up in Mathematics: An Application

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As mathematics teachers, we are often asked, When are we ever going to use this? The question is most disturbing because it implies that our students do not find our classes relevant and are probably frustrated and bored. But it is a fair question. As mathematics teachers, we must address questions regarding the relevancy of our subject discipline, that is, describe where mathematics is used. After all, mathematics did not just appear in a text one day. It was developed over thousands of years as people sought to provide descriptions and predictions of the world around them: mathematics is a process of generalization and an act of summarizing and describing the universe and the events within it. But how do we reflect this vision of mathematics to our students? One way to achieve an increased sense of relevance is through implementing activities, games and examples known as applications.

What Is an Application?

An application may be defined as any event, activity, description, problem or demonstration that illustrates how a mathematical property or definition occurs or is employed in an alternative context such as the *real world*. This definition has two important elements: (1) an application must address an identifiable mathematical concept, and (2) an application must show where mathematical concepts are found or used in a context outside of the classroom, preferably in the lives of our students. Simple examples of applications include the path that a football travels after kickoff (a parabolic path) and the application of estimation principles to predict our total at the grocery counter (no one likes to be caught short at the checkout.)

The strength of a true application lies in the fact that it provides a sense of genuine relevance to the study of mathematics, unlike the three traditional forms of relevance described by Haylock et al. (1985): artificial relevance, long-term relevance and vicarious relevance.

Artifical relevance is achieved through reference to some character or event that will capture the interest of the student. Implementing artificial relevance often provides an age-appropriate context to a problem. For example, the following problem employs artificial relevance:

> Each of the New Kids on the Block ate 7/8 of a pizza.
>
> How many whole pizzas were consumed?

In presenting this problem to students, it is hoped that reference to a particular music group will capture the students' interest and thus motivate the students to solve it.

Long-term relevance is achieved through a claim of usefulness in a future event or situation. For example, the teacher who responds to the student who asks, When am I going to use this? with You will use it on the exam next week! or You better know this when you get Miss Smith next year! is employing long-term relevance.

Finally, *vicarious relevance* is achieved through reference to another person who uses that principle or idea, or to another event in which the idea is employed. For example, if the teacher states: Farmers construct ratios like these when mixing herbicides and pesticides, then the teacher is employing vicarious relevance. Though vicarious relevance does provide a link to the real world, it remains somewhat unsatisfying to the student unless he or she *is* a farmer mixing herbicides and pesticides. None of these traditional forms of relevance constitutes genuine relevance. What do we mean by genuine relevance?

Genuine relevance is achieved through a perceived need for a given item of knowledge or process given that the lack of this knowledge or process serves as an impediment to some desired goal. For example, if a student wants to calculate the percentage he or she needs on the final exam to get a given grade in a course, then a lack of understanding of ratios, proportions and percents may

impede the desired goal. The inherent difficulty with applications that express genuine relevance is that they are based on a *perceived individual* need, making them very difficult to develop and implement on a class-wide basis.

So, where does this leave the teacher? The teacher ultimately has three means to encourage and support a sense of relevance in the classroom:

1. Recognize and employ *teachable moments*. Teachable moments occur when students recognize they lack an important mathematical skill or item of information and thus are motivated to develop that skill or construct the needed knowledge.
2. Consistently employ *subject matter integration*. To integrate subject disciplines, the teacher should plan for and point out mathematical principles and properties whenever they appear during instruction in other disciplines such as science, physical education and social studies.
3. Involve the students in activities that *employ challenging decision making contexts* not unlike those found in the real world. The following activity is provided as an example of an application for the junior high mathematics classroom.

Stocking Up Game

This game is a simulation of the stock market where students work cooperatively in teams to construct a company, buy and sell a stock, and predict market trends so as to maximize profits. In this game, students are divided into groups of four. One student is the president of the company, one student is the stock analyst and two students serve as members of the board of directors.

Objectives

- Uses paper-and-pencil algorithms, estimation and calculators to perform computations.
- Records data in line graphs and interprets data from line graphs.
- Understnads and uses the terms *probability* and *chance*.
- Generalizes the probability of the occurrence of an event from a practical situation.

Materials

- Each team/company will require one copy of the Stocking Up chart (Figure 1), one six-sided die, one or more calculators.
- The teacher will require different spinners for each of the five trading sessions (Figure 2).

Procedure

- To begin the game, each team must select a company name and designate the following roles:
    1. The *president* is responsible for announcing the decisions of the company and for monitoring the company's cash and stocks.
    2. The *members of the board of directors* are responsible for determining market trends, assisting the president in all decisions, and keeping account of the company's cash and stocks.
    3. The *stock analyst* is responsible for charting the stock's progress through the five trading sessions (using the chart shown in Figure 1).
- Each company begins the game with $20,000. At the beginning of the game, each company is given a chance to purchase as many stocks as they would like at $50 per stock.
- On a turn, a company may elect to do one of (a) spin, (b) buy stocks or (c) sell stocks.
- If a company elects to spin, the teacher spins the appropriate spinner as shown in Figure 2, and the president of the company rolls a die. The spinner marked with a '1' should be used throughout the first trading session, while the spinner marked with a '2' should be used throughout the second trading session and so on. The result of the spin determines whether the value of the stock will go up or down while the result of the roll determines the amount the stock will change. Note: Spinners for the five trading sessions are hidden from the companies until the conclusion of the game.
- If a company elects to buy stocks, it must purchase the stocks at their current value. The number of stocks a company may purchase is determined by the company's president and board of directors. The number of stocks purchased is limited by the remaining cash.
- If a company elects to sell stocks, the stocks are converted to cash at their current stock market

value. The number of stocks sold is determined by the company's president and board of directors. The number of stocks sold is limited by the number of stocks owned.

- The turn continues to rotate between companies until all five trading sessions are completed.

Rules

- If a company cannot come to a quick consensus on a turn (as to whether the company will spin, buy or sell), the president will decide. All decisions of a president are final.
- If on any turn the value of the stocks reaches 0, all stocks for each company are lost. The stock is reset to a value of 50. Companies are given a chance to purchase new stocks with their remaining cash before play continues.
- If on any turn the value of stocks reaches 100, all stocks for each company are doubled. The stock value is reset to 50 and play continues.

Declaring the Winner

- At the end of the five trading sessions, all stocks are converted to cash. The company with the greatest cash total is the winning team.

Questions

- What trends in the stock value did you notice in each of the five trading sessions? Describe what might be found on the spinner used in each of the five sessions.
- Which of the spinners is likely to drive the value of the stocks up? Which of the spinners is likely to drive the value of the stocks down? Which of the spinners is likely to have the least effect on the value of the stocks? Explain.
- Which of the spinners express the same probability of driving the stock up or driving the stock down?
- If you knew what each of the spinners looked like before you started the game, how would you change your strategy? At what times in the game would you buy or sell to maximize your profits?
- Knowing what is found on each of the spinners, do the trends in any of the sessions surprise you? Why or why not?
- Create your own spinners the next time the game is played. Some spinners should drive the value of the stocks up, and some should drive the value of the stocks down.
- Create two different spinners that, on average, would simply maintain the value of the stock.

Adaptations

- Have students roll more than one die at a time—this adaptation will greatly increase fluctuation in the stock value.
- Introduce a second stock. When a company elects to spin, both stock values are changed using the process described above.
- Change the rules so that a team must spin on each turn. After spinning, the team may elect to buy, sell or pass the turn—this adaptation will shorten the time needed to play the game.

Suggestions to the Teacher

- Keep track of each company's stocks and cash on the blackboard, and assist students in making computations (at least initially).
- Help the students chart the first few fluctuations in stock value, and check with students regularly to ensure consistency of stock value between companies.

Reference

Haylock, D.W., et al. "Using Maths to Make Things Happen." *Mathematics in School* 14, no. 2 (1985): 32–34.

Figure 1

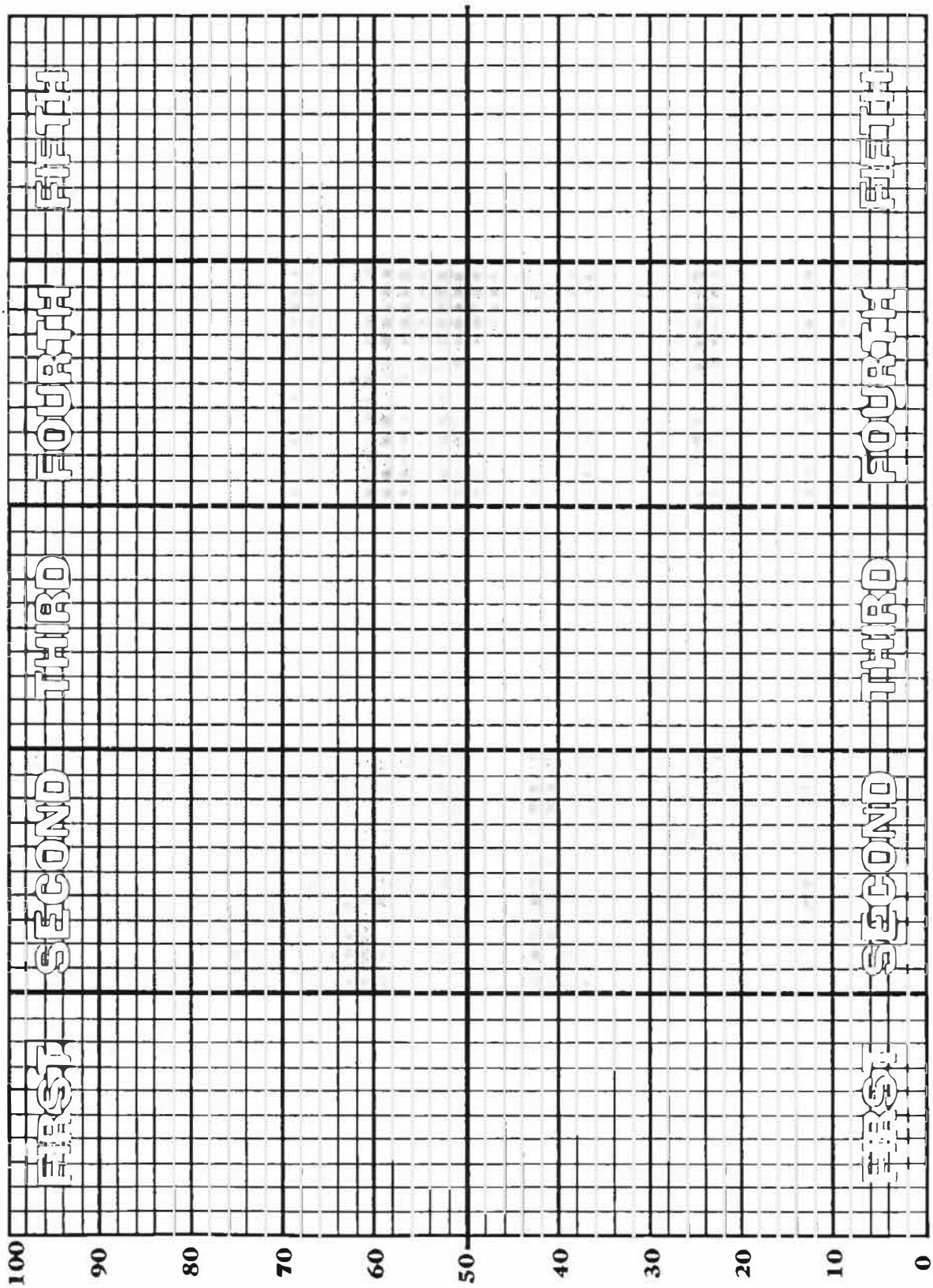
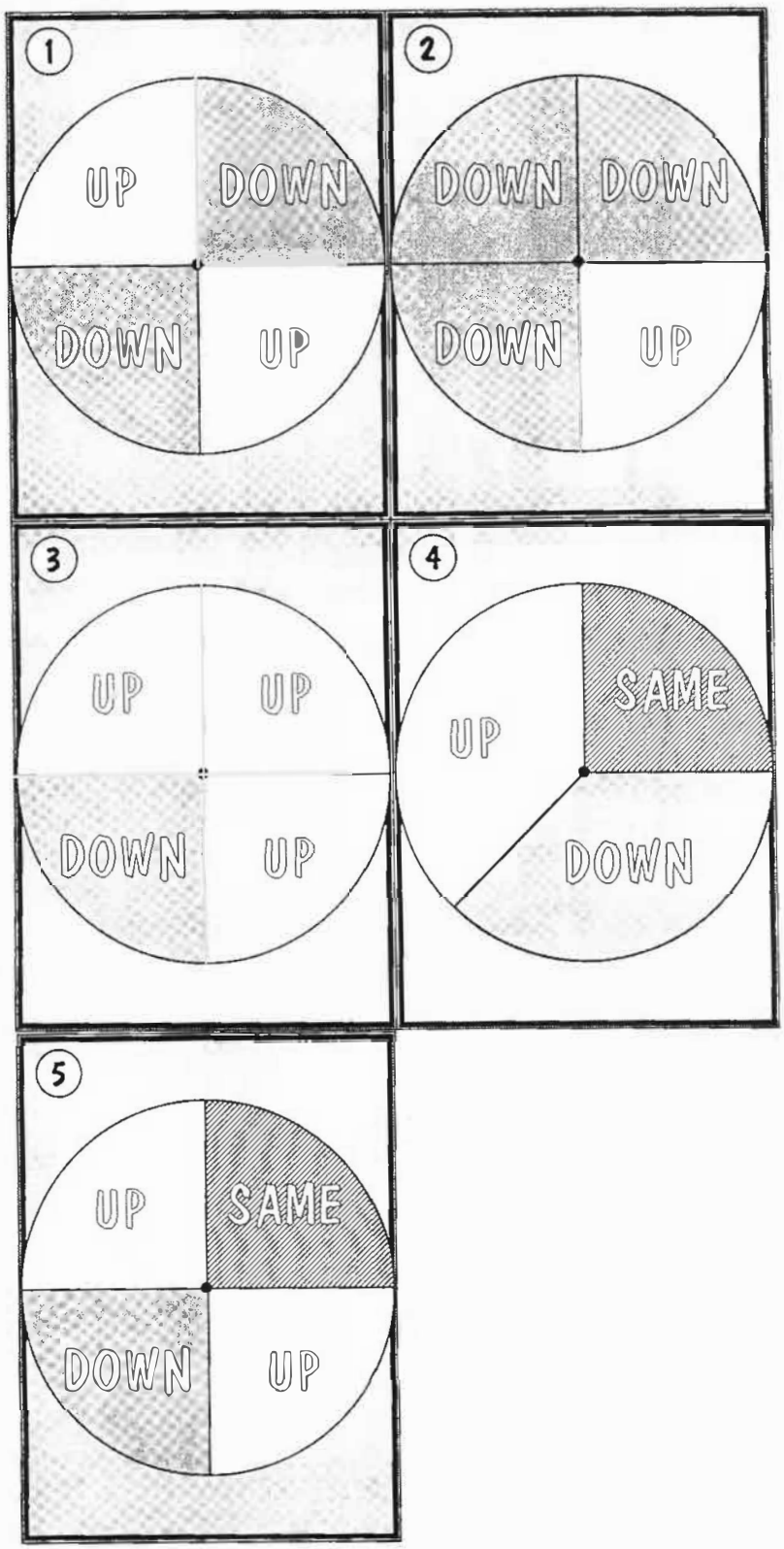


Figure 2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