

Math Games for Adolescents

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Carlos, a high school sophomore, missed several days of school each month and became more involved in gang activity as the school year progressed. He had been moved to an alternative high school but was in danger of being expelled because of his repeated absences and because he did not comply with rules. His mother, who was worried about his academic achievement and prospects for high school graduation, brought him to our university training center for academic tutoring.

Carlos was a warm and friendly adolescent who developed a close relationship with his tutor as his academic skills improved. However, he did not seem to fully realize the consequences of his actions. The tutor, a graduate student in psychology, became concerned about Carlos' choice of friends and activities, both at school and during his free time. She talked with Carlos about his expectations and discovered that he believed he would be able to support himself comfortably with the kind of job that he could find as a high school dropout. Because she wanted to help him understand the financial difficulties that dropping out would cause, she developed a game called *That's Life—Money Game About Real-Life Expenses* (see box, "What Does the Literature Say About Mathematical Games?"). Figure 1 includes the rules for this game, as well as a depiction of the game board.

Carlos and his tutor played this game many times during their tutoring and counseling sessions and refined it to create a realistic picture of life after high school. When Carlos landed on a square that represented financial difficulty, he was often surprised to learn that an event might really happen. When he

counted the money that he had at the end of a game, or when he ran out of money during a game, he began to realize that supporting himself might not be as easy as he had thought.

That's Life and Shopping Spree

That's Life is loosely based on the *Monopoly*[™] board game but incorporates financial events that young adults often face. A teacher can adapt the game in several ways. For example, expenses such as income, rent, or transportation can reflect typical costs in a given locality. Students can use check-book registers or play money to keep track of income and expenses.

The second game, *Shopping Spree*, uses a game board that is somewhat similar to that used in the *Clue*[™] game. Players must complete their shopping list by making purchases at different stores shown on the board and returning home. They move through the board to get from store to store. While shopping, students develop strategies and solve math problems. Figure 2 includes the rules for this game and shows the game board.

Students can play these games in many different ways. Two or more players can play either *That's Life* or *Shopping Spree* in a classroom or resource room setting. Students can play the games in pairs or in teams. In addition, a student can play either *That's Life* or *Shopping Spree* alone.

The teacher can ask students to design and create their own game boards, which can include local shops and banks. And, of course, the teacher can control the level of mathematical difficulty by varying prices and expenses in *That's Life* or by changing the problems required for purchases in *Shopping Spree*. These basic formats

enable teachers and students to customize the games to meet their own instructional objectives and needs.

Using Games in the Classroom: Some Cautions

Games are only one type of classroom activity. To maintain their motivational value, the teacher should not overuse them. As with any classroom activity, teachers should monitor and evaluate the effectiveness of games as part of the instructional curriculum (Blum & Yocom, 1996).

Other factors that teachers should consider include the following:

- Teachers should watch for excessive competition and overstimulation.
- Before students play games such as *That's Life* and *Shopping Spree* without direct teacher involvement, their mastery of the content should be at a high level—in fact, it should approach 100%, unless students can obtain prompt teacher assistance when needed (Brophy & Good, 1986).
- Teachers should consider the complexity of the rules and the mathematical concepts necessary for successful play, any physical requirements, and the social skills needed for interaction, so that every player has a chance to win (Blum & Yocom, 1996).

Final Thoughts

Proponents of mathematical games (Blum & Yocom, 1996; de la Cruz, Cage, & Lian, 2000; Holton, Ahmed, Williams & Hill, 2001; Quinn, Koca, & Weening, 1992) have enumerated many benefits in instructional settings. Games and simulations can:

- Increase student motivation and participation in practice and review activities.
- Provide immediate feedback.

What Does the Literature Say About Mathematical Games?

Such experts as Dewey, Erikson, and Piaget (Holton et al., 2001) have emphasized the importance of play in learning. Educational games and simulations motivate and engage learners and provide opportunities for students to practice acquired skills (Blum & Yocom, 1996; Kafai, Franke, Ching, & Shih, 1998). Mathematical simulations allow for creativity and experimentation in developing strategies to reach a goal and require metacognitive skills to maintain focus on the goal while playing the game (Holton et al.).

A review of the research on instructional games and simulations from 1963 to 1991 showed that games are more likely to have beneficial effects when they focus on precisely defined content or when they require drill and practice, such as in mathematics (Randel, Morris, Wetzel, & Whitehill, 1992). This review also indicated that students show more interest in games than in traditional classroom instruction and that games result in improved content retention over time, possibly because of the opportunity for greater student participation. Mathematics games improved on-task behavior and achievement in arithmetic for students with mild intellectual disabilities (Beattie & Algozzine, 1982).

When students and teachers developed their own math games, they engaged in reflective inquiry about the mathe-

matical content and about ways to represent that content within the game. At the highest level of sophistication, both students and teachers attained seamless integration of the content with the motivational aspects of the game (Kafai et al., 1998), as exemplified by the two games presented in this article. Results of that study suggest that it is advisable to involve students in analyzing, adapting, or modifying games, either commercial games or those in this article, for their own needs before playing.

Mathematical games allow the learner many opportunities to reinforce current knowledge and to try out strategies or techniques without fear of getting the "wrong" answer. They often encourage students to use trial-and-error strategies. Games can provide an environment for experiencing incorrect solutions not as mistakes but as steps in connecting pieces of mathematical knowledge (Holton et al., 2001; Quinn et al., 1992). With reference to money games and simulations, Hopkins and Dorsey (1992) state that mathematical learning is optimized when it is tied to real-life experiences and that simulations develop metacognitive skills for analyzing and organizing data, checking responses, justifying solutions to problems, and applying mathematical knowledge to daily activities.

- Increase opportunities to respond.
- Use a variety of manipulatives in problem-solving.
- Support positive attitudes toward mathematics.
- Encourage connections among different areas of mathematics.
- Allow students to try new strategies.
- Stimulate logical reasoning.

In addition to reinforcing mathematics content knowledge, the use of games and simulations also encourages students to develop such skills as attention to task; social skills, including taking turns and courtesy; cooperation with others; leadership skills; and fine motor skills. Games such as *That's Life* and *Shopping Spree* encourage students to review mathematical concepts and help them better understand their weaknesses and their areas of competence. In addition, students benefit from watching others solve problems. These flexible games in familiar formats can enhance students' math skills.

References

Beattie, J., & Algozzine, B. (1982). Improving basic academic skills of educable mentally retarded adolescents. *Education and*

Treatment of the Mentally Retarded, 17, 255-258.

Blum, H. T., & Yocom, D. J. (1996). A fun alternative: Using instructional games to foster student learning. *TEACHING Exceptional Children*, 29(2), 60-63.

Brophy, J., & Good, T. L. (1986). Teacher behavior and student achievement. In M. C. Wittrock (Ed.), *Handbook of research on teaching* (pp. 328-375). New York: MacMillan.

de la Cruz, R. E., Cage, C. E., & Lian, M-G. J. (2000). Let's play mancala and sungka! *TEACHING Exceptional Children*, 32(3), 38-42.

Holton, D., Ahmed, A., Williams, H., & Hill, C. (2001). On the importance of mathematical play. *International Journal of Mathematical Education in Science and Technology*, 32, 401-415.

Hopkins, M. A., & Dorsey, C. M. (1992). Math is everywhere—If only we could find it! *Preventing School Failure*, 37, 10-13.

Kafai, Y. B., Franke, M. L., Ching, C. C., & Shih, J. C. (1998). Game design as an interactive learning environment for fostering students' and teachers' mathematical inquiry. *International Journal of Computers for Mathematical Learning*, 3, 149-184.

Quinn, A. L., Koca, R. M., Jr., & Weening, F. (1992). Developing mathematical reasoning using attribute games. *Mathematics Teacher*, 92, 768-775.

Randel, J. M., Morris, B. A., Wetzel, C. D., & Whitehill, B. V. (1992). The effectiveness of games for educational purposes: A review of recent research. *Simulation & Gaming*, 23, 261-276.

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Figure 1. That's Life: A Game About Real-Life Expenses

That's Life—A Math Game About Real-Life Expenses

 Pay Day Collect \$850	 If you have a car, Pay Car Insurance \$50	You now have a roommate... split all monthly bills in half from now on	If you don't have a car pay \$25 for bus fare 	 Rent Due Pay \$500
You can buy a car...if you do, you must pay \$200 each month	Need a Loan?			Clothes Shopping Pay \$50 
Credit Card Payment Pay \$50 	If you have a car, you can use the car as collateral and borrow \$500 from the bank. Just pay back \$75 each time you get paid.			Health Insurance Pay \$70 
2 sick days...when you pass Pay Day you earn only \$765				Your roommate moved out... start paying full monthly bills
 Grocery Shopping Pay \$100	Cell Phone Bill Payment Pay \$50 	If you don't have a car pay \$25 for bus fare 	Entertainment for the month Pay \$100 	Utilities Due Pay \$100 

Objective

That's Life gives students a chance to apply mathematics and helps them recognize the costs of living on their own.

Learners/Context

Learners are students in middle school or high school who need practice with money concepts and with concepts relating to adult life. This game is particularly appropriate for students in resource or consumer math classes.

Rationale

The monthly net pay of \$850 reflects a 40-hour-long workweek and a wage of \$7 per hour, less 25% for taxes. The net pay figure assumes that each month consists of exactly 20 workdays. The two-sick-days square lowers the monthly pay to \$765 to reflect the

approximate cost of missing 2 days of work. The option to purchase a car allows students to determine whether riding a bus makes more sense financially than incurring the expenses of owning a car. The only arguments in favor of purchasing a car are that each car owner will have some property

Equipment and Setup

One six-sided die and one game piece for each player.

Game board.

Checkbook register for each player; the teacher can create a simple checkbook register in the following format:

That's Life Checkbook Register			
Date	Deposit	Withdrawal	Balance

value at the end of the game and that each car owner has the option of obtaining a bank loan.

The teacher or students make a game board with 20 squares. The four corner squares are labeled as follows:

- Payday—collect \$850

Figure 1. (Continued)

- Rent due—pay \$500
- Grocery shopping—pay \$100
- Utilities due—pay \$100

The remaining squares may contain the following labels, any order:

- If you have a car, pay car insurance—\$50
- You have a roommate...split all monthly bills in half from now on
- If you do not have a car, pay \$25 for bus fare
- Clothes shopping—pay \$50
- Health insurance—pay \$70
- Your roommate moved out...start paying full monthly bills
- Entertainment for the month—pay \$100
- If you do not have a car, pay \$25 for bus fare
- Cell phone bill due—pay \$50
- Take 2 sick days...when you pass Payday, you earn only \$765
- Credit card payment due—pay \$50
- You can buy a car...if you do, you must pay \$200 each month

The center of the board should contain the following text:

Need a loan? If you have a car, you can use the car as collateral and borrow

\$500 from the bank. Just pay back \$75 each time you get paid.

Playing the Game

1. Each player has a checkbook register.
2. One trip around the board represents 1 month.
3. The players start on the square marked "Payday—collect \$850," so each player enters \$850 as a deposit to start play.
4. Players roll the die to determine how many squares they should move. The student then subtracts the amount owed or adds the amount deposited to his or her checkbook register, as indicated on the square. Each time the student passes the square marked "Payday—collect \$850," he or she adds \$850 to the checkbook register.
5. The game consists of at least six rounds, reflecting 6 months.
6. If a player decides to purchase a car, she or he adds one quarter of the amount paid toward the car to the balance (asset: resale value). For example, if the student has made three payments (\$600), he or she

can add \$150 to the checkbook register as an asset.

7. At the end of the game, a player who purchased a car must subtract any remaining loan balance from his or her checkbook register.
8. The player who has the largest balance in his or her checkbook register at the end of the game wins.

Modifications

- The teacher can modify the contents of the squares to reflect the possible future spending habits of different students and different localities.
- The students can use play money instead of the checkbook register.
- Students can research the costs for items represented in specific squares and add information to the game as they learn it.
- The teacher can vary costs to reflect different levels of mathematical difficulty.

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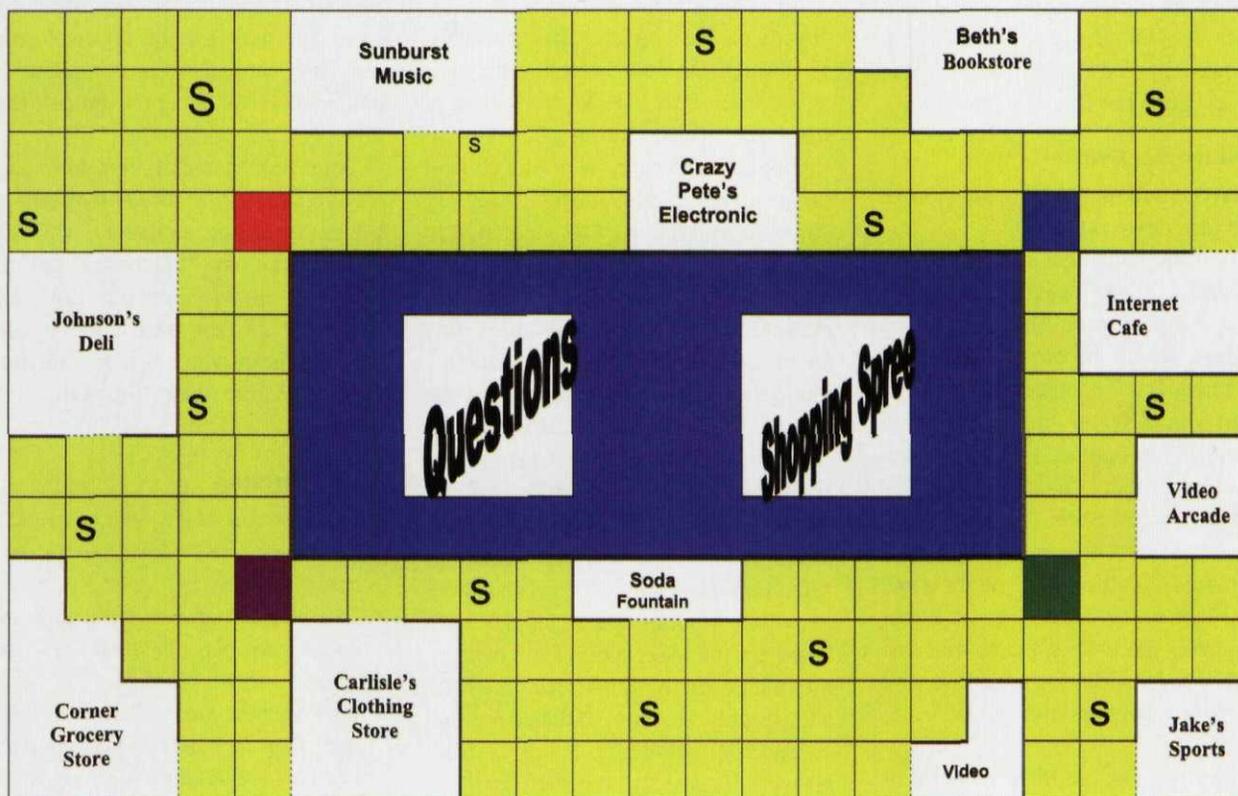
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Figure 2. Shopping Spree



Objective

Shopping Spree reviews mathematical concepts. Teachers can generate individual questions based on the content area that the class is studying.

Learners/Context

This game is targeted particularly for those students in Grades 5 through 9. The game is designed so that teachers can modify play for time constraints, number of participants, and question difficulty.

Rationale

This game is an interactive, motivating way for students to review different kinds of math problems. Students must follow a randomly generated "Shopping List" of items by visiting stores around town, "purchasing" items from a list of designated stores by solving teacher-created math problems. The cost of each item is determined by the difficulty of the math problem that the student attempts to answer.

Equipment

- Three 6-sided dice.
- One game piece for each player.
- Calculator for checking answers.
- Balance sheets for keeping track of debit card charges.
- Timer (optional).

The teacher should create a game board, as shown in the illustration. The teacher should create the following three types of cards:

- "Shopping List" cards, each with a name of a different store on the Shopping Spree board.
- Question cards for each store—three different levels of difficulty should be reflected in the value of the questions; the correct answers should be worth \$10 for a "Super Shopping Spree Special" card, \$20 for a "Satisfying Saver" card, or \$50 for a "Splurge" card, depending on the level of difficulty, from hardest to easiest.

The teacher can create a simple balance sheet in the following format:

Shopping Spree Debit Card Account	
Debit	Balance

Figure 2. (Continued)

- Shopping Spree cards: These can include "Impulse Buy Cards" that require purchase and "Sale" cards that reduce the cost of a purchase.

Playing the Game

A player shuffles the Shopping Spree cards face down into a pile.

The "Shopping List" cards are shuffled and a player deals five cards to each person or team. The stores listed on these cards become the player's "Shopping List." Each player starts the game with \$500 in their Debit Card Account. This amount is written on the first line under "Balance" on the Account Balance Sheet.

Each player chooses a game piece and places it on the square on the game board that is the same color as his or her playing piece. Each player rolls one die. The highest die roll goes first, and play then moves around the board to the right.

Player #1 rolls all three dice. He or she must then use at least two of the dice to form a mathematical question. The player must write down the equation and the answer within 60 seconds of rolling the dice. If the answer is correct, the player moves that many spaces vertically, horizontally, or diagonally, making sure to only land on each square once during a turn. If the answer is incorrect or the player takes more than 60 seconds to formulate and solve the problem, the player's turn ends and the next player rolls the dice.

To enter a store, players must land directly on the store area, being sure to go through the door, which is marked by a dashed line. If a player lands in a store for which he or she has a "Shopping List" card, he or she chooses to answer a \$10 "Super Shopping Spree Special," a \$20 "Satisfying Saver," or a \$50 "Splurge" question. Easier questions cost the players more money, providing motivation for attempting the more difficult questions. The person to that student's right asks the question from the chosen store Question card and checks the student's answer. If the player responds correctly, he or she keeps the Question card, placing it on top of the corresponding "Shopping List" card. The player then marks the amount "paid" for the item based on the face value of the card in the Debit column of their balance sheet and records the new Balance in the appropriate column. If he or she answers incorrectly, the card goes to the bottom of the card pile, and the next player begins his or her turn.

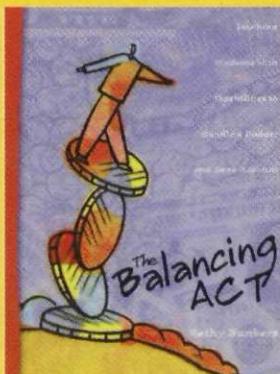
A player who lands on an "S" space takes a "Shopping Spree" card. If the "Shopping Spree" card is an "Impulse Buy" card, players must go directly to the store indicated and attempt one of the Question cards. This is true even if the store indicated is not on the player's original Shopping List." If the "Shopping Spree" card is a "Sale" card, the player must use the designated discount in the next store he or she

enters. If the player incorrectly answers the question, he or she forfeits the "Sale" card, and it is returned to the bottom of the "Shopping Spree" card pile.

After purchasing an item from each required store, the student returns to his or her home square to win. The player who has "purchased" all the items on their "Shopping List" and returns home first wins. If time runs out, the player who has made the most purchases from their "Shopping List" wins.

Modifications

- Students can make their own game boards and use local shops and banks.
- To promote cooperative learning, students can play in teams of two against another team.
- The teacher can write math questions that are based on skills that the students are learning in class, or students can prepare the questions.
- To adjust the time needed to play the game, the teacher can increase or reduce the number of stores that students must visit by designating a different number of items on each "Shopping List."



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