Creating Board Games with Children: 
A lesson in probability 

An Honors Thesis (HONRS 499) 

by 

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Abstract

As a math concentration at Ball State University, I felt that students need more experience working with various mathematical concepts. After working with the Tiger Latchkey Program in the past, I developed a ten day unit that would introduce students of varying levels and abilities to the concepts of ratios and probability. At the end of the unit, students were encouraged to design and create their own board games to demonstrate their knowledge of probability in games.

Acknowledgements

-I would like to thank Dr. Nancy MeIser for her support and ideas in implementing this project. She has taught me many aspects of classroom management and organization that have been implemented during this unit.

-I would also like to thank the student and staff from the Tiger Latchkey Program for allowing me to successfully implement this project.
Creating Games with Children: A Lesson in Probability

The Social Development Theory was developed by Lev Vygotsky of Russia. His stated that social interaction played a large role in development. With this project, I worked to create a classroom and unit based on Vygotsky’s theory. According to *A Vision of Vygotsky*, a Vygotskian class would consist of:

- constructing a collaborative community
- engaging in purposeful activities involving whole persons actively forming identity
- incorporating activities that are situated and unique
- using curriculum as a means for learning, not just as an end result
- producing outcomes that are both aimed for and emergent
- constructing activities that must allow diversity and originality.

When I began planning my lessons, I attempted to include all of these aspects. I worked to have the lessons include active inquiry, group work, meaningful activities, activities that would provide a means for learning probability, as well as a final project that requires diversity and originality.

In order to “construct a collaborative community,” I had the students sit in groups. We began each class with a question. For example, when you roll a die, which number are you most likely to roll or are they all equal? I would take responses from individual students. They not only had to hypothesize, but they had to state why they chose that specific response. After asking the individual students, I took a class vote. We would then work in groups to perform the experiment, like rolling dice.

To “engage the students in purposeful activities” I had them first form their hypothesis and then complete the experiment. When the results of the experiment were in, I had them try to explain why those specific results occurred. For instance, I
introduced the concept of fair and unfair in probability. We used two separate spinners to see how the amount of each color influenced the outcomes. The students thought that the mostly red spinner would get mostly red. This assumption was correct. When we completed the experiment, one group ended up with mostly yellow. We then had to explain the discrepancy. This group's spinner was human made. We had to account for human error. They also were colored with crayon. One student suggested that the crayon was stopping the arrow from getting all the way to red. This activity helped students to realize that although the probability for an event to occur was high, it was not certain that it would occur.

To be able to incorporate "activities that are situated and unique," I decided to have the students apply their new knowledge of ratios to the children's card game "Old Maid." I felt that this real world use of ratios would be the simplest way for the students to see probability in the context of a game and not as a separate experiment. Students were paired up to play. They helped each other to decide who to pick cards from based on the best ratio. For example, it is better to choose a card from a person with six cards than four cards.

This curriculum was developed as a "means for learning." The students were learning probability and ratios simply to be introduced to the concepts. They were going to use the information to create their games. The were not memorizing information for a test or grade. The academic goals and pressure were removed so that the student would feel more comfortable making mistakes and learning from them.

My goal was to have the students understand probability in terms of ratios and fair versus unfair. While this goal was accomplished, I was surprised at the other information
students learned. I created a design sheet for the students to create their games, but once they started, it was easy for them to forget specifics. Students were creating games and directions that involved a starting and finishing point, but they forgot to make one on the actual board. When given the opportunity to play and self-evaluate their own games, they learned that they needed to edit their games to make them easier to play. They also found out that board games require more than game pieces and a way to move around the board. Board games need directions that match the board, complete sets of trivia cards, and/or a way to determine for certain who wins.

Finally, the board game project was an activity that allowed for diversity and originality. The students planned their own board games with their own themes. They were able to decide what type of pieces to use, how to move around the board, what ways to win. Students created these original games to demonstrate their understanding of how probability exists in games. Each game was different in theme as well as play. The students demonstrated their originality and diversity in the creation of their own games and rules.

In conclusion, I was able include Vygotsky’s theory in many ways throughout my unit and classroom experience. The students were able to learn and express themselves in a safe environment. The diversity of the games provided more information to discuss than one class game could have. The students were really able to internalize the information. Many are eager to try to create new and better games based on their self-evaluation. Overall, the openness of the classroom and project allowed for a controlled discovery of probability which in turn promoted a motivation for future exploration.
INDIANA ACADEMIC STANDARDS

This unit is written as an enrichment program for use in an after school environment. It can easily be adapted to a specific grade level and geared higher or lower in content. The students being taught will range from first grade to sixth grade, and the lessons are written with a lot of group work to accommodate the varying levels. While Indiana Academic Standards are taught, they are taught in varying levels depending on the majority age of the students. If this unit is taught in the classroom, the standards would need to be more directly addressed.
Range of Indiana Academic Math Standards Addressed throughout unit:

First Grade - Standard 6 In a general sense, mathematics is problem solving. In all mathematics, students use problem-solving skills: they choose how to approach a problem, they explain their reasoning, and they check their results. As they develop their skills with numbers, geometry, or measurement, for example, students at this level move from simple ideas to more complex ones by taking logical steps that build a better understanding of mathematics.

Sixth Grade - Standard 6 — Data Analysis and Probability
Data are all around us — in newspapers and magazines, in television news and commercials, in quality control for manufacturing — and students need to learn how to understand data. At this level, they learn how to display data in frequency tables and in stem-and-leaf plots. They compare the mean, median, and mode. They find probabilities for compound events and write them as fractions, decimals, and percentages. They also estimate the probabilities of future events.

Sixth Grade - Standard 7 — Problem Solving
In a general sense, mathematics is problem solving. In all mathematics, students use problem-solving skills: they choose how to approach a problem, they explain their reasoning, and they check their results. As they develop their skills with negative numbers, calculating angles, or finding areas, for example, students move from simple to more complex ideas by taking logical steps that build a better understanding of mathematics.

Range of Indiana Academic English Standards Addressed throughout unit:

First Grade — Standard 6 — Writing
Students write using Standard English conventions appropriate to this grade level.

First Grade — Standard 7 — Listening and Speaking
Students listen critically and respond appropriately to oral communication. They speak in a manner that guides the listener to understand important ideas by using proper phrasing, pitch, and modulation (raising and lowering voice). Students deliver brief oral presentations about familiar experiences or interests that are organized around a coherent thesis statement (a statement of topic). Students use the same Standard English conventions for oral speech that they use in their writing.

Sixth Grade — Standard 6 — Writing
Students write using Standard English conventions appropriate to this grade level.

Sixth Grade — Standard 7 — Listening and Speaking
Students deliver focused, coherent presentations that convey ideas clearly and relate to the background and interests of the audience. They evaluate the content of oral communication. Students deliver well-organized formal presentations using traditional speech strategies, including narration, exposition, persuasion, and description. Students use the same Standard English conventions for oral speech that they use in their writing.
Lesson Concept: Ratios

Purpose: Students will be able to write and label ratios at both an abstract and pictorial level.

Materials – Interactive worksheet (1), dry erase board and markers, center materials (see end of lesson), sports worksheet (1 per student), pencils, nametags

I. Setting the Stage
Before I can teach you about game probability and ideas that might help you win, we need to learn about ratios. Let’s start with an activity where we get to know you a little better. Use attached activity sheet to have students act out different ratios by moving to different sides of the room. Complete only the first 5. This activity doubles as an introduction to ratios as well as an icebreaker. You may include yourself in the ratios. Write results on the board. (7 min.)

II. Development of the Concept
Demonstrate on the board the three ways to write and read ratios. Tell students that for our purpose we will always write in the word form. Have the students act out the next 5 ratios from the activity page. Have one student from each group write their ratio on the board. Continue until all questions are answered on activity page. (9 min)

Have students sit back down. Randomly number students in to groups for centers. Tell them there are going to be a few objects at each center. Their mission is to write a ratio with labels at each center. When we are done, we will talk about the “right” answers. There will be many right answers. (3 min)

Have students complete centers. (5 min.) Regroup the class. Student should provide answer for teach center. Ask if there is one right answer? Is there a wrong answer? YES! If you count wrong. (3 min.)

Pass out the sports ball worksheet on ratios. Have students work in pairs to complete the worksheet. This brings students to a pictorial level which is where most of the unit will take place. (10 min.) Go over sheet verbally.

If there is a lot of extra time, have students play “I spy” with ratios. For example, I see 3 to 4. Have others guess what the ratio is comparing.

III. Conclusion
In order to talk about what is most likely to happen, people use ratios. We will use ratios later in the class to talk about dice, blocks, spinners, and cards.

Gearing Up: Teach students to compare ratios with common denominators.
Gearing Down: Work each center as a class. Discuss as you complete the centers.
Centers:

1. Two types of balls
2. Two types of school supplies
3. Fake money – both bills and coins
4. One deck of cards
5. One die
6. Bag of colored square tiles
What’s a RATIO?

1. Boys to girls  

2. Ten and older to Younger than 10  

3. Glasses to No glasses  

4. A-M to N-Z (First name)  

5. A-M to N-Z (Last name)  

6. Plays sports to No sports  

7. Pets to No pets  

8. Home lunch to School lunch  

9. Radio to CD  

10. Chocolate to Vanilla ice cream  
Name ________________________

1. baseballs to footballs
   _______ A

2. soccer balls to baseballs
   _______ L

3. round balls to footballs
   _______ A

4. basketballs to soccer balls
   _______ P

5. kicked balls to bouncing balls
   _______ L

6. footballs to baseballs
   _______ L

7. baseballs to basketballs
   _______ B

8. basketballs to footballs
   _______ Y

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Lesson Concept: Probability in spinner and one die

Purpose: The students will explore the probability of spinning a certain color using both a fair and unfair spinner. The students will find that the probability of rolling any number a dice is equally possible.

Materials: spinners, dice, record sheet

I. Setting the Stage
Hold up two spinners. Ask them which one they would rather use during a game? Why? Then hold up a dice. Why do we like to use these? This is the notion of fair and unfair. Today we are going to experiment with spinner and dice.

II. Development of the Concept
First explain each of the centers to the students. Remind them that directions are on the envelopes. (They will forget them.)

Fair Spinner:
Take turns spinning the spinner and tallying the results on the record sheet. Continue until time is up.

Unfair Spinner:
Take turns spinning the spinner and tallying the results on the record sheet. Continue until time is up.

Dice:
Take turns rolling the dice and tallying the results on the record sheet. Continue until time is up.

Break the students up into groups. Pass out the center envelopes. If there are too many students for three groups, use doubles of the envelopes to speed up the centers. Have the students work at each experiment for about 30 seconds, pack up and pass on the envelope.

Once each center is completed by each group, tally the results on the dry erase board to have a larger sample. Then, have the students figure out the experimental ratios of each color or dice number.

To figure out the actual ratios for the spinners, use their concept of fractions. The circles are set up so that the fair spinners are in fourths. The unfair spinner has segments of \( \frac{1}{2} \), \( \frac{1}{4} \), and (2) \( \frac{1}{8} \) of the circle.

For the dice probability ratios, think of the ratio wanted outcomes to total possible outcomes. For example, if we want to roll a 1, the probability would be \( \frac{1}{6} \) because there is only one “1” on the die and there are six total numbers.

If time permits, let the students play a high/low dice game where the higher roll wins.
III. Conclusion
Today we talked about the probability of one die. Next time we will talk about what happens if we have two dice. Does the probability change? Also, we will work with the probability of drawing marbles out of a bag. Is there a way to make that experiment unfair?

Gearing Up: Have students determine ratios individually or in pairs.
Gearing Down: Complete the centers as a class. Have a designated person roll or spin while a different person records the marks. Switch students for each “center.”
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Lesson Concept: Probability of 2 dice and bag of marbles

Purpose: The students will determine the probability of rolling certain numbers using two dice. The students will determine the fairness of drawing marbles from a bag.

Materials: pencils, record sheets, dice, marbles in bag,

I. Setting the Stage

Last time we were together, we found out that there is an equal chance of rolling any number when using one die. Do you think it is the same for two dice? Take a vote and write results on board. First we are going to find the experimental probability by rolling the dice a lot of times. Then we will analyze the results.

II. Development of the Concept

Break the students up in groups of about four students. Give them two dice and a result sheet. Have one person roll the dice and a different person record the data. Then pass the sheet. Record as many rolls as possible. All groups are doing this so that there is a large amount of data in a short period of time.

After about sixty seconds, call time. Have each group read their results while you write them on the board. Have each group find one experimental ratio. Is there a number that appears more often? (YES! 7!) Why does this happen?

Pass out the note sheet. When you roll two dice, there are many ways to get one number. Make a list of all possible sums when rolling the dice. (2-12). Now, how many ways can we get each result. To find this out we will use the table on the notes. Explain that the top row is one die and the row on the side is the other die. When you roll the die, you add the two numbers together, so that is how we are going to fill in the table. As a class, fill in the table.

Which number appears most? (7) Least? (1 or 12) Why? There are many ways to roll a seven, but only one way to roll a one or a twelve.

Now, we are going to do another experiment. Keep the students in the same groups. Pass out bags of marbles. Explain that they will pull out a marble, record it, and put it back. Do not tell the students that some bags are fair and some are unfair. After recording, have each group write the results on the board. Have the students discuss why they think each group has different results. Ask which bag they would rather play with. (The fair one.) Now, have each group dump out the bag and inventory their marbles. Write this information next to the experiment information. Why do you think there are different results now? (The bags had different marbles.)

In order for a game to be fair, there has to be an equal chance for all results. Monopoly uses two dice. Is it fair? Explain that for all the places on the board you can only land on them by rolling except “go” and “jail.” Jail is landed on the most because you can roll on it, be sent to it by a space on the board or a card. For them the next most likely space to
land on is 7 away from jail. This space is “Community Chest.” If this space was a color or free parking, the game would be less fair, but the makers of the game figured out to keep that space neutral. The next space that is 7 away is Illinois Ave. This makes the red property a little better to buy than the other colors.

II. Conclusion
Soon we will be creating our own games. We need to remember to keep them as fair as possible. If a space is landed on a lot, it should not be one that helps one player over another. Games are only fun if everyone has the same chance of winning.

Gearing Up: Find ratios and fill in chart as a group or independently.  
Gearing Down: Work as a class the whole time.
## Two dice and Marbles Record Sheet

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Lesson Concept: Card probability in Old Maid

Purpose: Students will follow the probability of just the Old Maid during one game.

Materials: Old Maid cards, paper and pencils

I. Setting the Stage
Put students in groups. Pass out decks of cards. Explain game and allow students to play for about 10 min. Have students put the cards in the boxes. Explain that for the last few lessons we have studied probability of different events. Today we will apply the knowledge to a game.

II. Development of the Concept
Have the students sit in a circle around three players. Shuffle and pass out the cards. Have the students put their matches on the table. Explain that we only have to worry about not getting the old maid.
Record the possibilities of each person holding the old maid as 1 out of the total # of cards in the other players’ hands. Pick from the best probability. If you have the old maid, does it matter who you choose from? (No.) If the old maid card is drawn from your hand, do you know who has it? (Yes.) For how long? Only until someone else pulls a card from the other person’s hand. Complete a full simulation of the game with students. Then pair students in groups of 4 or 5 to play and have them discuss probability ratios as they play.

III. Conclusion
The goal that you are trying to achieve is what decides the probability that you consider. Today we only had to think about the Old Maid. Next time, we will look at a whole deck of cards and all the different categories involved in the probability of a regular deck.

Gearing Up: Have the students figure out what card to watch and how to write the probabilities.

Gearing Down: Work only as a group or think about probabilities at only very end of game.
Lesson Concept: Probability in playing cards

Purpose: The students will write probability ratios that pertain to a regular deck of playing cards.

Materials: dry erase board and markers, playing cards for all groups (jokers removed), worksheet copies for each person or group

I. Setting the Stage
Yesterday we explored the probability involved in the game of Old Maid. Today we will look at the different ratios for a regular deck of playing cards. Pass out the cards. Look at the cards as a group and write down the characteristics you notice about the deck.

II. Development of the Concept
As a class, list the different characteristics that the groups came up with. Circle the words so that they are in the following categories: color, face value, suit, and specific card. Each category will have a different denominator for the ratio fraction. Have the students come up with this number by finding the total number of subcategories. For example in color, the subcategories are black and red. Each color has 26 cards. The denominator for this group would be 2. Continue for each category.

To determine the ratio of a card first figure out what category that card fits into. For example, if you only ask about a red card, then color is the category. Determine the bottom number by using the number of subcategories. The top number is the number of preferred choices. For example, the probability of a black card is 1 (preferred choice) out of 2 (number of subcategories).

List five questions on the board for the groups to discuss
Have students work as a group to write the probability ratio of drawing the named card.

Questions:
1. a red card (1/2)
2. the queen of hearts (1/4)
3. a four (1/13)
4. a club (1/4)
5. a blue card

Regain attention of the class. Have them provide the answers to the questions. Pass out the probability worksheet. Let the students work in their groups to figure out the ratios.

III. Conclusion
Think about these ratios next time you are playing a card game. If you want a queen of hearts there is only one card in the whole deck that you can have, but if you just need a queen, there are four different cards you can get that would allow you to win.

Gearing Up: Work individually to find ratios.
Gearing Down: Work as a class for the complete lesson.
Find the ratio.

1. a black card
2. the jack of hearts
3. a six
4. a diamond
5. not a heart
6. a two, four or six
7. a red or a black card
8. not a spade
9. a green card
10. the four of clubs

NEED A HINT? LOOK AT THE TABLE!

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</table>
Lesson Concept: Components of game directions

Purpose: The students will state what parts of directions are universal.

Materials – paper, pencils, various directions from game boards, actual game Chutes and Ladders

I. Setting the Stage
When you get a new game that you have never heard of what is the first thing you do? (Look at the board, pieces, read directions.) What is one thing ALL games have in the box? (DIRECTIONS!) Today we are going to look at the directions in various games and find out what they all have in common.

II. Development of the Concept
Students should have some familiarity with directions. Have them brainstorm what they think should be included. Write responses on the board.

Break the students into groups. Pass out the directions. Have them THINK about what might be on the other direction pages. Have them DISCUSS in group what parts are included on other direction pages. Finally have the students volunteer ideas while you write add them to the board.

Then, go through each idea and see if it really appears on more than one page. If not, take it off the list. Ask the students what parts absolutely must be in directions. Use this minimal list as the requirements of the student generated directions for the game.

Hold up the game “Chutes and Ladders.” Have the students write their own set of directions for this game. Compare each edition of the directions.

III. Conclusion
Today you learned about directions. We are going to use this information soon when you create the directions for you own games. Now that you know how directions are usually set up, you might be able to learn how to play new games faster.

Gearing Up: Give different groups different games in order to write directions.
Gearing Down: Write directions for “Chutes and Ladders” as a class.
Lesson Concept: Making game boards

Purpose: Using their knowledge about probability and games, students will design and create their own game boards.

Materials
I. Setting the Stage
We have learned about a lot about probability and games. Today you will design and make your own games. First you will have to decide the title, theme, and how to set up the board. Then decide how pieces will move around the board. Finally you will draw and decorate the game. You will have to create all pieces for the board from the materials that I have.

II. Development of the Concept
Write the following list on the board. Tell the students they the have to check with you before they go on to the next step.
1. Title and theme
2. Board Set up
3. Movements
4. Pieces
5. Rough Draft
6. Final Draft (PENCIL ONLY)
7. Color final draft

III. Conclusion
Next time you will have time to complete the board as well as write the directions for your game. You will get a chance to play your own game and then present it to the class.

Gearing Up: Students will move on to writing their directions.
Gearing Down: We will go though the list as a class while each group completes the specific step for their own game.
Group Names

-------------------------------------

What is the theme? _______________________

What is the title? _______________________

Draw a picture of what the board will look like

How will you move around the board? _______________________

Draw a picture of what the pieces will look like.
How many players can play your game?

What should the ages of the players be?

How long do you think it will take to complete a whole game?

How will you win the game?

Are there any other ways to win the game?

Extra Information:
Lesson Concept: Create direction pages for game

**Purpose:** Using information from a past lesson, students will create directions to accompany their game.

**Materials:** student games, paper, pencils, crayons or colored pencils, direction template from lesson 6

**I. Setting the Stage**
You have created your games, and they look great. No one can play them until they know how. You might not be there to explain. What should we do about that? (MAKE DIRECTIONS!) Today you will work together to write the directions for your games.

**II. Development of the Concept**
Students will get their games and break into respective groups. They will use the short outline from the previous lesson to create their directions. First they should take to each other about how to play the game. Once they have a wording they like, they should write in on the template.

Once the directions are made, if computers are available, have students type their direction. If no computers are available, proof read directions then have groups make final copies.

Once final copies are made, students should write/ practice their presentations about their games.

**III. Conclusion**
Now that your directions are made, we have all the parts of your games. Next time, each group will present its game to the class. After the presentations, we will play all the games. You will have a chance to self evaluate how good your game actually is.

**Gearing Up:** Students will write their directions and peer edit another group's.  
**Gearing Down:** Students will dictate their directions to the teacher (or a fluent writer) to write.
Lesson Concept: Present self-made game boards

Purpose: Students will present and play their games. Students will self-evaluate their games based on if others can understand their directions.

Materials – students’ games

I. Setting the Stage
You have worked really hard in the last weeks to create a game that other people can enjoy. Today we will give each group a few minutes to explain their games, and then we will take turns playing all of the games. Remember we want to respect and support each other so, after each presentation we will clap politely.

II. Development of the Concept
Students will describe why they chose to create the game the way they did such as what was their inspiration and why did they chose that probability. Each group will explain the directions of their game. They will also explain the setup of the game board.

Once all groups have presented, we will set up stations for each game. The groups will rotate to different games to test them out. After each session, they will mark if they understood how to play the game.

Once all games are played, groups will meet and evaluate their own game based on clarity of directions, creativity, and use of probability. Is their game fair?

III. Conclusion
I have had a lot of fun the last few weeks with you. I learned a lot about games from you, and I hope you learned a lot from me. Maybe now that you know a little about how games work, you will be a better player on game night.

Gearing Up: Students will have the class explain the probability of their game, and then tell the class if they are right or not.
Gearing Down: We will discuss the probability of the games as a class. We will decide together if the games should be considered fair.
Teaching Journal

Feb 27th
Today I meet three students that will be enrolled in the game course. We started with the ice breaker of forming ratios as well as a very short note sheet. Then, we worked on the centers as a class because it is difficult to break three students into a smaller group. The students were in grades 1, 2 and 4. We basically did a short introduction to the unit. I did not feel that I could go to far considering at least seven students were absent.

March 1st
Today I was moved to the stage. This is going to be a difficult placement. The students that are not with me play loud games on the other side of the curtain. About halfway through the lesson, the about 20 or 25 students come in from outside and must hang their jackets in the cubbies that are on the stage with me. I am finding it difficult to keep the attention of the class throughout all of these distractions. On a positive note, seven students were present today. We reviewed ratios from the Monday. The three students that were there helped to summarize the basic concepts. Then we experimented with spinners and one die. They were able to tell from looking at the spinner that the red color would most likely be counted the most. The die experiment was more interesting. They were unsure of what would happen. They each had different guesses about which number would come up most often. We rolled the dice and their numbers all came out very close to even. I was happy that the experiment followed the theory I wanted them to discover, that each number is equally as likely to show up. With only seven children, this lesson went quickly, so we also performed the experiment with two dice. We found that seven came up the most. I informed them that next week we would find out why this happened. Overall, besides the quickness of each lesson, I think I am successful in teaching or at least introducing the concept of probability to these students.

March 13th
We are still on the stage, and it is still distracting. Today we filled in addition tables to see why 7 is rolled the most. The older kids really understood this phenomenon, but the younger kids seemed only to accept it as true without understanding. Then we sorted a deck of Old Maid cards. Based on the last lessons, I was surprised that when I asked what card we needed to follow, most students said the Old Maid. We did a simulation about how to win by picking from the ratio in your favor. I thought the older kids would pick up much more, much faster than the younger kids, but they were all on about the same level. When we broke into groups, it was actually the younger group that I heard discussing which ration was better. For example, “one out of five” is better than “one out of 3” for not getting the Old Maid card. While this lesson impressed me, I realized that I was moving quickly through the unit. If I kept the playing card lesson in, I would be teaching about one lesson after their spring break. So, to keep with the school schedule and to finish before their spring break, I decided that on Thursday they would begin designing their games.
March 15th
Game design began today. I think that the outline worked well to get them to think about all the various components that go into game making. They seem to have good plans. I was surprised by how much they decided to change their plans when they saw the materials that I had available. The games are being created at many levels. Some are very detail oriented, but some really just over decorate. I also noticed that some aspects are being forgotten, like a starting point or a labeled finish. I decided not to point this out to the groups so that they could discover it themselves when they tried to play their game.

March 20th
Today we wrote directions for the games. Some students noticed that they needed dice, but they were not in the games. Others did not notice. I cannot wait for them to play the games and see what is missing. I think that the students will have a revelation. After writing the directions, I let the students finish creating their games. I told them that on Wednesday we would be playing them so they had to be completely finished.

March 22nd
Game day. The students were first asked what probability their games had. When no one knew how to answer, we had to back up and see where the probability was. After I asked what we talked about before making the games, they realized that the dice and spinners were what they had to consider for the probability question. We worked as a class (of 8) to write the sentences for each kind of probability. I asked what made the dice a good choice. They were able to say that for one dice all numbers were equally possible, but for two seven was better. They told me that spinners had to have equal space for each color. Even when considering trivia cards, they came up with the fact that the person who knew the most would probably win. We did not discuss this as probability, but they were able to recognize it.

Then they played their games. They evaluated their good and bad parts of their own games. Many students found missing spaces during this part. I think it was a good exercise to be able to self-evaluate rather than me just pointing out inconsistencies with the direction and the boards. I think that the unit was successful. When I asked what they had learned, I received answers such as rations, probability, fair and unfair, making games, as well as “how to make better games.” I am pleased with the outcome of this experience.
Resources


## Game List by Grade

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<tr>
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<tr>
<td>GIRL MONOPOLY</td>
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</tr>
<tr>
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<td>Fourth Grade</td>
</tr>
<tr>
<td>ANY QUESTIONS?</td>
<td>Third Grade</td>
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