

G r e a t   S o u r c e

# Every Day Counts<sup>®</sup> Partner Games

Research Base and Program Effectiveness

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## INTRODUCTION

This document details the research base and evidence of effectiveness for the *Every Day Counts® Partner Games* as a tool for increasing students' mathematical motivation and proficiency.

Special thanks to Elizabeth B. Beckner and the Hopkins Road Elementary School for participating in the effectiveness evaluation of *Partner Games*.

## EVERY DAY COUNTS PARTNER GAMES® PROGRAM OVERVIEW

*Every Day Counts Partner Games* offers 20 simple yet effective games for learning, reviewing, and practicing key number concepts through fun, hands-on activities. Aligned with NCTM and state standards, it's an ideal companion to *Every Day Counts Calendar Math*, Title 1 remediation, and after-school math programs.

*Partner Games* includes:

- Key number concepts from place value to patterns and multiplication to decimals;
- Multi-sensory activities using manipulatives and visual models;
- Mental math and communication skills with hands-on activities and discussion;
- Step-by-step implementation guidelines including assessment strategies, extension activities, and guidelines for tailoring instruction to individual needs.

The benefits of *Every Day Counts Partner Games* include:

- As students discover math during game play they share strategies, verbalize their thinking, and learn the language of math.
- Students who use math symbols and number sentences to record the results of games begin to understand the purpose of recording math.
- Students have opportunities for social growth as they play together.
- A variety of learning styles are addressed with games that include visual, oral, aural, written, and hands-on activities.
- Open-ended discussion and presentation allows multiple points of entry to challenge students at all levels of mathematical achievement.
- The games feel like play but students are actually engaged in good, meaningful practice that is based on state and NCTM standards.

*Partner Games* is available in two packages:

1. *Partner Games Class Pack*—for whole-class activities and workshops.

- 1 Partner Games Kit
- 5 Ten-Grid Card Decks (K-3)
- 3 copies of each game on cardstock
- 5 Fraction/Decimal Card Decks (4-6)

2. *Partner Games Kit*—for classroom math center.

- Teacher's Guide
- Counters
- Dice (K-2)
- Manipulative Materials on Cardstock (K-6)
- Ten-Grid Card Deck (K-3)
- Number Cubes (K-6)
- Fraction/Decimal Card Deck (4-6)

# Every Day Counts® Partner Games

## R e s e a r c h B a s e

### Introduction

*Every Day Counts® Partner Games* is a collection of powerful number games that use manipulative materials and visual models to help students develop key number concepts. The program is based on best classroom practices for teaching mathematics that have been validated by scientific research (e.g. Baratta-Lorton, 1994; Burns, 2000; Kamii, 1993). These practices include whole class and peer discussion, the usage of informal learning and games, the use of real life data and visual models, continuous exposure to critical mathematical concepts, offering students multiple points of entry, cooperative learning, developing number sense and computational fluency, differentiating instruction, and ongoing assessment.

### **Whole class and peer discussion encourages social interaction and dialogic discourse to help promote a deeper understanding of key mathematical concepts.**

The five mathematical process standards—communication, reasoning and proof, connections, problem solving, and representation—are ways in which children can acquire and use content knowledge (National Council of Teachers of Mathematics [NCTM], 2000). Communication is an integral aspect of *Partner Games*. Children make connections and share their reasoning with their peers as they learn and solidify their understanding through explanation and discussion, and teachers listen and observe to assess learning (Copley, 2000). “Cobb, Yackel, and Wood (1991) say that when children are given opportunities to talk about their mathematical understanding, occasions for learning mathematics are natural” (Steele, 1998).

Instruction through discourse and collective reflection helps children achieve mathematical understanding. In their research, Whitin and Whitin discovered “[T]alking was an effective way for children to clarify their thinking, discuss new possibilities, [and] extend the thinking of others” (Whitin & Whitin, 2002). “The establishment of a classroom participation structure that provides students with opportunities to explain and justify different solutions allows teachers to build on students’ contributions as they move toward desired pedagogical goals. This discourse is central to reform and makes possible students’ development of mathematical beliefs and values that contribute to the development of their intellectual autonomy” (McClain & Cobb, 1999).

The activities in *Partner Games* are based on peer discussions. The students play various math games such as “make the sum,” “take the difference,” “odd or even,” “multiple rally,” “factor search,” and “try for one” and discuss their moves and outcomes with their partner. These discussions work to foster interaction among the students and promote dialogue about mathematics. During these discussions students exchange ideas and approaches to mathematical topics that help them develop a deeper understanding of various mathematics concepts as they compare and contrast different ways to view and solve problems and learn from each other (Schoenfeld, 1992; NCTM, 1989). Furthermore, daily discussion benefits students by providing them opportunities to express their thinking before a small group in a non-threatening, secure setting.

One result of this exchange of ideas and strategies is that students build their own understandings of mathematics concepts based on their discussions. Their understanding is deeper than that gained by memorizing a teacher's examples. "Children who have the opportunity to consistently construct their personal understandings of mathematics concepts are more mathematically powerful than those who do not" (Kamii, 1993). Research clearly supports the superior depth and stability of the mathematical concepts that children construct for themselves based on effective experiences (von Glasenfeld, 1995; Kamii, 1993). When children have built their own personal understandings, they have a more solid grasp of the concept and a stronger base on which to build future concepts. While mathematical vocabulary can be difficult for young children to acquire, the repeated conversations fostered by *Partner Games* help students learn and retain key mathematical terminology. "When children talk about mathematical concepts, they are actually increasing their understanding of that concept. Language allows them to reflect on and revise their thoughts" (Andrews, 1997).

**Programs that provide informal learning and games that challenge students without overwhelming them help motivate and engage students in the learning process.**

"Games help build community. They allow us to practice and enhance skills, challenge our intellect, and improve our ability to solve problems, all while we are having fun" (Barta & Schaelling, 1998). The content of the mathematics in *Partner Games* is drawn from topics that are appropriate for each grade level and complements what students are learning in their math textbook. Students play and discuss games that are rich in mathematical content and application that will improve their mathematical abilities. Students continue to be interested in mathematics because the activities in *Partner Games* are not simply drill and practice. In addition to being engaging, the various games promote an interest in mathematics and motivate children to learn more challenging aspects of mathematics. While doing so, students improve their skills and understanding of mathematics at their level (O'Conner & McGuire, 1998).

"Group games can provide a rich context for social and mathematical development" (Hildebrandt, 1998). *Partner Games* has a positive effect on students' general attitude about and interest in mathematics. Many younger children are interested in all school subjects, but their interest in mathematics wanes as they approach the upper elementary school grades. Students involved in supplemental mathematics programs are more likely to have a positive attitude towards mathematics (Bransford, Brown, & Cocking, 2000). *Partner Games* allows students to work with mathematics concepts in a fun and compelling context and show them that mathematics can be appealing and fun.

**The use of manipulative materials and visual models promotes students' problem solving ability.**

"At every level from kindergarten on up, manipulative materials can help by providing students opportunities to get their hands—and also their minds—around abstract ideas" (Burns & Silbey, 2000). Burns and Silbey provide five important reasons for using manipulative materials: manipulative materials give students an opportunity to make abstract ideas concrete, take the math out of the textbook and into students' hands, increase students' mathematical confidence by letting them test and confirm their reasoning, are helpful tools

to help students solve problems, and make math more enjoyable and interesting (Burns & Silbey, 2000). “Classroom lessons involving manipulatives have a higher probability of producing greater mathematics achievement than do lessons not using manipulatives” (Johnson, 2000). *Partner Games* uses a variety of manipulative materials (from the kit and the classroom) to help students to better visualize, understand, and talk about mathematical concepts. Manipulative materials and visual models vary at each grade level but include cardstock, fraction/decimal cards, play money, number cubes, and counters.

**Continuous exposure to critical math concepts allows children to develop an understanding of important mathematical concepts over time and learn at an individual pace.**

Not every child acquires mathematical understanding at the same time, the same pace, or through the same modality (Bowman, Donovan, & Burns, 2001). *Partner Games* is designed to deliver content incrementally to promote continuous learning and understanding. The repetition of the games allows students to develop understanding of important mathematical concepts over time and learn at an individual pace. Allowing students to build understanding over time with continuous review has proven to be an effective way to maintain skills and an understanding of critical mathematical concepts (Baratta-Lorton, 1994). “Through repeated play, children develop new strategies for doing mathematical calculations and share them with one another” (Hildebrandt, 1998).

This understanding thus promotes remembering. “Evidence from verbal learning and comprehension suggests that these modifications are made to bring the information in line with the person’s current knowledge” (Rumelhart, 1975). That way, the information is represented by students in a way that fits with their existing network of knowledge. Making connections between new information and prior knowledge already represented in networks is one way of characterizing Bartlett’s (1932) observation of a natural “effort after meaning.” Memory, if viewed as a reconstructive process, involves the same cognitive activity as understanding: constructing connections between representations of new knowledge and existing knowledge” (Hiebert & Carpenter, 1992).

**Offering children multiple points of entry helps them construct mathematical knowledge.**

By presenting mathematical concepts orally, visually, and kinesthetically, each child can move the information into long-term memory in a manner that works best for him or her. These deep and sustained interactions with key mathematical ideas enable children to acquire mathematical understanding (NAEYC/NCTM, 2002). *Partner Games* is based on the information gleaned from brain research and the understanding that young children must actively construct mathematical knowledge. Through the various games, children have the opportunity to preview and review math concepts. *Partner Games* offers continuous points of entry through a variety of modalities to provide deep understanding of concepts not achievable in a single chapter or unit.

## Cooperative learning engages students, encourages them to share their thinking, and helps students to learn from each other.

An integral aspect of *Partner Games* is that students play games together and talk with their peers about math concepts. “Cooperative learning promotes the use of effective reasoning strategies and greater critical thinking than do individual learning strategies.” (Johnson, Johnson, Holube, & Roy, 1984). *Partner Games* can be used in a variety of ways to best meet students’ needs. The whole class can play the games in pairs, the whole class can play as a team against the teacher, or the class can be divided into two teams competing against each other. When the students are playing in pairs, the teacher has an opportunity to observe their dialogue and thinking skills.

*Partner Games* provides concept development and meaningful practice in a non-threatening way. Students learn to work with others in a collaborative effort and are encouraged to explain their thinking to each other. Cooperative settings promote a positive attitude towards mathematics, as well as continuing to motivate children (Johnson et al., 1984). Each student takes their turn at the game and then they share their thinking with their partner and benefit from hearing how others thought about and solved a particular problem (Mueller & Fleming, 2001). Such social interaction helps children develop strategies for doing mental math as they describe the number relationships they see and listen to those of other children. *Partner Games* requires students to describe their actions at each turn. This encourages the use of math language and allows teachers to assess the students’ thinking. Numbers and equations are used to record the results of players’ turns, helping students understand written math.

## Developing number sense and computational fluency allows students to construct understanding internally.

*Partner Games* allows students to acquire number sense by constructing understanding internally rather than the teacher telling the children what to do. Through a variety of structured games, children develop number sense and computational fluency. *Partner Games* is intended to help children develop key number concepts such as place value, addition, subtraction, multiplication, division, fractions and decimals. By playing the games many times children gain number sense, discovering number relationships that will help develop counting with more efficient mental math strategies. While playing these games, children explain what they see and make predictions and generalizations based on what they understand. “Taking the time to listen to other strategies is important ... it is an opportunity for students who may not be as confident to hear a strategy that they can relate to, and also for students who consistently rely on one strategy to hear other strategies verbalized” (Sisul, 2002; Griffin, 2003).

“Counting and counting knowledge in its various forms is an integral aspect of young children’s everyday life. Indeed, it could be argued that the construction of counting concepts and skills is the single most important element in young children’s mathematical development. *Partner Games* includes games that involve counting by ones, twos, threes, fours, fives and tens. Other games focus on counting mixed coins or adding large bills. Not only are counting competencies essential everyday ‘survival skills’ in their own right, they provide a basis for the development of number and arithmetic concepts and skills” (Baroody & Wilkins, 1999).

## Mathematics instructional materials should be accessible for all students.

“The challenge of teaching any subject is to find learning activities that are accessible to all learners and, at the same time, have the richness to challenge the more interested or capable students. Manipulative materials are a wonderful resource for this” (Burns & Silbey, 2000). *Partner Games* appeals to students with many different learning styles and backgrounds including English language learners, children of poverty, and the learning disabled. The visual, verbal, kinesthetic, social, and interpersonal aspects of the program not only help make mathematics accessible to all students but also help students in their overall academic achievement. A study of limited English proficiency students funded by the Office of Educational Improvement found that children learn best when they are given a relevant context for their learning. For example, for students learning a new language, “[r]ather than participating in structured skill-and-drill practice selected and directed by the teacher, these students are practicing English by using it to communicate their own ideas to each other and to the teacher” (McLeod, 2004). Through the games and peer discussions, students are given a tangible real-world context for their learning. As a result, students internalize important concepts quickly and are able to communicate their understanding to others and connect it to new topics. In addition, children of poverty need greater opportunities to direct their own learning (Knapp & Shields, 2004). *Partner Games* encourages all students to be active participants in their learning by involving everyone in the games and discussions.

## Meaningful, ongoing assessment helps students achieve.

“Assessment should be more than merely a test at the end of instruction to see how students perform under special conditions; rather, it should be an integral part of instruction that informs and guides teachers as they make instructional decisions” (NCTM, 2000). “Assessment should be an integral part of instruction . . . [and] focus on children’s understanding of ideas, problem-solving abilities, and reactions to their learning” (Burns, 2000). The informal assessment in *Partner Games* is not cumulative, occurring after a number of weeks, but is ongoing, and provides students with several opportunities to demonstrate mastery. The student discourse that occurs as a result of *Partner Games* allows teachers to evaluate students’ understanding and comprehension. “The teacher ‘becomes aware’ of the students’ thinking through their language” (Steele, 1998). Students reap the benefits of immediate assessment by correcting any flawed reasoning and applying this corrected thinking to subsequent problems. The assessment is in line with the National Council of Teachers of Mathematics recommendations for effective assessment in mathematics classrooms (NCTM, 1995).

## Summary

The *Partner Games* program format is similar at every grade level, ensuring continuity throughout the program from grades K–6. The topics and challenges at each grade are aligned with and help implement the National Council of Teachers of Mathematics standards. The games build on what students learn in class with activities that engage students, allowing them to explore, make and test conjectures, and apply their mathematical understanding. The games are fun and captivating which keeps students motivated and interested as they learn mathematics concepts and relationships. *Partner Games* also promotes children’s social skills as they actively participate in discussions about mathematics. Students become engaged in activities and explorations that are age-appropriate and involve topics that are suitable for their respective grade levels, in a safe, secure environment.

## PROGRAM EFFECTIVENESS

### Participants

Approximately 250 students in grades 3-5 and twelve classroom teachers under the direction of the site-based mathematics specialist participated in the *Partner Games* evaluation. The student population targeted was in the lower quartile in mathematics and are largely disadvantaged and have limited reinforcement of mathematics skills at home.

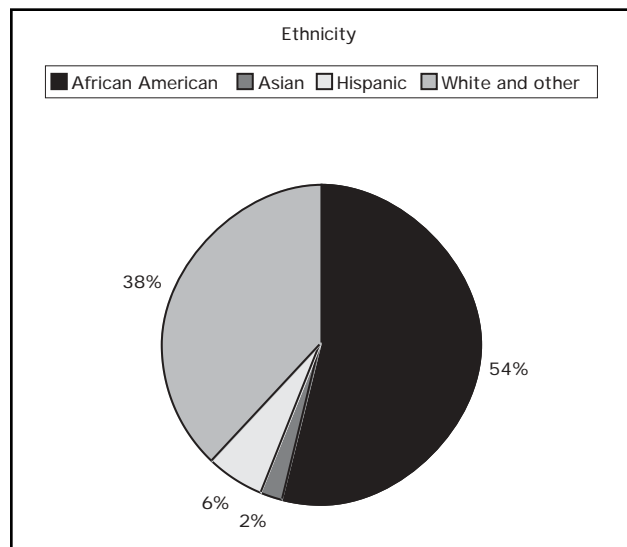
### School Demographics

Gender: 52% male; 48% female

Special Education Population: 22%

Students receiving free and reduced lunch: 50.2% (For grades 3-5: 44%)

Ethnicity: 54% African American; 2% Asian; 6% Hispanic; 38% White and other (Beckner, personal communication, 2003).

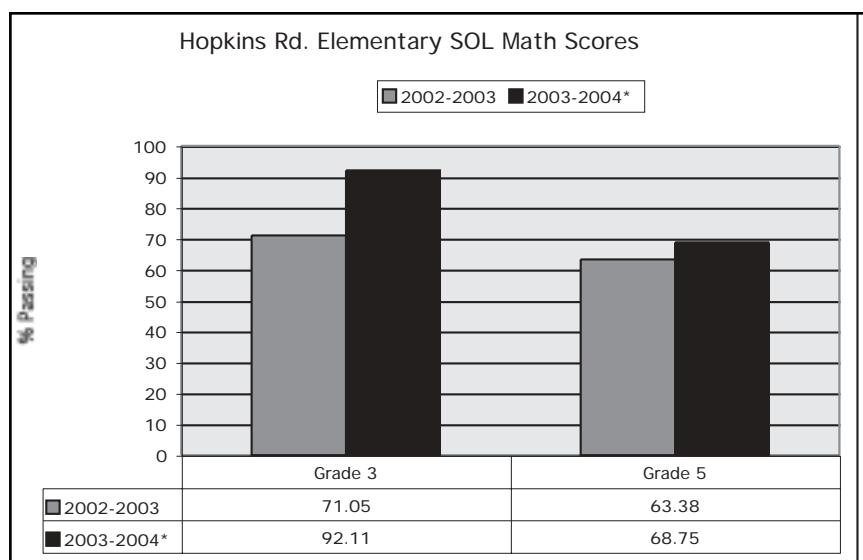


### Method

During the 2003-2004 school year the site-based math specialist introduced games from the *Partner Games* Class Pack biweekly and left each game with the classroom teacher to continue to use in the classroom. Selected teachers used the games 15-30 minutes per week as supplemental activities.

### Results

Virginia SOL scores for grades 3 and 5 show increases in the percentage of students who passed over the prior school year (Virginia Department of Education, 2005). It is difficult to isolate exactly how *Partner Games* influenced student performance on the SOL test but the results are encouraging.



\*First year with Partner Games.

Reports from Elizabeth B. Beckner, the on-site math specialist, add evidence for the effectiveness of *Partner Games*, especially as a tool for increasing students' enjoyment in math and math vocabulary and improvement in students' communication of mathematical ideas.

"The students enjoyed using the games and the games allowed them to improve their ideas, thoughts, and concepts about mathematics. The students and teachers both have expressed desire to use the *Partner Games* again and again. Utilizing the *Partner Games* has improved math vocabulary among our students as the games have the students using the math language to discuss their solutions and answers.

*Every Day Counts Partner Games* are exciting and of high interest among the students that have been using them. They are engaged in learning and active practice without realizing they are working on math skills. The students have enjoyed using them so much that they have wanted to play them at home."

Elizabeth B. Beckner  
 Site-based Mathematics Specialist  
 Hopkins Road Elementary  
 Richmond, VA

### Conclusion

The results suggest that *Every Day Counts Partner Games* have a positive effect on students' mathematics proficiency in several key areas.

Results show evidence for the effectiveness of *Partner Games* in increasing:

- student motivation and enjoyment of mathematics;
- math vocabulary;
- concepts about mathematics;
- depth of mathematics knowledge;
- performance on assessments.

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