Introduction to Communication

Grades 6–8

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The Math Process Standards Series
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Students who have opportunities, encouragement, and support for speaking, writing, reading, and listening in mathematics classes reap dual benefits: they communicate to learn mathematics, and they learn to communicate mathematically.

—National Council of Teachers of Mathematics,
Principles and Standards for School Mathematics

Why Communicate About Mathematics?

In mathematics, as in other subject areas, talking and writing are critical processes through which students develop content understanding. Through communication, students are able to test their thinking, clarify misconceptions, discover alternate ideas, and extend their understandings. As students struggle to get their thoughts into words, they are challenged to process the ideas in order to restate them, elaborate on them, or conjecture about them. As they listen to their own and others’ thinking, they often recognize their confusions, question their understandings, and fold others’ ideas into their own in order to modify and refine their knowledge. As students read, write, talk, and listen, they are challenged to think, analyze, summarize, prioritize, and reflect.

Talking and writing about math allows students to monitor and assess their own thinking. In addition, it plays a critical role in the classroom assessment process. Communication, whether oral or written, allows us to know what our students are thinking. It provides us with more information than simply whether an answer is right or wrong; rather, it allows us to assess the degree to which our students understand a math skill or concept. Communication provides us with a window through which we can see their thoughts. Whether our goal is to support concept development or to pro-
vide a means of assessment, communicating about mathematical ideas plays a vital role in our mathematics classrooms.

While we recognize that communicating about content is valuable for both learning and assessing that content, communicating about math offers special challenges for many students. In mathematics, the communication process is complicated by a specialized vocabulary, an uncertainty about how to verbalize one’s thinking, and the sheer complexity of some mathematical concepts. Students must be supported as they learn to communicate mathematically. We can assist our students in developing their abilities to communicate effectively about mathematics through attention to foundational skills such as vocabulary development, organization of thinking, and understanding of question/answer relationships. Teacher questioning techniques to spark student thinking and teacher modeling to illustrate ways to express mathematical ideas have tremendous benefits. Providing our students with opportunities to talk about math through cooperative learning activities and to write about math through a variety of classroom writing assignments assists students in developing their communication skills. And frequent and specific feedback helps students refine and enhance their communication skills. As we explore best practices in communicating about mathematics, we must focus on helping our students use communication as a tool to learn mathematics, while also helping them learn to communicate effectively about mathematics.

**What Is the Communication Standard?**

The National Council of Teachers of Mathematics (NCTM) has developed standards in order to support and guide us as we develop classroom lessons and create activities to build our students’ mathematical understandings. The first five standards delineate the content to be addressed in the math classroom (Number and Operations, Algebra, Geometry, Measurement, and Data Analysis and Probability), while the next five standards address the processes through which students explore and use mathematics (Problem Solving, Reasoning and Proof, Communication, Connections, and Representation). Communication is a critical math process, and the components of the NCTM Communication Standard reflect its integral role in student learning.

Instructional programs should enable students to:

- organize and consolidate their mathematical thinking through communication
- communicate their mathematical thinking coherently and clearly to peers, teachers, and others
- analyze and evaluate the mathematical thinking and strategies of others
- use the language of mathematics to express mathematical ideas precisely (NCTM 2000, 60)

Throughout this book, we explore ways to assist students in developing and refining their thinking through verbal and written communication. We investigate com-
How This Book Will Help You

This book is designed to help you better understand the NCTM process standard of communication. It explores communication as a process through which students learn mathematics and as a skill that enables students to express the mathematics they have learned. This book focuses specifically on the mathematical goals of students in the middle grades (grades 6 through 8) and offers practical ideas for helping them communicate effectively about mathematics.

This book addresses a variety of significant topics related to the communication standard. The importance of teacher talk to express and model ideas is explored, as well as ideas for teacher questioning techniques to promote student reflection and discussion. A variety of classroom activities that promote discourse through partner, small-group, and whole-class discussions are included, as are strategies to aid students in increasing their math vocabularies and strengthening their skills in reading math text. Attention is given to the challenges of writing about math, and specific strategies are offered to support students as they learn to effectively record their math understandings. Suggestions for improving the quality of students’ writing through varied feedback techniques are included, as well as tips for selecting meaningful writing tasks and scoring students’ writing assignments.

Once we have explored the communication standard in depth, we examine the standard as it connects to math content in Chapter 9, titled “Communication Across the Content Standards”. Through sample classroom activities, we explore the interconnectedness of the content and process standards. You will see student work to illustrate these lessons and will be asked to reflect on the teaching of math content through communication, as well as the teaching of communication skills in the context of mathematics.

Examples of student work are presented throughout the book to offer a glimpse into students’ mathematical thinking and communication, and classroom-tested tips are shared to provide you with practical ideas to better meet the needs of your students. Following each chapter, several questions for discussion prompt you to think about the content presented in the chapter, whether alone or with a group of your colleagues. The accompanying CD is filled with a variety of teacher-ready materials to make it easier for you to implement the ideas explored throughout the chapters. Graphic organizers, rubrics, and a parent letter are all included on the CD, along with a wealth of math
writing activities that connect specifically to the math content for grades 6 through 8. All of the CD resources are customizable, allowing you to modify them (i.e., alter the problem situation, change the data, or insert your students’ names), providing you with a practical tool for meeting the needs of varied levels of students within your classroom.

This book was written to provide you with both theory and practical resources for building your students’ math communication skills. It is hoped that this book enhances your understanding of the communication standard and provides you with insights and practical ideas to further develop your students’ skills. As we better understand the importance of verbal and written communication in our math classrooms and the challenges facing students as they attempt to talk and write about their math thinking, we are better able to identify, select, and design meaningful tasks.

It is hoped that the varied instructional practices highlighted in this book assist you in developing your students’ skills as well as expanding your own understanding of the communication standard. The more we reflect on the role of communication in our math classrooms, the more we are able to recognize its benefits to our students in both helping them learn mathematics and in helping them effectively express the math they have learned.

**Questions for Discussion**

1. Do you remember talking and writing in your math classrooms when you were a student? Was communicating about your thinking encouraged and valued?

2. Why might we want to do away with quiet math classrooms? How might talk about mathematics support our students’ understanding of math?

3. In what ways is writing used as a tool for learning content? Think about times when students are asked to write in other subject areas. What are some benefits of asking students to write about their thinking?
Why Are Student Activities on a CD?

At first glance, the CD included with this book appears to be a collection of teaching tools and student activities, much like the activities that appear in many teacher resource books. But rather than taking a book to the copier to copy an activity, the CD allows you to simply print off the desired page on your home or work computer. No more standing in line at the copier or struggling to carefully position the book on the copier so you can make a clean copy. And with our busy schedules, we appreciate having activities that are classroom ready and aligned with our math standards.

The editing feature of the CD allows you to modify each activity to suit the needs, interests, and skill level of your students. With this CD, you are able to use the activities exactly as they appear in the book or to modify them in countless ways. You may want to simplify some tasks or add complexity to others. The activities often include several parts or have added challenge extensions. When it is appropriate for your students, simply delete these sections for a quick way to simplify or shorten the tasks. Here are some examples of ways you may want to change the tasks and why. A more complete version of this guide with additional samples for editing the activities can be found on the CD-ROM.
Editing the CD to Motivate and Engage Students

Personalizing Tasks or Capitalizing on Students’ Interests

The editable CD provides a quick and easy way to personalize math problems. Substituting students’ names, the teacher’s name, a favorite restaurant, sports team, or location can immediately engage students. You know the interests of your students. Mentioning their interests in your problems is a great way to increase their enthusiasm for the activities. Think about their favorite activities and simply substitute their interests for those that might appear in the CD tasks.

In the second version of the following task, the teacher knows that many of his students have never belonged to a swim team, so he modifies the task to fit their interest in track, a popular sport at the school. Using the editable CD feature, he makes simple changes to the problem task to create a version of the problem that works well for his students.

Note: This type of editing is important when the problem situation may not be culturally appropriate for your students. It may be that they have no previous experience with swim clubs or swim teams and would not relate to this prompt. Substituting an experience that makes sense for your students will make the problem relevant to them.

Name _______________________________________________________

Swimming Laps

The swim team was practicing laps in a 75-meter pool. Ben swam \( \frac{3}{5} \) of the way, while Kyle swam 60% of the distance, and Alex made it \( \frac{5}{6} \) of the distance.

1. How far did each boy swim?
   Ben ______________            Kyle __________________            Alex  ________________

Show your work.

2. Which boy swam the farthest? Use math data to prove your answer. __________________
   Show your work.

Challenge: The swim coach told the boys that they had to double the distance they swam. How far will they have to swim? Explain how you got your answer.

Running Laps

The track team was practicing running laps on a 400-meter track. Ben ran \( \frac{3}{5} \) of the way, while Kyle ran 60% of the distance, and Alex made it \( \frac{5}{6} \) of the distance.

1. How far did each boy run?
   Ben ______________            Kyle __________________            Alex  ________________

Show your work.

2. Which boy ran the farthest? Use math data to prove your answer: __________________
   Show your work.

Challenge: The track coach told the boys that they had to double the distance they ran. How far will they have to run? Explain how you got your answer.
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About the CD-ROM

Editing the CD to Differentiate Instruction

Modifying the Readability of Tasks

Adding some fun details can generate interest and excitement in story problems, but you might prefer to modify some problems for students with limited reading ability. While the problems in the second version that follow are the same as in the first version, the tasks are written in simpler ways to support those students who might benefit from fewer words and simpler vocabulary. Simply deleting some of the words on the editable form will result in an easy-to-read version of the same task.

<table>
<thead>
<tr>
<th>Name ________________________________</th>
</tr>
</thead>
</table>

### Which Phone?

Joe’s parents have told him that they will buy him a cell phone if he compares the cost of the plans so that he can get the best buy.

**Talk Time** offers a plan for $29.95 per month and $0.25 per minute.

**Cell to Cell** offers a plan for $19.95 per month and $0.50 per minute.

1. Describe several methods Joe could use to compare the prices in the plans.

   - ______________________________________________________________
   - ______________________________________________________________
   - ______________________________________________________________
   - ______________________________________________________________
   - ______________________________________________________________
   - ______________________________________________________________

2. Complete the table for each phone company to compare the total cost for the following numbers of minutes: 5, 10, 25, 50, 75.

<table>
<thead>
<tr>
<th>Minutes</th>
<th>Talk Time Total Cost</th>
<th>Cell to Cell Total Cost</th>
</tr>
</thead>
<tbody>
<tr>
<td>5</td>
<td>0.25</td>
<td>0.50</td>
</tr>
<tr>
<td>10</td>
<td>3.25</td>
<td>5.00</td>
</tr>
<tr>
<td>25</td>
<td>10.00</td>
<td>12.50</td>
</tr>
<tr>
<td>50</td>
<td>17.50</td>
<td>25.00</td>
</tr>
<tr>
<td>75</td>
<td>23.75</td>
<td>37.50</td>
</tr>
</tbody>
</table>

3. Write an equation to show how you found the total cost. Let m represent the number of minutes.

   **Talk Time**: _________________________________________________________
   **Cell to Cell**: ______________________________________________________

### Which Phone?

Joe is buying a cell phone. Which plan should he buy?

- **Talk Time**: $29.95 per month and $0.25 per minute.
- **Cell to Cell**: $19.95 per month and $0.50 per minute.

2. Complete the table to compare the cost for 5, 10, 25, 50, and 75 minutes of phone time.

<table>
<thead>
<tr>
<th>Minutes</th>
<th>Talk Time Total Cost</th>
<th>Cell to Cell Total Cost</th>
</tr>
</thead>
<tbody>
<tr>
<td>5</td>
<td>0.25</td>
<td>0.50</td>
</tr>
<tr>
<td>10</td>
<td>3.25</td>
<td>5.00</td>
</tr>
<tr>
<td>25</td>
<td>10.00</td>
<td>12.50</td>
</tr>
<tr>
<td>50</td>
<td>17.50</td>
<td>25.00</td>
</tr>
<tr>
<td>75</td>
<td>23.75</td>
<td>37.50</td>
</tr>
</tbody>
</table>

3. Write an equation to show how you found the total cost. Let m represent the number of minutes.

   **Talk Time**: _________________________________________________________
   **Cell to Cell**: ______________________________________________________
Creating Shortened or Tiered Tasks

While many students are able to move from one task to another, some students benefit from focusing on one task at a time. By simply separating parts of a task, either by cutting the page into two parts or by using the editable CD feature to put the parts of the task on separate pages, teachers can help focus students on the first part of the task before moving them to the second part. Teachers might choose to provide all students with the first part and then give students the second part after they have completed the first part and had their work checked by the teacher. In this sample, the two parts of the task initially appeared on the same page. In the modified version shown here, the two parts of the task are separated and the work box and lines for writing responses are enlarged for students who may need more writing or work space.

About the CD-ROM

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Modifying Data

While all students may work on the same problem task, modifying the problem data will allow teachers to create varying versions of the task. Using the editable forms, you can either simplify the data or insert more challenging data including larger numbers, integers, decimals, or percents.

In the second version that follows, the data were altered to create a problem with a bit more complexity. In the initial version the admission discount is 10%, but the modified version includes discounts of 15% and 20%. In addition, the students are asked to calculate the wait time when two people ride at a time. Whether you decide to simply change the numbers in the problem or slightly alter the other problem information, the editable feature of the CD will allow you to create various versions of the original activity.
Vinny’s Video Arcade

Part 1
The floor in Vinny’s Video Arcade is black, and Vinny would like to brighten it with a colorful rug. Use color tiles to design a rug for the arcade floor. Your rug must have 4 colors and can have an area of no more than 30 square tiles.

Part 2
Use grid paper to create a color representation of your rug design.

Part 3
Complete the table to show the fractional part and percentage of your rug that is red, blue, green, and yellow.

<table>
<thead>
<tr>
<th>Color</th>
<th>Fractional Part</th>
<th>Percentage</th>
</tr>
</thead>
<tbody>
<tr>
<td>Red</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Blue</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Green</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Yellow</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Part 4
Explain how you figured out the percentage of each color.

Challenge: Explain why you are sure that your percentages are correct.
What's Missing?

Given this triangle, find the length of the missing leg.

15 inches

25 inches

? 

Justify your answer using words, numbers, and/or symbols.
Exploring Surface Area

1. Looking at the net, how many rectangles are there? ________

What is the area of each rectangle? ______________________________________________________________________

_____________________________________________________________________

Work space

Find the total area of the rectangles on your net. _____________________

2. The formula for surface area of a rectangular prism is \(2lw + 2lh + 2wh\). Show how you would find the surface area using the formula.

_____________________________________________________________________

3. Which method did you think was easier? Why?

_____________________________________________________________________

_____________________________________________________________________

_____________________________________________________________________

_____________________________________________________________________

_____________________________________________________________________

_____________________________________________________________________

_____________________________________________________________________

_____________________________________________________________________

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Net Directions

Directions: Cut out the net and fold it to form a solid figure. Then, use the measurement data on the net to determine the surface area of the solid figure.
Probability Grand Prix

Is this a fair game? Why or why not?
Thank you for sampling this resource.

For more information or to purchase, please visit Heinemann by clicking the link below:


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