

## Title

“Teaching Math (Grades K-2)”

## Target Audience

This course is intended for pre-service and in-service teachers of grades K-2 and mathematics specialists.

## Prerequisites

To successfully participate and complete the assignments in this course, the learner must:

- Have past experience using the classroom computer.
- Have past experience working with the Internet.
- Be familiar with taking an online course or have completed the PBS “Practice Learning Online with PBS TeacherLine” course.
- Be familiar with elementary/primary school curriculum.

## Course Description

This inquiry-based course will enable learners to research and explore the concepts from the *Teaching Math (Grades K-2)* course. During the course, learners will:

- Be introduced to the five process standards developed by the National Council of Teachers of Mathematics (NCTM, 2000): Communication, Problem Solving, Reasoning and Proof, Representation, and Connections.
- Understand ways to expand their practice, and, in turn, help students better understand mathematics.
- Develop lesson plans for each of the five mathematics process standards.
- Watch videos of best practices, explore interactives, and discuss key issues and topics with their fellow online learners.

## Instructor/Facilitator

See instructor/facilitator sheet.

## Credits

To be determined by college or university.

## Goals

This course provides pre-service and in-service teachers an overview and exploration of the National Council of Teachers of Mathematics (NCTM) process standards. There are three key goals for the course:

- To increase familiarity with and understanding of the NCTM process standards.
- To provide direct examples of effective ways to apply the process standards in the classroom and integrate their use with content goals.
- To help teachers develop habits and practices that improve their teaching and strengthen their students' mathematical process and content skills.

### **Outline of Content and Assignments**

After previewing the documents in the Course Information area, learners will proceed to Course Content to complete the following six sessions in order. Throughout the sessions, learners are asked to articulate their ideas in various forms and are required to reflect on their thoughts and experiences. The discussion forums are designed to allow learners to glean information from other learners' experiences and develop a deeper understanding of the topic. Learners will create a lesson plan for each NCTM process standard.

This course specifically addresses the following standards:

- ISTE NETS\*T 1 (a, b, c, d); 2 (a, b); & 5 (a, c)
- National Council of Teachers of Mathematics—*Principles and Standards for School Mathematics*
  - Communication;
  - Problem Solving;
  - Reasoning and Proof;
  - Representation; and
  - Connections

### **Session 1: Introduction**

Session 1 focuses on how to take this course, introduces the NCTM standards, introduces the course structure and format, and requires learners to practice participating in the discussion forum. Learners also complete their first journal reflection with a pretest.

This session will do the following:

1. Explain how to take the course
2. Introduce the NCTM Principles and Standards for School Mathematics
3. Introduce the course structure and goals
4. Present the syllabus for the course
5. Present a pretest on the course concepts for review at the end of the session.

### **The NCTM Standards**

Learners read "Principles for School Mathematics" from the NCTM and discuss how they can use the learning standards and principles, as described by NCTM, to help prepare students for mathematical success.

### **Course Goals and Structure**

Learners explore the different elements of the course structure and what they can expect to learn and do in each session of the course through the Observe, Explore, Define, Apply, and Evaluate design.

### **Course Pretest**

Learners complete their first journal reflection by writing about what knowledge about the process standards they have now, what questions they brought to this course about the process standards, and what new questions this session has prompted for them.

### **Session 2: Communication**

In this session, learners explore and reflect on different aspects of communication in helping young children to make sense of mathematics. The session content shows learners how to help students do the following:

- Use oral communication to share their mathematical thinking.
- Use invented and traditional symbols to express their ideas.
- Use methods of communication other than talking and writing, such as movement, pictures, and number sentences.
- Clarify their thinking and extend their understanding by working with and listening to the ideas of others.
- Develop mathematical ideas through effective teacher questioning.

### Session Content and Assignments

Learners will work through the five main sections of the session: Observe, Explore, Define, Apply, and Evaluate Student Communication. In each section, learners read dialogues between teachers and students for examples of students developing their mathematics communication skills. They will watch videos of students and teachers working on mathematics activities and complete interactive reflection activities to think deeply about what they observed in the lessons. In the discussion forum, learners discuss the usefulness of communication in helping students make sense of mathematics. Learners complete the following four journal activities to demonstrate their understanding of communication in mathematics:

1. What types of mathematical communication have you used as a learner? As a teacher? How do your practices compare to those in the video?
2. Do you present problems like these in your classroom? What are some characteristics of problems that are worthwhile mathematical tasks and also encourage communication among students? Consider an activity similar to these that you have used in the past. How would you modify what you have done in previously to encourage precise mathematical communication from your students and to assess their understanding of the underlying concepts?
3. As you think about your own classroom and the Communication Standard, what do you feel successful about? What would you like to do differently? How might you go about it? What obstacles will you need to navigate, and how will you address them?
4. How can you organize your mathematics lessons so that they foster communication in a variety of settings? What can you do to help students improve their ability to communicate their understanding of a mathematics concept?

Finally, learners complete an assignment by creating a lesson plan that focuses on student communication.

### Session 3: Problem Solving

In this session, learners understand the concept of problem solving as it is explained in the *Principles and Standards for Mathematics* from the NCTM. Learners explore different types of problem solving in the early grades. The session content shows learners how to help students do the following:

- Make sense of mathematical concepts by applying them to a variety of problem-solving settings.
- Solve problems using a variety of strategies.
- Learn to monitor and reflect on their own ideas in solving problems by sharing their thinking with other students and the teacher.

### Session Content and Assignments

Learners will work through the five main sections of the session: Observe, Explore, Define, Apply, and Evaluate Problem Solving. In each section, learners read dialogues between teachers and students for examples of students developing their problem-solving skills. They will watch videos of students and teachers working on mathematics activities and complete interactive reflection activities to think deeply about what they observed in the lessons. In the discussion forum, learners discuss how the Communication and Problem Solving standards are connected and why communication is an important

element of effective problem solving. Learners complete the following four journal activities to demonstrate their understanding of student problem solving in mathematics:

1. In what ways is this lesson a rich topic for young children to explore? How does the problem encourage mathematical discussion among the students?
  - a. What is the role of the teacher in creating a classroom environment that is conducive to effective problem solving? Be specific.
2. Which problem-solving methods do you personally find effective and why? Would you suggest the same methods to your students? Why or why not?
3. What are important things to consider as you select rich mathematics problems for your students to work on? What changes do you need to make to have your mathematics lessons become structured around problem solving?
4. How can you organize your mathematics lessons so that they foster problem solving in a variety of settings? What are some ways that you might allow students the freedom to investigate problems in their own way while still providing some structure for the lesson?

Finally, learners complete an assignment by creating a lesson plan that focuses on student problem solving.

#### Session 4: Reasoning and Proof

In this session, learners will look at various examples of mathematical reasoning typical of early childhood. They will observe students' thinking about mathematical ideas and their efforts to draw conclusions and make generalizations about those ideas. Learners will explore how reasoning is an integral part of mathematical experiences in the early grades and how educators can help students connect their own reasoning processes with the mathematics work they do in school. Finally, learners will reflect on the teacher's role in helping students develop habits of making, testing, and refining conjectures. The session content shows learners how to help students do the following:

- Use logical thinking to make sense of mathematical ideas.
- Use patterns and relationships to analyze mathematical situations.
- Draw conclusions as they do mathematics.
- Use models, known facts, properties, and relationships to extend their thinking.
- Justify their answers and solution processes.

#### Session Content and Assignments

Learners will work through the five main sections of the session: Observe, Explore, Define, Apply, and Evaluate Reasoning and Proof. In each section, learners read dialogues between teachers and students for examples of students developing their reasoning and proof skills. They will watch videos of students and teachers working on mathematics activities and complete interactive reflection activities to think deeply about what they observed in the lessons. In the discussion forum, learners discuss why mathematical reasoning is an important process to include in the teaching of mathematics to young children. Learners complete the following four journal activities to demonstrate their understanding of student reasoning and proof in mathematics:

1. How can you make reasoning an integral part of mathematics instruction in your classroom? Be specific.
2. Think about your own work with the attribute pieces. How did explaining your reasoning help you know that your solution was correct — even before you selected the Check key? What implications would using the same approach have for students?
  - a. Having young children explain their thinking leads to many positive outcomes in developing mathematical expertise and attitudes. What are some positive outcomes for your students that resulted from having them explain and justify their thinking?
3. It can be difficult for young children to explain their thinking in a way that makes sense. What are some strategies you can use to support students who are having difficulty putting their thinking

into words? Put yourself in the place of a reluctant student, possibly one who is in the process of learning English. Which tasks are more likely to entice this student to engage in the mathematics? Why?

4. What can you do in your classroom to help students learn by explaining their reasoning to one another? How do teacher questions help lead students to see patterns, draw conclusions, and make conjectures? What else do teacher questions need to focus on?

Finally, learners complete an assignment by creating a lesson plan that focuses on student reasoning and proof.

### **Session 5: Representation**

In the previous sessions, learners studied the Communication, Problem Solving, and Reasoning and Proof Standards. In this session, learners will examine the Representation Standard. Representations include all the different ways that students depict their mathematical thinking as well as the processes they use to put their thinking into those forms. Representations can include written work, oral explanations, models with manipulative materials, and even the mental processes one uses to do mathematics. In this session, learners will look at both non-conventional and conventional forms that young students might use to represent their mathematical thinking and how the Representations Standard is part of the total process of helping students make sense of mathematics. The session content shows learners how to help students do the following:

- Create representations.
- Use multiple representations to solve problems.
- Use representations to model their thinking.
- Translate among different representations of the same idea.
- Use representations to communicate mathematical understanding.

#### **Session Content and Assignments**

Learners will work through the five main sections of the session: Observe, Explore, Define, Apply, and Evaluate Representations. In each section, learners read dialogues between teachers and students for examples of students developing their representation skills. They will watch videos of students and teachers working on mathematics activities and complete interactive reflection activities to think deeply about what they observed in the lessons. In the discussion forum, learners discuss how they can make student representation an integral part of mathematics instruction. Learners complete the following four journal activities to demonstrate their understanding of student representations in mathematics:

1. Think of the mathematics curriculum for your grade level, and choose one content strand. How can you include student representations in that strand? Give some examples.
2. How can representation help a learner acquire new knowledge or extend existing knowledge? Do you prefer some representations to others as you work on problems? Why? Do you think your students have similar preferences? Does that have implications for your teaching?
3. Since young children have limited writing and drawing skills, one of the greatest challenges for a teacher is to "interpret" the way they represent their thinking and strategies. What are some steps you can take to help you make sense of your students' thinking?
  - a. Why do you think representations help students develop a deeper understanding of the mathematical concept(s) they are learning?
4. How can you support student thinking in moving among various forms of representation?

Finally, learners complete an assignment by creating a lesson plan that focuses on student representations.

### **Session 6: Connections**

In this session, learners will study the Connections Standard. As they examine aspects of connections in the teaching and learning of mathematics, the interconnectedness of the Process Standards themselves will become apparent. Learners will consider three different facets of mathematical connections. They will examine and reflect on connections between mathematical ideas, look at examples of how to connect mathematics to the broad curriculum in early education, and will also consider ways to connect mathematics to what happens in a child's world. The session content shows learners how to help students do the following:

- Use the connections between mathematical ideas to develop understanding of mathematical concepts.
- Connect new mathematical ideas with familiar ones.
- Recognize the usefulness of mathematics in everyday life experience.
- Use representations and communication to connect mathematical ideas.

### **Session Content and Assignments**

Learners will work through the five main sections of the session: Observe, Explore, Define, Apply, and Evaluate Connections. In each section, learners read dialogues between teachers and students for examples of mathematics instruction that focuses on the relationships between different ideas to help students understand those ideas better and use mathematics to solve problems. They will watch videos of students and teachers working on mathematics activities and complete interactive reflection activities to think deeply about what they observed in the lessons. In the discussion forum, learners discuss some of the advantages of connecting several concepts within a single mathematics activity such as the tangram problem and then extending those activities over multiple lessons. Learners complete the following four journal activities to demonstrate their understanding of making connections in mathematics:

1. How can you make connections an integral part of mathematics instruction in your class? Be specific.
2. The tangram problems were designed to help you explore and consider connections in the teaching of mathematics. How could you adapt some of these activities for your own students? Be specific.
3. Select one of your favorite picture books. How could you use it to introduce a mathematics problem?
4. Select a topic from your mathematics curriculum. What are some connections of this topic to other subjects at your grade level?

Finally, learners complete an assignment by creating a lesson plan that focuses on making mathematics connections.

### **Schedule**

This course is scheduled to take approximately 45 hours to complete. Each session spans one week. The number of hours identified for each session reflects time spent online, but does not reflect the total time spent completing offline coursework and assignments. All learners are different and some may spend double the indicated number of hours completing all coursework depending on learning styles and work habits.

### **Requirements**

Learners are expected to:

- Complete all assignments.
- Participate and actively engage in discussions with fellow learners while contributing to the social construction of knowledge.

- Be self-directed and self-motivated.
- Ask for assistance when they need it.

## **Materials** (hardware, software, plug-ins)

### Technical Requirements

- Word processor
- Internet service provider
- E-mail

## **Academic Dishonesty Policy**

To be inserted by university institution only.

## **Evaluation**

This course is evaluated on a letter grade basis, and may be available for graduate credit. See graduate credit details pertaining to specific graduate credit institutions.