

## **Title**

Teaching Writing in Mathematics

## **Target Audience**

This course is intended for pre-service and in-service teachers of grades 6-12.

## **Prerequisites**

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

- Have access to students in order to implement instructional strategies, preferably in a formal classroom setting; however, a group of students in an informal setting will be acceptable, as well.
- Be familiar with taking an online course or have completed the PBS “Practice Learning Online with TeacherLine” course.
- Have experience in teaching mathematics.
- Understand and apply mathematics standards in their teaching.

## **Course Description**

*Teaching Writing in Mathematics* is a highly interactive course that brings an online learning community together, draws upon prior knowledge and experiences, and offers opportunities for learners to construct their own knowledge. We will explore the benefits and challenges of using writing in mathematics and offer tools to integrate writing in substantial, meaningful ways in the classroom. Each session will contribute to the development of an action plan – focusing on both short-term and long-term goals – for infusing writing into the mathematics curriculum. This course emphasizes practical applications; learners are asked to apply their learning with actual students. As such, access to students in a classroom or informal educational setting that has computers with an Internet connection is required for full participation in this course.

## **Instructor/Facilitator**

See instructor/facilitator sheet

## **Credits**

To be determined by college or university

## **Goals**

The overarching goal of the course is to assist learners in developing an understanding of the knowledge, skills, and tools for incorporating writing in the mathematics classroom. By the end of this course, learners will:

1. Recognize the benefits of integrating writing to differentiate teaching and learning in the mathematics classroom.
2. Understand the teachers’ role in supporting mathematics writing, including the use of supportive technologies.
3. Apply a variety of writing strategies into math instruction.
4. Establish a plan for implementing writing in the mathematics classroom.

### **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, working through each session in order. Throughout the sessions, learners are asked to articulate their ideas in various forms: reflections on their ideas and experiences in their online journals; online discussions that allow learners to glean information from other learners' experiences, and written assignments that are submitted to the course facilitator. During Sessions 1 through 5 of the course, learners will apply their learning by implementing instructional strategies with students; these firsthand experiences will help to inform their culminating project in Session 6. As a final project, learners will develop a strategic plan of action and rationale for integrating writing into their mathematics curriculum.

This course is designed to address ISTE's *Educational Technology Standards and Performance Indicators for All Teachers*. These standards define the fundamental concepts, knowledge, skills, and attitudes for applying technology in educational settings.

This course specifically addresses the following ISTE NETS\*T:

#### **I. Technology Operations and Concepts**

Teachers demonstrate a sound understanding of technology operations and concepts.

Teachers:

- A. Demonstrate introductory knowledge, skills, and understanding of concepts related to technology (as described in the ISTE National Education [Technology Standards for Students](#))

#### **II. Planning and Designing Learning Environments and Experiences**

Teachers plan and design effective learning environments and experiences supported by technology. Teachers:

- A. Design developmentally appropriate learning opportunities that apply technology-enhanced instructional strategies to support the diverse needs of learners.
- B. Apply current research on teaching and learning with technology when planning learning environments and experiences.

Visit [cnets.iste.org](http://cnets.iste.org) for a full list of the ISTE's *Educational Technology Standards and Performance Indicators for All Teachers* and more information about these standards.

### **Session 1: Room for Writing in the Mathematics Classroom?**

This session explores how writing can be a powerful instructional tool in the mathematics classroom. Learners will examine the research on the effects of literacy-based activities on students' learning in mathematics and review the National Council of Teachers of Mathematics' (NCTM) vision for communication in mathematics education. After comparing NCTM's Communication standard as well as the International Society for Technology in Education's (ISTE) standards with their own district or state standards, learners will critically evaluate their current classroom practices. By the end of this session, learners will implement a writing activity that will help them to gain insight into their students' attitudes toward mathematics.

Learners will:

- Define their professional goals and expectations for this course in the online journal.
- Explain their prior knowledge of writing in mathematics.
- Evaluate their current use of communication in the classroom according to national and state/district standards.

- Assess student attitudes toward mathematics through a mathography lesson.
- Discuss their findings, benefits, and challenges of implementing the mathography activity with students.
- Identify ways that teachers can support the integration of communication and writing in mathematics.

Read

- “What is the importance of reading and writing in the mathematics curriculum?”
- The National Council of Teachers of Mathematics’ (NCTM) Communication Standard from *Principles and Standards for School Mathematics*
- NCTM’s Communication Standard for Grades 6-8 or for Grades 9-12 from *Principles and Standards for School Mathematics*
- “Writing in Math”

Write in online journal

- Reflect on professional development goals and expectations for this course.
- Reflect on prior knowledge by writing a mathography—a story about your experiences in learning mathematics—that describes strategies your instructors used to develop mathematical understanding.
- After reading the NCTM Communication Standard for Grades 6-8 or Grades 9-12 and the article “Writing in Math,” reflect on what you see as your role in supporting communication and writing activities in the mathematics classroom.

Participate in an online discussion

- Introduce yourself to other learners.
- After assigning a mathography to students and completing the Attitude Tracker Chart, share your experiences with your online colleagues by considering the following: What discoveries did you make while implementing the mathography? What were the benefits as well as challenges you faced? Based on what you have learned from this initial experience, what do you envision as next steps?

Complete activities and assignments

- Compare and contrast the National Council of Teachers of Mathematics’ Communication Standard and the International Society for Technology in Education’s standards on technology communications tools with state or district-level standards. Describe current classroom applications that meet each of the standards.
- Explore the Communication Standard practice by reviewing the Meeting in the Middle activity from the PBS Web site “Building Big”.
- Create and implement a mathography prompt with students. Assess two anonymous mathographies to determine the students’ underlying attitudes toward mathematics.

Session 2: Using Writing and Rubrics to Inform Learning

In this session, learners will deepen their knowledge of how to help students organize and communicate mathematical thinking. Teachers often use writing prompts to help students access prior knowledge about a mathematical concept, as well as provide focus and/or review of content. Learners will see teachers use writing prompts as an informal strategy to help students focus their learning, organize their thinking, and communicate their understanding about a mathematical concept. In addition, learners will expand their knowledge of how to communicate learning goals for students more clearly through rubrics and have the opportunity to design their own rubric in order to provide feedback based on specific criteria. By the end of Session 2, learners will have greater insights into how to use writing and rubrics to inform learning.

Learners will:

- Discuss how writing can help students communicate understanding.

- Design a rubric to provide feedback to students about their level of understanding of specific content or skill.
- Review rubrics created by colleagues to provide feedback to students about their level of understanding of content or skill.

Read

- “Improving Writing Prompts to Improve Student Reflection”
- “Using Rubrics to Promote Thinking and Learning”

View videos

- “Introduction to Writing Prompt”
- “Three-Point Rubric”
- “Rubric for Using Formulas”

Participate in an online discussion

- Respond to the following question: How does writing in mathematics help provide a window into students’ thinking and understanding?

Complete activities and assignments

- Create and implement a writing prompt for students that is designed to activate their prior knowledge and/or focus their learning on the current mathematics content.
- Review lesson plans from PBS that incorporate writing prompts and mathematics.
- Review samples of rubrics.
- Design or modify a rubric to assess student learning of content that is currently being taught or will be taught in the future.
- Conduct a peer review of an online colleague’s rubric.

Session 3: Metacognition: Using Writing to Develop Self-Directed Learners

In this session, learners will gain experience with writing-to-learn strategies as a way of promoting metacognition and self-directed learning. Furthermore, you will have the opportunity to tap into the instructional benefits of writing and technology as you design an interactive-based learning log activity that can be used with your own students.

Learners will:

- Discuss the impact of writing activities on teaching, learning, teacher time, and class time.
- Describe how to use an Internet-based interactive to engage students in writing to promote metacognition.
- Design learning log prompts to help students reflect on their own learning.
- Explain the actions that can be taken to promote students’ assuming responsibility for their own learning.
- Assess the effectiveness of a metacognitive or writing-to-learn strategy on increasing students’ mathematical understanding.

Read

- “How can teachers help students reflect on and communicate their own learning?”
- “Using Learning Logs in Mathematics: Writing to Learn”

View videos

- “Part 1: Direct Instruction Through Modeling”
- “Part 2: On Their Own”

Write in online journal

- Reflect on your experience implementing a writing-to-learn strategy with students by considering the following questions: How did the writing-to-learn strategy impact students' understanding of the content? How effective was it in helping students tap into their own thought processes? How did/could you improve students' motivation to use this writing-to-learn strategy to maximize understanding? How did/could you provide feedback to students?

Participate in an online discussion

- Based on your past experiences, the article "Using Learning Logs in Mathematics: Writing to Learn," and the ideas provided in the videos, explain your opinion of this statement: "...learning logs take neither a great deal of teacher time nor much class time, but they have tremendous value for teachers and students."

Complete activities and assignments

- Use the Directed Reading/Thinking Activity (DR/TA) strategy while reading a short text.
- Explore Web sites that feature mathematics interactives.
- Select an Internet-based interactive that is appropriate for one's curriculum and grade level. Write a brief, one-page description of this interactive and share it on the discussion board.
- Create three learning log prompts to accompany the selected interactive that engage students in metacognition. To share these with online colleagues, post the prompts to the discussion board.
- Implement one of the writing-to-learn strategies introduced in this session with a group of students.

#### Session 4: Using Writing to Support the Problem-Solving Process

Teachers promote mathematical inquiry when engaging students in writing about solutions to problems. Furthermore, writing solutions to problem-solving activities can help students communicate more clearly their understanding of mathematical concepts. In this session, learners will take a closer look at how to use writing to help students strategize when solving problems in mathematics, which fosters mathematical thinking in the classroom.

Learners will:

- Discuss insights about how to incorporate the problem-solution strategy with students
- Reflect on insights about incorporating writing in the problem-solving process

Read

- "Petals Around the Rose: Building Positive Attitudes about Problem Solving"

View videos

- "Ten Thinking Strategies"
- "Identifying the Strategy"

Write in online journal

- After reading the article "Petals Around the Rose: Building Positive Attitudes about Problem Solving," reflect on the following question: What insights do you now have about writing to deepen understanding of solving problems and how do you plan to apply these insights to your instructional program?

Participate in an online discussion

- Share your thoughts about the Problem-Solution strategy by cutting and pasting your written reflection from the Problem-Solution interactive into the online discussion.

Complete activities and assignments

- Experience the Problem-Solution Online Interactive
- Learners write responses to each of the statements on the Problem-Solving Process form about a time in life when they wanted something and worked hard to get it. Then, learners record this information in the Visual Organizer for Solving Problems, which connects problem-solving and writing.

### Session 5: Setting Students Up for Success

In this session, learners will consider differentiated instructional strategies that can help students with various learning styles find success in their classes. Learners will also expand their repertoire of writing activities by exploring possibilities for creative writing in mathematics as well as structures for helping students feel prepared when faced with the writing prompts on standardized assessments.

Learners will:

- Discuss strategies for addressing different learning styles.
- Design or revise a lesson plan that addresses different learning styles.
- Reflect on the impact a creative writing activity or text structure exercise had on student motivation.

Read

- “Learning Modalities: Pathways to Effective Learning” from PBS Teachers
- “Learning Styles and Writing in Mathematics”
- “Diagnosing and Assessing Writers”
- “Writing Tasks That Succeed” OR “The Math Poem: Incorporating Mathematical Terms in Poetry”

Write in online journal

- After implementing one of the writing activities presented in this session with your students, reflect on the following: Describe how the activity impacted student motivation with regard to writing. How did your students who may be reluctant to writing assignments react to the activity? What recommendations do you have for improving the activity to help all of your students find success?

Participate in an online discussion

- Respond to the following question: How can you integrate writing and mathematics while taking into account that some students may struggle with writing while others may excel?

Complete activities and assignments

- Use the Learning Styles Lesson Plan Template to revise or create a lesson that incorporates strategies for integrating writing-to-learn mathematics while meeting the needs of visual, auditory, kinesthetic, interpersonal, and intrapersonal learners.
- Experiment with the Common Writing Structures Interactive.
- Implement one of the writing activities presented in this session with a group of students. This could be one of the creative writing activities, the RAFT strategy, a framed-paragraph exercise, or the Common Writing Structures Interactive.

### Session 6: Developing Your Plan to Integrate Writing in Mathematics

As a final project for this *Teaching Writing in Mathematics* course, learners will develop a plan of action for implementing their vision of writing in a mathematics program. In this session, learners will spend some time considering how Weblogs can be used in place of traditional student journals or learning logs

to support their plan. Then, learners will review notes, assignments, and readings throughout this course to help formulate and explain the immediate next steps for integrating writing in mathematics. At the end of this session, learners will reflect on their learning in this course and how their experiences will influence their practice.

Learners will:

- Explain how a Weblog could be used as a medium for writing in the mathematics classroom.
- Develop a plan of action for integrating writing in their mathematics curriculum.
- Assess their learning in this course by comparing their prior knowledge and acquired knowledge in a journal activity.
- Analyze the learning experience in this course by reflecting on professional goals and expectations in the online journal.

Read

- "Writing with Weblogs: Reinventing Student Journals"
- An excerpt from "Scaffolding for Struggling Students: Reading and Writing with Blogs"
- "Advanced Math? Write!"

Write in online journal

- Reflect on the knowledge and skills you acquired through this course. Identify the essential ideas and strategies you gained from this course and how you plan to incorporate them into your current or future classroom.
- Reflect on your professional goals by responding to the following questions: How does this learning experience compare with your goals and expectations? Were there any professional goals you were unable to achieve? Why? How do you plan to address these areas of professional development in the future?

Participate in an online discussion

- After learning about Weblogs, how could you use blogs for writing-to-learn opportunities in your mathematics classroom? In your response, think holistically about how to manage the blogs, assess students, and even troubleshoot problems that may arise.
- Take a moment and visit the discussion forums. Post any final discussions to discussion prompts of interest and say goodbye to your online colleagues.

Complete activities and assignments

- Explore Internet resources about Weblogs

Final Project: Developing Your Plan of Action

Throughout this course, learners have been encouraged to prepare for the culminating project by documenting their thoughts and ideas in the Final Project Planning Guide. During this session, learners will review their written reflections, notes, and any other course content as they complete the Final Project: Developing Your Plan of Action. The final project will consist of the following parts:

- **Part 1** – A completed Action Plan Chart
- **Part 2** – A projected timeline to show when and how learners will incorporate writing into their mathematics classroom
- **Part 3** – A 1- to 2-page reflection paper in which learners explain their purpose for using writing in mathematics and their rationale for the curricular decisions highlighted in their chart and timeline. The basis for their rationale will stem from their responses to guiding questions in the Final Project Planning Guide.
- **Appendix** – If learners have specific assignments completed during the course that they feel would help to illustrate features of their action plan, they may include them as appendices with the final project.

Schedule



This course is scheduled to take approximately 30 hours to complete readings, activities, videos, assignments, reflections and a final project.

## **Requirements**

Learners are expected to:

- Complete all assignments.
- Maintain an online journal.
- 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.
- Have access to a group of students for implementing lessons.

## **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.

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