

Project-Based Learning in the Middle and High School Mathematics Classroom

How are some teachers addressing both the content and process standards described in the National Council of Teachers of Mathematics (NCTM) [*Principles and Standards for School Mathematics* \(2000\)](#)? They are using the method of instruction known as project-based learning; whereby, students are actively engaged in projects involving mathematics skills and knowledge. These projects are designed to help students attain the goals and objectives established by their schools and/or states using a dynamic form of learning. Project-based learning varies from classroom to classroom, but is often characterized by the following attributes.

- Allowing student a degree of choice on topic and/or project presentation/product.
- Resulting in an end product such as a presentation written recommendations for solving a large scale real-world problem.
- Involving multiple disciplines.
- Varying in duration from one period to a whole semester.
- Featuring the teacher in the role of facilitator rather than leader.
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Reasons to Use Project-Based Learning

Research shows that students often cannot transfer their mathematical knowledge to situations outside the classroom. Projects engage students in applications of mathematics, which may help them to transfer their mathematical skills to other disciplines and to real-world problems. Using significant problems often increases student motivation, in turn promoting learning.

The NCTM *Principles and Standards* support inquiry, or discovery based learning, which is an important component of project-based learning. In addition, projects address the NCTM *Principles and Standards* process standards better than many other teaching strategies. Students gain valuable skills in problem solving, reasoning, and communicating mathematics, while learning how to conduct research, manage resources, and collaborate with others, important skills for the workplace of today.

Examples of Project-Based Learning in Mathematics

There is a wide variety of the type of project that teachers use in math class projects. Some teachers present a scenario for the project and have students take the role of a person in the workplace. Here are some examples of projects.

- In a middle school or consumer mathematics class, students take the role of a state official preparing a statistical report on the state, choosing a topic such as education. The end product can be a presentation with graphs and written descriptions of significant findings. Consider collaborating with a language arts or social studies teacher for this project.
- In a high school geometry class, students take the role of an architect and design a shopping mall. Students research the design of malls and the feasible sizes for various types of stores. The end product can be a brochure, poster, or webpage presenting the design to a panel of adults or students serving as a city-planning board.
- In a high school algebra or trigonometry class, students take the role of historian by researching the life of a mathematician of the past. Students present an

important contribution of the person, in addition to his or her life story. The end product can be a PowerPoint® presentation about the mathematician presented to interested students or adults.

- In a high school algebra class, students take the role of an investment planner. They research various forms of investments and formulas for calculating interest on savings. The end product can be a written report or investment plan with relevant formulas defined, and graphs as appropriate.
- In an advanced high school mathematics class, students take the role of scholar by researching various proofs of the Pythagorean Theorem. The end product can be a webpage showing the proofs or an oral presentation of one of the proofs.
- In any mathematics classroom, students take the role of a statistician researching population trends for a state, country, or the world. The level of sophistication of the project will depend upon the mathematical level of the students. The end product can be a presentation, written report with appropriate graphs, or webpage of the findings. You may want to team with a social studies teacher for this project.

Getting Started

- Start small. Begin with a project lasting only a few class periods.
- Define the project and the objectives carefully and clearly. Have the objectives align with both process and content standards for your school or state.
- Give students a timeline so that they know exactly what is expected and when the project is due. Insist on progress reports, assigning points for the reports.
- Look for projects that are already written. Check newer textbooks, ancillary materials, or the Internet.
- Design your assessment plan in advance. Share the rubric you will use with the students before they begin the project. If possible, show students samples of what you expect, including project documentation and the end product itself.
- Consider teaming-up with teachers in other subject areas.

Intervention and Facilitation

- If students need a particular skill for the project, such as graphing data, teach mini-lessons along the way.
- Have appropriate resources for the students: Web sites, books, people available to answer questions, computer software, including various programs for helping students present their project.
- Give students class time to complete some of the steps necessary, such as brainstorming, writing an outline, drafting a report, and having others edit and revise the report. Be sure to provide specific feedback regarding their ideas and plans to execute the project prior to their beginning.

Internet Resources

The following Web sites contain additional information to help you get started in project-based learning.

Foundations for the Road Ahead: Project-Based Learning and Information Technologies

International Society for Technology in Education

Implementing Project-Based Instruction

Northwest Regional Educational Laboratory