

CREATING OPEN-ENDED PROJECTS IN MIDDLE SCHOOL MATHEMATICS

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Prelude

- Think of an essential topic you will cover in your classroom next year
- Keep that topic in mind as we talk about ways to develop engaging projects

Beginning Thanks

- Projects began as an assignment with Dr. Nancy Hertzog, University of Illinois
- Several teachers have collaborated on these projects. They include:
 - Doug Stotts
 - Serra Nicollette
 - Liz McHenry
 - Jennifer Kuntz
 - Trena Thomas

Presentation Structure

- Description of Open-ended Projects
- Structure for Creating Open-ended Projects
- Theoretical Backgrounds
- Examples of Open-ended Projects in Mathematics
- Practical Considerations

Reference for Related Article

Carmody, H. G. (2010). Water bottle designs and measures. *Mathematics Teaching in the Middle School*, 16 (5), 272-277.



What are Open-ended Projects?

- Ill-structured assignments that require creativity to finish
- A form of learning activities and authentic assessment
- A way to build differentiation into a general assignment

What is the purpose of an Open-ended Project?

- Application of academic concepts to real life situations
- Movement beyond basic skills and to explore meaningful applications
- Encourage independence and autonomy
- Require students to reflect upon and refine their work

Where have they been used?

- Seventh grade classrooms
- Large public schools with ≈ 30 students per class
- Small private school with ≈ 15 students per class
- Wide range of abilities
- Culturally and linguistically diverse settings
- Other settings (rural, urban and suburban) by other teachers

How do they fit with school curriculum?

- Designed to complement daily lessons
- Students work in class and at home
- Projects typically take 2 to 3 weeks to complete

Structure for Creating OMPs

- Seven Design Components
 - Content Components
 - Supportive Instructional Components
- Questions to Develop New OMPs

Content Components

1. Extensive mathematical computation
2. Algebraic notation
3. Written expression
4. Visual or graphic representation

(Carmody, 2010)

Supportive Instructional Components

5. Project proposal
6. Peer collaboration
7. Reflection and self-evaluation

(Carmody, 2010)

Questions to Create an OMP

- What topic is essential to the curriculum?
- What are some meaningful and real world applications of this topic?
- What applications are appropriate for students of this age and level of mastery?
- How can I include the different components?

Questions to Create an OMP

- What choices can I offer in terms of content or product?
- What resources will students need for the project?
- What amount of time will students need to produce quality work? How can I structure a timeline that allows for creativity and rigor?
- Are there adequate opportunities for differentiation to accommodate various student needs?
- Does this project encourage a deeper understanding of mathematics than students would otherwise have?

Justification from Educational Research

- Recommendations for Students
- Recommendations for Classrooms
- Recommendations for Teachers
- Recommendations for Assessment

Recommendations for Students (gifted and beyond)

- Depth of application (Hirsch and Weinhold, 1999)
- Opportunities to reflect upon and refine their work (Koshy, 2001)
- Opportunity to discuss their thinking with peers and adults (Hirsch and Weinhold, 1999)
- Differentiation in terms of content, process and product (VanTassel-Baska, & Stambaugh, 2006)

Recommendations for the Classroom

- “Challenge students with rich problems that encourage deep exploration” (Warshauer et al., 2010)
- Provide opportunities to demonstrate giftedness (Koshy, 2001)
- Move past “unimportant knowledge” (Renzulli, 1982)

Recommendations for Teachers

- Provide time to let ideas develop and form (Hadamard, 1945)
- Provide the chance for “responsible risk taking” (Costa, 2001)
- Emphasize independence, and favor flexibility over structure or chaos (Wheatley, 1999)
- Provide students support to move beyond the familiar into areas of challenge and creativity (Mann, 2006)

Recommendations for Assessment

- “assessment [should] be an integral part of teaching” (Zemelman, Daniels and Hyde, 1998, pg. 105)
- Assessment can have “a significant role in the learning process” (Taylor, 2009)

Examples

- Rate and Ratio Project
- Water Bottle Project
- Project “flops”
- A few warnings

Rate and Ratio OMP

Targeted Concepts

- Rates
- Unit Rates
- Ratios
- Proportions
- Dimensional Analysis

Required Components

- Researched starting fact
- Seven equivalencies with at least two visualizations
- Poster or PowerPoint

Rate and Ratio OMP Student Materials

- [Project Assignment](#)
- [Grading Rubric](#)

Rate and Ratio OMP Examples

- Amanda – [Gasoline Consumption](#)
- Sean – [Professional Athlete's Salary](#)
- Caven – [Chewing Gum](#)

Water Bottle OMP

Targeted Concepts

- Volume
- Surface Area
- Solving for Unknown Quantities
- Relationship between 2-D patterns and 3-D objects

Required Components

- Table with three proposals
- Flat pattern or prototype of favorite design
- Writing to persuade others that their design is best

Water Bottle OMP Student Material

- [Assignment Sheet](#)
- [Grid for 3 proposals](#)
- [Grading Rubric](#)

Water Bottle OMP Examples



OMPs that Did Not Work

- Story Project
- Menu Project took a few years to refine

Small Warnings

- Start small – a goal of 4 Open-ended Projects per year is very reasonable
- Construct your grading rubric ahead of time
- After completing the project, ask for student opinions. My projects are always evolving.

Resources

Through NCTM resources

- Bibliography
- OMP Components
- Questions to Develop OMP
- Presentation Slides

By email request

- OMPs
 - Water Bottle
 - Rate and Ratio
 - Spreadsheet
 - Integer Game
 - Menu
 - Transformations
 - Surveys
- Examples of student work

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