TECHNOLOGY INTEGRATION

Using Video Projects to Reinforce Learning in Math

A collaborative project can help students deeply explore math concepts, explain problem-solving strategies, and demonstrate their learning.

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September 3, 2024

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Problem-solving, and the creativity that generates and fuels it, lies at the heart of mathematics. Mathematics is essentially about reasoning and much less about memorization or even procedural skills, although both processes are meaningful and useful to simplify and support problem-solving. The National Council of Teachers of Mathematics (NCTM) has consistently advocated to keep problem-solving as the centerpiece of mathematics teaching, and global trends in mathematics education have increasingly emphasized problem-solving and mathematical modeling.

Problem-solving *allows students to deepen their conceptual comprehension* (/article/3-ways-to-improve-student-problem-solving) and appreciate the usefulness and relevance of mathematics. Thus, it generates and fosters interest, engagement, and a deeper understanding of the world around them. Because problem-solving is often used in the mathematics classroom, it's particularly important to find fresh and interesting ways to attract and maintain students' engagement.

VIDEO PROJECTS SUPPORT INTEREST IN PROBLEM-SOLVING

To this end, I assign video projects to my students. In groups of two or three, they solve a set of problems on a topic and then choose one to illustrate, solve, and explain their favorite problem-solving strategy in detail, along with the reasons they chose it. The student-created videos are collected and stored on a Padlet even after I have evaluated

them—kept as a reference, keepsake, and support. I have a library of student-created videos that benefit current and future students when they have some difficulties with a topic and associated problems.

Some topics in mathematics are well-suited for applications and problem-solving. These are usually multistep problems that require a combination of strategies and procedural fluency. Typical examples are the motion, work, and mixture problems in algebra, the optimization problems in precalculus or calculus, and related rates problems in calculus.

This *collection of student-created videos* (https://padlet.com/alessandra_king/calculus-in-real-life-16jnkwdnxfpkdkh8) is about related rates problems (note that some links may not work, as this collection is old). Video activities based on problem-solving can be done at any level of mathematics, as problem-solving is a task in which children are engaged in math class from an early age.

USEFUL RECORDING TOOLS

Some examples of useful recording apps include *Screencastify* (https://www.screencastify.com/products/screen-recorder), *ScreenPal* (https://screenpal.com/plans/education#feature-comparison), *iMovie* (https://apps.apple.com/us/app/imovie/id377298193), and *QuickTime* (https://support.apple.com/en-us/106375). Each of them has pros and cons, so I suggest looking at the particular specifications of each tool in terms of the number and length of videos allowed by the free version of those apps. I let my students choose what app they want to use to create their videos—they are generally very familiar with this sort of technology and may be more at ease with one tool over another. All they have to produce is a usable link to their video that will be posted on the common Padlet.

Loom (https://www.loom.com/) is an intuitive, user-friendly screen recording tool that can record audio, video, browser windows, or entire screens in a Chrome extension, desktop app, or mobile app. You can sign up for a free Loom for Education account; students don't need an account to watch a teacher's videos, but they will in order to create their own videos.

Loom's training module is thorough and includes tutorials, special feature descriptions, and examples. Once you click the Loom icon, there's a short countdown that precedes the recording. When you stop the recording, a link automatically saves to your clipboard and can be easily shared via email, social media, or an embed code.

The videos will also save to your personal library and can be shared to a team library to make them easily accessible to colleagues. Editing features are quite limited (trimming and changing playback speed), which means you may have to do multiple takes, but teachers can control the settings for comment and download options.

4 PROBLEM-SOLVING STRATEGIES

Mathematician George Polya outlined a four-step model in his famous book, *How to Solve It* (https://press.princeton.edu/books/paperback/9780691164076/how-to-solve-it?srsltid=AfmBOopR29QuNtI4aNwdaJsv18MVFYbPqzm5XDeP2rBTKKCtEQ2j2B_Z). It involves understanding the problem, devising a plan, carrying it out, and finally looking back and reflecting. These are the strategies that my students must demonstrate while creating their videos.

1. Understand the problem: Students reread the problem carefully, summarize and rewrite the information in mathematical notation, use keyword analysis, draw a picture or a diagram, or even act out the scenario.

2. Devise a plan: Looking for patterns and solving a simpler problem are my favorite approaches, but other ideas—guess-and-check, working backward, eliminating possibilities, using a formula and solving an equation—can work well too, depending on the circumstances. Most often, for good problems, several of these strategies have to be employed at the same time and help support confidence in the solution.

3. Carry out the plan: This is where "show your work" comes in with full force. Communicating their thoughts and ideas is paramount: Students should be systematic, show their thinking in a logical progression, check their work, and be flexible and persistent.

4. Look back and reflect: It's important to consider which part of the problem was the most challenging and why, which process was most effective, and other strategies that could have worked. This makes for more efficient and deeper learning.

Related rates problems can be intimidating at first, and it is useful for students to write out explicitly the steps and strategies they take to solve the first few problems.

My students come up with a model that follows the previously mentioned steps. It includes labeling the rates with their units and sign, an understanding of the rate they must find, finding at least one equation that binds the variables together, differentiating this equation with respect to time, plugging in the given information, and, finally, writing a short sentence that summarizes their conclusion (including sign and units).

BENEFITS OF THE VIDEO ACTIVITY

My students and I have experienced several benefits of this task.

Students are encouraged to communicate mathematically. The importance of communication among learners is also heavily emphasized in the NCTM publication *Principles and Standards for School Mathematics* (https://www.nctm.org/Standards-and-Positions/Principles-and-Standards/).

Student collaboration. Viewing *learning as a collective endeavor* (https://www.cultures-of-thinking.org/6-collective-learning), rather than an individual competition, helps students develop their social and collaborative skills. When students take joint responsibility for their learning—sharing ideas and resources—it fosters a safe environment where they perceive each other as allies rather than competitors, which increases engagement and academic achievement.

Problem-solving skills are strengthened. As reported in the Executive Summary of the NCTM *Principles and Standards for School Mathematics* (https://www.nctm.org/uploadedFiles/Standards_and_Positions/PSSM_ExecutiveSummary.pdf), when solving mathematical problems, students acquire ways of thinking, habits of persistence and curiosity, and confidence in unfamiliar situations that serve them well beyond the classroom.

Teachers can clearly see students' understanding. This includes conceptual understanding, procedural precision, logical and analytical thinking, problem-solving strategies, and clarity of communication.

A sense of belonging in math class is cemented. The experience generates positive, affirmative memories—the goal of social and emotional learning—and "*encourages student focus and motivation, improves relationships between students and teachers, and increases student confidence and success* (https://www.mdpi.com/2254-9625/10/3/61)." It should be promoted, particularly in the STEM disciplines.

In other words, it's a keeper.

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