Association of Teachers Of Mathematics In Maine

ATOMIM Grant Incentives for Teachers (*GIFT)* Program Application

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Project Title: Using a Document Camera to Create a Multimedia, On-Demand Classroom

Grade Level/Courses Affected: Geometry and Algebra 2 students primarily in 10th grade, but including all grade levels 9-12 and lower-achieving students in an everyday course.

Project Abstract:

The goals of this project are two-fold: to use a pair of document cameras to address the hands-on components of our changing curricula as we transition to the Common Core State Standards; and to create a digital classroom where lessons, homework review, student explorations and other work will be recorded in real time actual video that we are able to post to Blackboard and other media sites for students to access on demand, for review and remediation.

Project Description:

As Maine transitions from its present learning standards to the Common Core, one of the biggest areas that will be affected in our curricula at Lewiston High School is the increase in problem-based learning – particularly, the addition of traditional compass-and-straight-edge constructions in Geometry.

This purpose of this project is two-fold. First, the goal is to allow for an enriched multimedia classroom presentation of new material (and material that is traditionally challenging for students to physically see in a classroom), in the process increasing student performance and building student math literacy and communication skills. Second, the goal is to allow for these presentations and explorations to be available to students on demand, via posting to Blackboard or other media sites.

I plan to use the document cameras with all of my classes. This year I teach three Geometry classes, and one Algebra 2 class. I expect that my teaching schedule will be similar next year. The document cameras are particularly useful for the new curriculum we will begin teaching in 2013-2014. Our present curriculum does not require teaching compass-and-straight-edge constructions or their applications; the Common Core State Standards for Geometry (see standards section, below) not only require constructions, but in general require more hands-on, problem-based learning. This type of problem-based learning is most successful when teachers are able to model and provide scaffolding.

Using Geometry as an example, the two document cameras will allow me demonstrate constructions (and other activities) in a hands-on, up-close manner. Having two cameras working in tandem will allow for limitless possibilities: I can have a student working side-by-side with me, or show two different stages of the same problem, or use a picture-in-picture technique, or show a problem and alongside it, we can work towards a solution. All my students will be able to see – at the same time, in real-time, full-color, video – my hands, my pencil, how to hold the compass – the kinds of things that are not only traditionally difficult to see and understand, but which are difficult to really teach without sitting with students one-on-one. In my experience, students who are absent for the lesson often struggle, because it's not the kind of thing students are able to teach themselves.

The document cameras are not just glorified overhead projectors, and I do not intend to use them as such. What makes them wonderful is that I will be able to record the actual audio and video as we use the cameras. This is invaluable for students on a variety of levels. Absent students will be able to view the daily lesson. Students who need remediation or review will be able to view what they need. We teach a unique population in Lewiston, and in particular our low-achieving students (my Everyday Geometry) class, will benefit from being able to view videos as many times as they want. Instead of just having answers to an assignment, students will be able to see and hear the class presentation of the material over and over, on whatever schedule they prefer. It's infinitely more powerful to see a real-time annotated explanation to, for example, question 7 on your practice test than to see that the answer is, say, 16x-5. I am excited to think how this will help our students who are motivated and conscientious, but who don't necessarily "get it" the first few times they see something. By comparison to other online resources such as Khan Academy, the document camera recordings will allow students to see our actual class: hearing our voices and tone, hearing the questions and answers, working our actual problems in the manner we work them with the techniques we are learning, at the rigor and pace the students would see if they were in the actual classroom.

Please note that although I am using the example of geometric constructions, the document camera's use is not limited to that. I presently have a document camera on loan in my room, and it affects our classroom in remarkable ways. It can be used to record lessons, notes, and review. Our students are a technology-reliant generation: they know and expect technology to be available and part of their lives. Even when we do something as mundane as reviewing homework, the document camera saves valuable time by allowing us to work from the actual worksheet or textbook, eliminating having to re-draw figures on the board. Believe it or not, students are generally more engaged and interested just by virtue of the technology aspect, and they race to volunteer to use the document camera.   It is a tremendous motivator and works neatly with a SMARTBoard, so that we often toggle between using the SMARTboard and viewing what is on our camera.

I'm losing this camera, though, because it's only on loan to me. I am applying for this grant to build and expand on the momentum I have created. The self-directed training I've sought out and explored this year has only proven to me that the little bit I've been able to do this year is only the proverbial tip of the iceberg. Our local funds have been frozen, and not only would it be impossible for me to get a two-camera system, but I am not going to be able to keep the one camera I have now. I know that the rich lessons we've been able to do thus far can be made better, and new lessons created, and certainly shared.

One of the goals with the Common Core State Standards is to increase math literacy, and our students at Lewiston High School are weak in this skill. (In fact, in the MHSA Math percent meets/exceeds comparison, Lewiston High School has been below the Maine average every year since 2008, and in 2012, our students were a full 9 percentage points below the state average.) It is very challenging for our students to take a worked example (or their own work) and follow it to understand (or justify) what happened and why. Although we do these types of translations every day in class, students aren't able to apply that skill on their own outside of the classroom. My goal is to use the document camera not just for lessons and activities, but also to record and capture video and audio as we review specific types of problems. I will make these videos available online, so that students will be able to see a problem as it is worked out. Again, this is different from (and arguably better than) third-party sites such as Khan Academy, because it will be our class' actual work, with our actual voices and pace. This type of multimedia presentation will support our underyling, ongoing goal of encouraging a richer meta-analysis: what did you do, why did you do it, what, if anything, was your mistake, and – most importantly – why was it right (or wrong)? Students will also be able to create and post these videos, so that they can take ownership of the process. This is especially important for our low-achievers, who will be able to view the videos on demand as many times as they want.

My target audience is the population of students I teach or who can access my pages through our high school Web page: primarily 10th graders, enrolled in Academic Geometry, Everyday Geometry, and Algebra 2.

I plan to evaluate the success of this project by tracking the views of the videos and other resources we post. It is hard to evaluate the success of the teaching aspect because I do not intend to create a control group, but instead to use the document camera resources with as many students and classes as I can reach. I will use periodic student surveys to gauge student interest in the cameras and their perceptions of how well the new teaching/reviewing tools are helping and what, if anything, students would also like to do or to see. I will also provide anecdotal evidence as to the successes (and unanticipated difficulties) of teaching different types of lessons using the system of cameras.

Project Budget:

Two HoverCam Solo 5 document cameras $249.99 x 2 = $499.98

This price is from www.touchboards.com, as quoted to our local technology liason teacher. There is no tax, and I have secured additional private funds to cover the cost of shipping.

Project Dissemination:

I will write a journal article for ATOMIM. Additionally, to the extent possible, I will make our videos available to students not enrolled in my classes, and to teachers both at Lewiston High School and elsewhere. I also hope to present a local professional development session at the end of the year, documenting the successes and advantages of the two-camera system as we integrate it into our daily classroom, and even training teachers on how to use the cameras and integrate them into their own classrooms. I read numerous math blogs and have taken part in the "math twitterblogosphere" (see http://mathtwitterblogosphere.weebly.com/ for reference) as a passive participant. I would be happy to take a more active role in that, posting and blogging about the two-camera system for teachers throughout (and even beyond) Maine. I envision document cameras being useful for science and other classrooms, and imagine that many ATOMIM readers would be interested in the article and excited to apply document cameras to their own classrooms.

Project State/National Standards:

Where appropriate, I have edited the standards to include only the relevant components. Because I hope the multimedia classroom will encourage and reinforce math literacy and meta-analysis, I have included the overarching “Math Practice” standards at the bottom.

CCSS.Math.Content.HSG-CO.D.12 Make formal geometric constructions with a variety of tools and methods (compass and straightedge, string, reflective devices, paper folding, dynamic geometric software, etc.). Copying a segment; copying an angle; bisecting a segment; bisecting an angle; constructing perpendicular lines, including the perpendicular bisector of a line segment; and constructing a line parallel to a given line through a point not on the line.

CCSS.Math.Content.HSG-CO.D.13 Construct an equilateral triangle, a square, and a regular hexagon inscribed in a circle.

CCSS.Math.Practice.MP1 Make sense of problems and persevere in solving them.

Mathematically proficient students start by explaining to themselves the meaning of a problem and looking for entry points to its solution. Mathematically proficient students check their answers to problems using a different method, and they continually ask themselves, “Does this make sense?” They can understand the approaches of others to solving complex problems and identify correspondences between different approaches.

CCSS.Math.Practice.MP3 Construct viable arguments and critique the reasoning of others.

Mathematically proficient students understand and use stated assumptions, definitions, and previously established results in constructing arguments. They make conjectures and build a logical progression of statements to explore the truth of their conjectures. They are able to analyze situations by breaking them into cases, and can recognize and use counterexamples. They justify their conclusions, communicate them to others, and respond to the arguments of others. They reason inductively about data, making plausible arguments that take into account the context from which the data arose. Mathematically proficient students are also able to compare the effectiveness of two plausible arguments, distinguish correct logic or reasoning from that which is flawed, and—if there is a flaw in an argument—explain what it is. Elementary students can construct arguments using concrete referents such as objects, drawings, diagrams, and actions. Such arguments can make sense and be correct, even though they are not generalized or made formal until later grades. Later, students learn to determine domains to which an argument applies. Students at all grades can listen or read the arguments of others, decide whether they make sense, and ask useful questions to clarify or improve the arguments.

CCSS.Math.Practice.MP6 Attend to precision.

Mathematically proficient students try to communicate precisely to others. They try to use clear definitions in discussion with others and in their own reasoning. They state the meaning of the symbols they choose, including using the equal sign consistently and appropriately. They are careful about specifying units of measure, and labeling axes to clarify the correspondence with quantities in a problem. They calculate accurately and efficiently, express numerical answers with a degree of precision appropriate for the problem context.

CCSS.Math.Practice.MP8 Look for and express regularity in repeated reasoning.

Mathematically proficient students notice if calculations are repeated, and look both for general methods and for shortcuts. As they work to solve a problem, mathematically proficient students maintain oversight of the process, while attending to the details. They continually evaluate the reasonableness of their intermediate results.