

# **MIT BLOSSOMS: International Co-creation and Co-utilization of Math and Science Video Lessons for High School STEM Classes**

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Well first, I want to welcome you all, and I want to especially welcome those of you who submitted papers to the conference, because I had extensive communication with each of you. And many of you I've talked to, but I hope that those of you that I haven't talked to would come up to me and say hello, because I really like to match a face with the name. So again, welcome.

So we're going to be talking today about BLOSSOMS, and one thing that we're really proud of about BLOSSOMS is that it is international co-creation and co-utilization, and we'll get into that. So BLOSSOMS stands for “blended learning open source science or math studies,” and it is a project of LINC. It grew out of LINC, out of one of these LINC conferences, which I'll tell you about later. But we don't really use that long name. We just use the name BLOSSOMS, because we like to think of this as a program that helps a love of math and science to blossom in students.

So what is BLOSSOMS? BLOSSOMS is math and science video lessons created by gifted volunteer educators from around the world. And here are many of our gifted educators from around the world. It's a free online library of interactive video lessons for high school math and science classes. And I'll explain what we mean by interactive. These are not boring videos that students sit and watch in the classroom and fall asleep, but instead they're actively engaged. The students are actively engaged in a learning experience with a virtual teacher whose home classroom might be a world away.

What we call interactive is something we call the "Teaching Duet" pedagogy. BLOSSOMS lessons are designed to be used in short spurts. For example, the first segment, we would like it to be just two minutes-- the first video segment with the guest lecturer, the guest teacher. The first two segments are just supposed to be exciting and engaging and pulling the students into the lesson. And then the teacher, the classroom teacher, stops the video and then she engages with the students in the class. Perhaps they're problem-based lessons, perhaps they're collaborative activities, but really challenging activities that have been designed by the video teacher for that particular break.

And once those activities have been done and the learning objective has been achieved, the teacher can turn the video back on. There might be up to five or six segments in all in a 50 minute lesson. But all of the other segments are never more than four minutes long and then the teacher stops, and again he or she does more challenging activities in class with the students. And this is how it goes. It's an iterative process. And the last segment of all of these videos is a video teacher guide, which is a conversation between the video teacher and the classroom teacher who may use it to explain why he or she created the lesson, what they hope the students will get out of the lesson, and also suggestions as to how the lesson could be taught, how the activities in the breaks would be used, and there are a lot of other supportive materials.

So the focus of the BLOSSOMS lessons is not on memorization or rote learning, but on developing critical and creative thinking skills. We're trying to develop those 21st century skills of problem solving, collaboratively working together. We try. It's not easy, as we heard this morning. It's not easy to really know exactly how, but we're trying to challenge students. We don't want them always to feel that they have to have the answer. We want them to be thinking and approaching the problems from different angles, and so that's what we're trying to do.

Let's see. OK, this is our website. I just thought I'd quickly show you the BLOSSOMS website. This is the BLOSSOMS website, and we have a video library of over 100 video lessons in this library – math, biology, physics, chemistry, and engineering. And this is the library. You would go to a specific page and you get all of this material, and every one has a summary.

I want to show you that this area for teachers has all the handouts that you would need for the lesson, anything that the teacher would need to actually do the lesson in the class. We provide a long list of additional online resources. Most importantly, you can see over here that every lesson comes with a complete written transcript in the native language of the lesson – for example, in English – and so this facilitates translation. Faten will tell you about how they used our English – they were able to subtitle into English the lessons that they made in Saudi Arabia, and it's the transcripts that make that the easiest. I just wanted to point out – I don't know, some of you might recognize this woman. Sandra Haupt – is she here today? Oh, there she is. This lesson just went up onto the website, and she is a teacher in Concord, Massachusetts, who won a national contest that we had last fall to make a lesson, and so congratulations.

What I want to show you now is a very quick and kind of jazzy video of a lesson actually being used in a classroom. It was used in a high school in Arlington, Massachusetts, by a math teacher, and it will just give you a feel for how these are actually used.

**HIGH SCHOOL TEACHER:** This is going to be exploring the probability that three sticks made out of this one long stick – we'll call that unit one, if you will. If you break it at two random points, what's the probability that the three sticks will

form a triangle? And then we'll move on to seeing the video that was made by one of my colleagues at MIT. The program is called BLOSSOMS. Now notice, this can be done in a very poor region. You can shift the video via computer anywhere in the world instantly with virtually no expense.

DICK LARSON: My name is Dick Larson and I'm a teacher at MIT here in Cambridge, Massachusetts, USA. I hope you're feeling fine today and full of energy.

HIGH SCHOOL TEACHER: Are you?

DICK LARSON: We have an interesting challenge, a problem for you that's going to build on the math skills that your teacher and you have been working on these past few weeks, and maybe months. Today's problem deals with triangles, and if you're currently in a geometry class in high school, that's sometimes called the science of triangles and so it's not inappropriate for us to study triangles, but we'll be doing it in a different way.

HIGH SCHOOL TEACHER: So our first job is to take any length and, of course, we don't have to break it in 1 through 36. You can break it through 1 through 100.

STUDENT 1: That was the one that we got and then we subtracted these two to get the--

STUDENT 2: To get the second one--

HIGH SCHOOL TEACHER: Second one in the middle. Good.

STUDENT 3: The two sides combined have to be greater than or equal to.

DICK LARSON: And they're all mixed up, and they're going to select two at random, and they're numbered 1 to 36. Let me pick out the first one here. He reaches in, he pulls out – ah – it is a 24.

STUDENT 4: This doesn't form a triangle. These three don't form a triangle.

HIGH SCHOOL TEACHER: So if we did this experiment over and over again, what percent of the times do you think that the two randomly selected numbers would result in being able to make a triangle?

DICK LARSON: Go with 24 and then I have to cut through at 10. OK. Gentleman, we have the three pieces so obtained. And let's ask the question, can we form a triangle with these three pieces? Well, look.

HIGH SCHOOL TEACHER: What is the probability that the first digits of the two numbers will be the same?

I can see I'm running out of time, so I think I have to move on. So I quickly want to show you-- you've seen this before. This was the conference in 2005, the LINC Conference. And that actually was where BLOSSOMS was born, because we had a professor from the Gaza who came here to talk about how they needed distance education in the Gaza because so often the university students couldn't even get to their classes because of roadblocks and stoppages. After he spoke, there were a lot of people from the Middle East who jumped up, including people from Israel and seven or eight other countries – in fact, Naveed, you were there – and they got together for dinner and breakfast, and they decided that they wanted to work on a cross border project with the countries working together. They decided that the level they wanted to focus in on was high school math and science, because they were all university professors and they felt that when they were getting into the colleges, into the university, the students were really weak in math and science.

So we started that. It was called the Middle East Project at the time. We never really got it funded, but the idea stayed in our heads. And then we were doing some research on distance education in Mexico and also China, and we came across this class in China where there was a very, very poor school. But the teacher would have lecturers coming in from Tsinghua University, and the students were really very involved with this and watching, and what she'd do is turn the video off and turn it on. And we thought, well, what if you design videos that were designed to be turned on and off? And so that's kind of where we got that idea. Also in our research that we did in Mexico, we discovered a lot of high school teachers are not comfortable with the computers and that technology, and so that was another contribution, too.

So why do we need an initiative like MIT BLOSSOMS? We're all affected by globalization, and our children, they need an education that enables them to find jobs in this new economy. We live in a Knowledge Age. Things have changed so much. The wealth of a nation is not like oil and coal, but the most valuable natural resources of a country lie buried between the ears of its citizens.

So within this framework, BLOSSOMS began with four guiding principles: improve math and science teaching and learning at the secondary level; introduce teachers in a gentle way to the power of technology-enabled education; encourage universities to reach down to help improve math and science education in high schools; and initiate an educational resource that involves international partners in co-creation and co-utilization.

So the first one, STEM Education – some people like to add the A for STEAM – and so these are the attributes of a STEM educated student. There are many others – problem-solvers, innovators, inventors. And the goal of BLOSSOMS are to enhance the development of critical thinking skills, engage students to think like a scientist in

observation, experiment, and discussion, to connect abstract concepts to the real world, to show how exciting STEM can be, and to increase student interests in careers in STEM. And I think we believe very strongly that we all need to be STEM educated. It's not just for people getting PhDs. In order to make the decisions that citizens will have this century, they need to have this to be well educated in these areas.

So now I'm again going to show you a very short part of a video that is interesting. It's by a professor who combines mechanical engineering and biology, and we'll watch a little bit of this BLOSSOMS lesson.

DAVID HU: Hi. My name is David Hu. I'm an assistant professor of mechanical engineering and biology at Georgia Institute of Technology. My lab is interested in how animals cope with their environments while they're moving, and today we'll be looking at how very small insects fly in the rain. Imagine that you've been shrunk down to the size of your pinkie nail. The world then becomes a very dangerous place. Raindrops, which originally were only a nuisance, have become the equivalent of five tons in weight, and they fall at a speed of 1,000 of your body lengths every second. That's incredibly heavy and fast.

Although this scenario sounds like science fiction, this is in fact a daily reality for the world's smallest insects. Mosquitoes thrive in rainy and humid conditions, and they've been around for 200 million years and in that time have evolved a variety of mechanisms to deal with such conditions like wind gusts and the rain.

By studying insects, we can gain insight into the simple question of how to fly in the great outdoors. It's a difficult problem. There are wind gusts, rain. And this is especially important for technology. Recently, there's been a lot of interest in what's called the design of microaerial vehicles, a very small flying –

Unfortunately, I don't have time to show you more, but you can tell that this is the exciting beginning. This is only a two-minute beginning and he pulls people in, and he's using physics, math. He's bringing it all in. We particularly like this because it cuts down the barriers between – he combines sciences and he combines math – because problems involve many different aspects.

And another thing we try to do is to introduce teachers in a gentle way to technology. And I think, very importantly, we made the decision to use video, and actually it turns out most people are more comfortable with video because it's something that they're used to in their lives. And also, we don't require that they have a broadband internet. We send our DVDs to people. We've sent them around the world if they request these in areas where they don't have good streaming video, and all that's required is a TV and a projector. Also I have to say here before I forget that a lot of teachers don't even use the TV and the projector. They just look at it themselves, use the materials, and give the lesson themselves having learned from the teachers.

The third point of BLOSSOMS was to encourage universities to reach down and help improve math and science. These are our partner universities so far. We've worked in all these different countries. And we wanted to initiate an educational resource that involves international partners in co-creation and co-utilization. I wanted to quickly show you another video that was made by a high school teacher in Jordan, and we voiced it over into English. And it's one of the most popular videos and it's used in the United States in the voice over version. And we think this is a wonderful example of co-creation and co-utilization. I'm only going to be able to show you a small clip –

TRANSLATOR: Hello and welcome. I am Ghada Sulaiman Abdullah Marmash, a teacher in the school of King Abdullah the Second, His Excellency from Jordan. I hope that you can help me solve a problem. This problem will develop your skills in mathematics and require some knowledge of space and some knowledge of volumes. The juice seller faces this problem every day since he is always trying to pour liquid from two containers into a third one, and he needs to know this without wasting time or effort. Let's try to help him.

Look. These are the containers holding the juice, and he wants to pour them into a third container. Unfortunately, he has no knowledge of the mathematics involved and tries to pour them into the third container. Let's see.

So again, I have to move on because I only have 20 minutes, but you can see that this was such a strong lesson that the teachers across the United States are using this and we hear about it all the time. We have 20 lessons from Saudi Arabia, and Faten will tell you about those also. So we really feel that it's so important to have co-creation and co utilization.

So for the students, it's critical thinking, but for teachers, it's equally important. It's to learn a new style of teaching. And we find that teachers are using these videos to model a new style of teaching, a more active learning for their students, not lecturing, because these are all broken down into short segments and also learning the kinds of activities that are challenging and that are problem-based, and collaborative.

The Hewlett Foundation funded us our first two years, and it was an international program. By the second two years of our funding – they stopped funding us for international, because they wanted us to do work in the United States. And that's why we've worked in Florida. We've worked in Washington, DC with schools there. We had our national contest that Sandra won. And just now, we're starting to work with Massachusetts teachers about how to prepare for some new standards that are coming down that are quite challenging for the teachers. And BLOSSOMS is working with Massachusetts teachers to make 10 lessons that will help to train Massachusetts teachers about how to use and teach with these new standards. And actually Massachusetts is number one in this country in terms of how well they do with education, but they know that their teachers need to learn how to teach with these new standards, and we're delighted to be part of that. And these are our distributors that distribute – and goodbye.