**Colleen teaches Physics and Earth Science at a rural 9-12 school**

Technology I had taught with prior to POD was computers with some GPS materials, and with physics technology like lab equipment, Lab Quests and Logger Pro. Equipment for data retrieval and plotting graphs and building data because I am a physics teacher. I mainly used them as teaching tools. Specifically, that is my background in other school districts. Currently I am in a very rural community where the computer is the technology. We do have an amazing graphic arts department but other than that, that's all I have been able to give to students.

We are a Title I school with 9-12 grades. The student-teacher ratio would be 15 to 20 students in a classroom. Ethnicity is Hispanic and Caucasian. A few Native Americans and a few, maybe 1% African Americans. There are 353 students at our high school.

I have a lot of flexibility in my teaching because I write my own curricula. In my area in science, it has been a challenging year because we have had problems with our Internet service. I need Internet service for the ArcGIS program, and it's not there. It will begin loading, and students will start uploading different maps, and we lose it. And it's no fault of ArcGIS, it's the Internet server. We have had problems even uploading our grades and attendance. It has been a really bad issue, and the school board has approved an alternative type of Internet for the coming year. It will be 500 times better. I'm excited because I can implement even more of the ArcGIS into my curriculum, which I'm actually working with.

I have implemented lessons from Making Spatial Decisions Using GIS. There is a scenario of a hazardous spill where 34,000 pounds of black powder spilled on the Alexandria, VA turnpike. That is not relevant to my students, because they don't know where that is. So I rewrote it to a freeway near our school. And it was more relevant for them.

They fumbled with some words like stakeholder, and I had to say “you are a stakeholder, anyone living in this boundary is a stakeholder.” And it was very positive. I've had problems, again, getting into ArcGIS because of the speed in our computers. But we did it. I actually did an integration with graphic arts. We took one of my Earth science classes and his advanced graphic arts class, and we paired one Earth science student with one advanced graphic arts student, and we gave them the scenario. “If a hazardous spill happened in our city, how are you going to keep everybody safe?” And then … “now we want you to create a map. Where is the boundary going to be? These roads are going to be closed, who are the stakeholders? How are you going to divert traffic, how are you going to have emergency people coming in?” It really made them think. They went back and did research on various explosions to see what exactly the worst possible scenario could be. I invited the fire department to come here. And they talked about...two years ago they had an aerosol can spill. There was just one aerosol can that was releasing gas, and it closed down I-10 east and west bound for 7 hours. The fire department was so impressed...they didn't know we had ArcGIS... they're wanting to meet with me and we're going to create a community integrated GIS project to do this fall.

Now I am still such an infant with using ArcGIS due to the fact of our problem with the Internet. I feel very comfortable in the software version we used in POD. I'm not as comfortable with this newer version.

It has been a challenge this year. I've only been able to use it twice for a total of about 7-8 weeks. And I am excited about the program. I'm getting ready to work with the fire department this summer. They are a big stakeholder. They said “we didn't know you had this technology” and I kind of chuckled because my school district doesn't get it. I've tried, and it just goes over their heads. I’ve said, “You don't know how important this is. If our students get trained in ArcGIS, they could get jobs even before they finish college to help supplement while they're going to college.” I’ve been banging my head against the wall because the administration has no recognition of what this is. As a teacher it's very frustrating because I think if they knew more, I could possibly

get approved not for this school year, but for next school year, a class that's on ArcGIS. So that is actually my goal. We're taking a baby step.

I've used the GPS units and I've used some of the scenarios where we go out and we plot the points. "Go to 2nd base on the baseball field and plot the point. Go out to the football field on the 30 yard line." And we come back and they upload. And we start learning. That's the baby step in it. So that's where I am right now. My aspiration is also to be able to go and look at recent earthquakes and volcanoes.

I require students to write claims based on evidence in all my classes. I call it "defend your response and show the evidence." For the project about the black powder spill I told my students, "the map that you and the graphic arts student created, you're going to present it to this class and you're going to have to defend why you chose these areas. And you will take questions from the other groups. Be prepared to defend your response and explain."

In Earth science, we just studied about the age of our community. How it was a convergent area, how volcanoes, basically, had made up this area 600 million years ago. And the community out here...even though it's only about 70 miles from a large urban area, they don't think outside of their home and coming to school. And I wanted them to get the big picture of their community and of their region. How something so small can impact the greater area. And that is when I turned to the graphic arts teacher, and said "how about an integrated project?" We put a graphic arts student with an Earth science student, and the Earth science student will teach some of the Earth science like T-waves and S-waves and what could happen with explosions and surface waves. And the graphic arts student who is good with using Google Maps and creating maps, put them together...both of them hopefully thinking outside the box about how to assist in this scenario. And that's where and how I came up with the plan. It wasn't until we were 2 weeks into the lesson that I realized "let's invite the fire department." It was 6 weeks total...we were meeting every day for 1 hour.

It was just one Earth Science class. If we had to work at which class period, I would have preferred my 1st hour Earth science class with his 6th hour advanced graphics arts class. But it ended up being my 6th hour Earth science with his 6th hour graphic arts. And the reason is, I have more students...I hate saying "higher level students" in the 1st hour than I do in my 6th hour. And my 6th hour was my smaller class. It had maybe 20 students. My 1st hour had about 28, and very on top of their game. But my 6th hour did really well.

I co-taught the lesson with the graphics arts teacher. I didn't receive any IT tech support, either. The graphic arts teacher has the computers in his classroom. The graphic arts teacher has no background with GIS but he was interested, and he thought it would be a good opportunity for his students to think outside the box and to generate and create maps for these areas because the students are stakeholders for their community.

I think what went really well for the lesson itself...at first they were going "what does this have to do with me? How is this going to affect me? This isn't going to affect me." And the more they read the lesson they realized ..."if we're in session at the high school and this happened at our exit off the freeway, are we going to be able to stay at the high school?" And we have a K-8th school near us, so the reality is no. How are we going to evacuate?" Once they understood the word stakeholder...I find it fascinating that they didn't get that...they realized what it meant to them. I said "this is not watching channel 5 or anything, you are the news." And I had to make it relevant for them. And again, to me it was the lesson itself... Mapping Our World lessons are very good. I had to flip it around and make it where it meant something to my students in the community. The only thing I changed was the scenario picture. Instead of it being Virginia, it's in our town.

I felt that it was an effective lesson. We had just finished learning about earthquakes and primary waves, secondary waves, surface waves and this lesson came after that. If there was an explosion, they had already in their minds what the waves were and could anticipate possible destruction between the secondary and surface

waves. So they were actually doing calculations on the computer and trying to do research on the bombing in Oklahoma City, because they used fertilizer, to the bombings of Japan in World War II to get an idea and get some mathematical numbers to project what could happen if there was an explosion. So between using their background knowledge that they just had from the Earth science, they were using their mathematics knowledge. And that is something that I have in my mind for possibly including next year - one of the math teachers. Because again, I'm all for STEM teaching. And I still want to implement graphic detail. We're possibly getting a new graphic arts person. So if I can't use the graphic arts teacher, we're still going to create and present the map. This year I wasn't able to, but I want to present the map at a school board meeting with the fire department present. I also want to present a copy of it to the fire department. So overall, the effectiveness was 3-fold. They were able to use some of the ArcGIS, they were able to experience some art, they were able to take some of the knowledge they had just learned in Earth science and implement with logistics, a scenario that has real life significance for what could take place.

Next year when I implement it...I am tweaking it. I'm going to have the fire department and the community more involved with this. I'm going to have more guest speakers. I'm going to have the fire department come at least 3 times instead of the 1 time this year. This next year, it's going to be more use of ArcGIS. I can already anticipate it. They're going to be more in-tune with creating the maps, looking at the logistics using ArcGIS, and I'm even looking at taking our GPS units out in the field. I've already gotten permission to have the students take the coordinates, and we upload it so we have a real-time map going.

I gave them those questions from the text as pretest. And I would see some of them were blank, some of them said "I have no clue." "Well maybe you could do this..." And then I could use that as the post. "Now I want you to answer it with all this research with the map you have, now I want you to go back and answer these questions." And they did extremely well.

Accessibility to the computers was a barrier. When I was a part of POD, because I did it with the CTE teacher, he has access to computers that I could use. He doesn't use ArcGIS, but he has access to the here-and-now computers. He can take his students in at any time. I have to schedule in an older computer lab, with slower computers, and we're having problems with the Internet anyway. And the computers have a slow processor. It's just very much a nightmare. Then trying to schedule my class in there...it has to be consistent, I can't have them in there Monday of one week and then in two weeks have them come back. I need them to be in there or they're going to forget what they're learning on those maps. I could see every two days. So my drawback has been accessibility to the computers, and then the Internet and slow processing time.

I'm staying positive that this fall is going to be a lot better. I'm also trying to see if someone would donate 7 computers to my classroom. No school has money for computers, but I'm looking at if anybody has computers that they would like to give. If I could even have 7 computers in my classroom, I could implement ArcGIS and what I've learned on a daily or weekly basis.

I came from a state where STEM and using computers and programs has been a part of science integration since 2000. I arrived here and it's like going back in time, because technology and science integration - it's like "what are you talking about?" You're talking a foreign language, you know.

I see students interested in geospatial careers and I feel like I'm sitting on my hands because I'm trying to teach one school-time class. I've seen big interest. And my problem is, the district doesn't know GIS is. They don't know what it could offer our students. And that makes me very frustrated, and I have no idea how to explain it. To say "we have this...thousands and thousands of dollars software program. If we offer a course, our students could leave high school working in this industry part-time or full-time while going to college." It's ignorance. They have no idea what it is. And I found it fascinating when I contacted the fire department, they knew exactly what it was. And they were shocked that our high school had it. And I said "well I hope to be chosen to work

with NAU on this." And they're going "well we have to do geospatial maps with ArcGIS. We can't afford it in our small-community fire department, and we capture information and we have to send away and pay for it. It would be wonderful to work with students and have them help generate these maps." And so I think this door opening out to the community with the fire department might actually bring more awareness with our Board members and our superintendent at the district office. Because right now, it's like...it's just science. It can be very frustrating.

I will continue to teach with geospatial technologies because it is the future. It is my students' future. They're following paths. They're on the Internet, they're computer savvy. This is going to be an asset for them. If they work as a fireman - the plotting, looking at where the next fire station is going. Or looking at erosion in the land, because out here, we have washes that will close parts of school districts down. We don't have snow days, we have rain days. So it is their future, and it is what is already happening. I wanted to bring this tool to them to use as they use tech with their friends, I want them to be that familiar with it.

If I could even have 3 computers in my classroom where I'm not trying to fight with the English department and other departments to get into the computer lab, it would be wonderful. Also, I need someone to present and educate to my superintendent and to the school board what we have. They have no clue. And it's going unnoticed. If I have a cow and it gets the blue ribbon, it's in the newspaper, pictures all over. If you're a football player or a business person and they're great, they're brought up in front of the district. Pictures are taken in the newspaper. But they have no idea about this science, about ArcGIS and what it can offer.

I'm going to implement more problem-based learning. Students accept it better, they have ownership of it, and, like our instructors did there at POD, when we had a problem, they were there to assist. And if we didn't know, we would find someone who did.