Paul teaches CTE and Math classes with Rob, the science teacher at a 7-12 school. They run a STEM Program (pseudonyms)

We are in a small school in a somewhat rural setting, where there is still a lot of heavy industry. We are 8 miles away from a larger town where it's mostly tourism and larger heavy industries moving in. It's resource-based industries. The ocean and/or the woods. About a third of the kids go to work, a third of the kids go into the military, or a two year college or a four year institution. Most of the students are pretty successful in what they endeavor to do. They come out of here usually with enough skills to be somewhat successful. Of course you always have the high end students; we also have the very low end students. Other than that, it's a working class town.

Rob and I teach a STEM course together. The kids learn how to use the software and learn the importance and the relevance of collecting data within the context of the cause and effects of certain events. Because they have been introduced to the tools, I can go directly into requiring my students to collect data on almost any other subject, collate the data in the correct manner, and analyze the data without opinion to see what really going on. It is an absolute boon. It is phenomenal. The students in the ArcGIS program are fundamentally head and shoulders above any other students, because they have the training in a manner which allows them to understand the use and purpose of data.

Currently I am helping to develop a new applied math program. The nice thing about ArcGIS is it makes the math more relevant.

In the STEM 2 program we design, we make. Of course we have to have to meet standards. We go to the Board and justify how what we want to do meets the science, math, and English standards. We teach, we provide an environment where students will be learning. We use ArcGIS to get kids used to collecting data and analyzing data, so that when they go to make something, they know we have to problem solve before we get there: How do we correlate the data and what's the data going to tell us?

We pose a problem like a levee breaking. I bring in the technology to show how levees break and pose the question: A levee broke, what does that really mean? Or another example is electricity. Hurricane Sandy wiped out the eastern seaboard's electricity. What does that really mean? This provides a reason for students to learn about transformers, or how electricity gets from point A to point B. Kids say: What do you mean you can't just throw a switch and it comes back on? Rob teaches the science of what the storm looks like, where it comes from. The weather data is just a model; this might be what will be happening twenty years from now. This might be happening ten years from now, 15 years ago this is what was going on. I ask: how do we filter the data? How do you do this, how do you apply this knowledge to live in the real world?

I posed a scenario to engage students in making claims based on evidence: a little old lady is in a 50 story building after Hurricane Sandy hit. There's no power for 10 days and she's in a wheelchair. What do you do? This spawns conversation around how many people experienced something like that? What other services were affected? How do you take care of the people during an emergency? So they have to consider 10,000 people didn't have power for multiple days. What does that mean? How did they get fed? The students have to search the internet to collect data and they have to be able to document

where their data came from, where their numbers are coming from, cross verify their numbers. They quickly realize that one report says five people were affected and another says 500 people. I ask: which one are you going to believe? 5 or 500? Where's your evidence? Show us your evidence.

Our curriculum is basically kind of modeled on what we did last year. We use lessons from Mapping Our World with GIS pretty closely but we try to find something that's currently happening in the real world or what has happened in the last four or five years so we can make correlations between what's going on and what has gone on. So we actually keep it pretty fresh, up to date.

We create our own rubrics and formative assessments. And Rob uses assessments from the Mapping Our World with GIS all the time. So they get both. They complete the Geospatial Inquiry lessons and then they have to do what I create. But it's all rubric-based. We are very fortunate that we get to do proficiency-based grading. We are allowed to allow a kid to do it until he can do it right. Until they get it right, they don't get a grade, they don't pass.

They use ArcGIS in STEM 1 but in STEM 2 it just progresses further. In STEM 1 they get introduced how to use GIS. STEM 2, they get introduced to how to make stuff, then in STEM 3 they go to work for people who are actually using this stuff in the real world. But they know how to use it so when they get out into the field they understand the progression. In other words, the first step is "this", the second step is "this is how it's done", and the third step is "ok, let's go do it". It a three or four year program we're trying to evolve.

The Hurricane Sandy lesson tied in very well with where we were at with ArcGIS. So it kind of mirrored a real life situation. We were studying weather patterns and putting data in. It gave us, an opportunity to ask students "if things change, what's going to happen, what are some changes observed?"

The kids got it and they came back the next couple of days, and said, "Oh I learned this, this, or this. I learned about how it affects people, what water did." We ended up doing a whole lesson on what salt water does to wire. That spun into a whole chemistry lesson on how salt water affects galvanized metals, copper, and technologic connections.

If I taught it again I'd probably add two more hours to it. This is one class and we have a 54 minute schedule and we have back to back classes with this one. So that gave us two hours long blocks. This is mostly freshman. Last year we had a much more stratified class, both academically and grade-wise. So it was a little better. This year was mostly freshmen, 54-58 freshmen in the class. We were used to something else. We had to slow it down. We're trying to get the great students, they work hard most of the time. They are on task most of the time. It was just so much volume of information I think we should have taken more time to do it. Rob and I always have that big debate. How much detail can you expose?

GIS is effective for student learning if it is used well. You stick a kid in front of ArcGIS. It is a really great program, but until they have a real world overlay of relevance to it, it just doesn't make connections. But when you do the layered approach that we've got, then you get is kids that are more able to use their intuitiveness to understand what you really want to teach them. They realize they're not just

learning information or a software program. They are learning how to use these things to solve a problem.

The question I posed was: “what do you do with the little old lady? How do you solve the problem?” Students produced essays in response. We provided a standard writing format and source documentation and data documentation. So we’re trying to teach them how to do technical writing. ArcGIS supports me to say “ok you need to write technically… show me the data for ‘I feel,’ I don’t really care how you feel. What does the data say?” “What’s your data show you?” In ArcGIS kids can explore the metadata to determine the accuracy of the data. They know they have to have documentable numbers to technically write on what happened. Not what they think happened, not why they think it happened, but what really happened. I’ve been teaching for 13 years, I’ve never been able to do that for them. Ever. It’s always been personal perception, personal theory, but now we’re technical writing, “where’s your data?” There’s no way I could do what I do without ArcGIS. I have done this for 13 years but not nearly as joyfully, happily, successfully.

Kids would say: “you know I think can do a little bit better on that. Can I have another shot at that?” I hear them talking in the hallways or the classroom about what they are doing. One of the things we’ve tried to make sure of is they don’t all go to the same source. So they don’t have parity going on. So that’s a really important concept. We teach our kids to go to different places.

Our principal came in a couple, three times and watched what we were doing, asked us if we need something. We get support from NOAA if we need it, we get support from the community if we need it. If we need something we can get it. Basically we make a couple of phone calls and say we need this then we got it. We’re pretty self-contained so we do a lot of stuff after hours. Rob will come up with some ideas, I’ll come up with some ideas, and then we’ll get together and figure out what we’re going to do. So it’s not like, “ok we’re going to walk in and you’re good to go.” There’s a lot of planning that goes into it. And we look up different resources, we bring certain things, they bring certain things. And we have a third teacher aide that used to be a researcher. She’s done this stuff. She’s done real research in a real lab, where they actually make a product.

This is our third year teaching it. The kids coming up know about it and that’s a synergy, that synergy translates to speed. Kids help each other. The kids are getting really used to saying, “I can help you with that” “Here let me show you again” and all of a sudden you’ve got a classroom of maybe 25 teachers versus one.

Local and state educators don’t know what ArcGIS is. So we had to do an awareness program. The other thing is we had to be successful. And we had to sell it and we did have to make sure that our students were actually using it. Rob did this whole original research project with the university. The students were able to use GPS to get the data points and they mapped it all, and they were able to tell the Ph.D. guys stuff. The researchers would ask the freshmen and sophomores “what do you think this really tells us?” The students would respond with, “well you know the data shows us only this” and that’s what we wanted to hear. There were people there that wanted the kids to speculate, and the kids wouldn’t. It was great, awesome.

We are a small school with limited resources. POD has opened up untold doors. I've been able to say that we've been doing this in conjunction with Northern Arizona University. Hey this is where the help is from. We didn't just pick this out. Now we're part of this national program. We're using data. It's allowed us legitimacy I don't think we would have had if it weren't for our participation in POD. We're actually changing, bringing change into our school. They're looking at how much more writing we're doing, we do a lot of technical writing now. We actually do probably more technical writing than English teachers do of regular writing, lots more. The school's benefiting from that.

I'm finishing up my administrator's license this year. Any school I go to, they're going to have to have programs integrating geospatial technologies and other disciplines if they want to get anywhere. I want to bring something like this with me because it's just changed everything.

This is what I really like about ArcGIS: it's a video game that has real world relevance that uses data to prove a point. And you can learn how to manipulate all these data, and it's real. So you've got all these really wonderful questions and it's easy to correlate to the real world. It's super easy to pick something happening in the world today that you can use in ArcGIS, in a heartbeat. You don't have to work at making the links. They just naturally occur and exist. And I think the way it's set up, the kids are successful. We take kids that are not very good at anything, and they can go through the lessons, it's pretty cut and dry.

I always used project-based learning. But the one thing I couldn't do before because I didn't have the language was data based project learning. And that's a totally different animal. It really is. I couldn't get it, I just didn't have enough time, there was not enough relevance, and there weren't enough times where teachers were using it in different environments. Now I get that. Now I can feel like I can go right to data based project learning because I can say "prove it to me with data. I don't care what you think, prove it. Data, where's your data?" Now they go right to that process and that eliminates a lot of error, it eliminates a lot of wasted time, and resources. So we even talk about resource management. Here's a correlation, data correlation, in between wasted resources and outcomes. Now when I'm project-based teaching I can go, "ok you only have this many resources and it's limited, you need to get here. How are you going to do it?" There's a correlation between those two things. They're not separate anymore. Kids don't understand resources, they don't understand limits of a resource. They just don't. Whether it's time or materials or whatever, in this way they learn it.

I can do so many more complex things I never could do before. I can get my kids doing things that they, technologically and intellectually could never achieve in the same amount of time. Even if would have had them all to myself for eight hours a day; it's just transformed them.

We tell students you can go and get a job doing this stuff tomorrow. That's our one of our big selling points. Do this stuff tomorrow. I'm seeing more kids going into engineering, and more kids talking about going into engineering than I ever have before. Both guys and girls, which is great. I no longer have issues with kids who ask why the heck we are doing this if we're never going to use it. I never hear that, ever. I don't think I've ever heard that this year yet. It's changed the way we look at the world.