**Pre-Calc Radar Project Tips for Teachers**

* Students may feel overwhelmed after being introduced to the project. There are many possible problems to investigate, and students may need help narrowing the scope and choosing a problem that matches their interests and abilities. I ran into several instances when students thought they had to solve every possible problem.
* We don’t often ask students to *create* problems so they may have a hard time expressing their problem in written form after choosing it. For example, a student may choose to determine the altitude of the airplane given a curved Earth. It may likely take some time for the student to write a well-crafted paragraph that describes the situation and clearly poses a mathematically solvable problem. Tell them that a word problems is what they need to write. This frames the problem in terms they understand. Refer them to their textbooks to see how word problems are formatted and written.
* Ensure the students submit a diagram with every problem description and solution. This helps make sure they have identified all the parameters and variables they need to solve the problem.
* Make sure the students understand the difference between the diagram used to describe the problem and the diagram used to solve the problem which may include auxiliary lines and other geometric additions necessary to solve the problem.
* Students often have a challenging time understanding uncertainty of computed values. For example, given the vertical dispersion of the radar beam, you may need to guide the student toward finding both a maximum and minimum possible altitude for the plane.
* As the teacher you need to determine if the selected problem is matched well to the student’s abilities. I found that strong students will often go for the most complicated problems and scenarios and need to be guided towards reasonable simplifications. For example, strong students may realize that the uncertainty of a plane’s position I the sky will be a rectangular section of a spherical surface and try to compute that area. You may need to guide the students to first solve the simpler case of just assuming the zone of uncertainty is a flat rectangle whose area can be computed by length times width. After solving that case, you can turn the student loose on finding the area of the spherical section.
* Students may also choose fairly simple problems. This may or may not be appropriate for them as they may find considerable challenge in expressing the problem in written form. This is where your knowledge and judgement about the student is key. You can either ask them to choose a more challenging problem, or have them solve the simple one, and follow-up with another problem.
* You may want to establish some agreed upon vocabulary and variable designations so when you see diagrams from different students you don’t have to learn each student’s naming convention. A consistent naming convention will also help students work with each other.
* Students have a hard time understanding what the strategy section in the solution document is for. They often want to put their solution in that part. Suggest to them that the strategy section is the roadmap of their solution listing the steps and theorems they may need to apply to actually solve the problem. For example the strategy may include the following “connect points C and D with an auxiliary line, forming triangle ACD, then use Law of Cosines to compute the length of CD” In the solution section they would actually do these computations.
* Make sure students have a reflection statement in their solution. Ask them to decide what the key insight was in solving the problem, or perhaps something they did in solving the problem that was useful enough to remember for the future. Its during the reflection that the learning sticks.
* Don’t be surprised if students come up with a problem you didn’t anticipate. You’ll have to determine if it’s solvable, or how solvable it is. When this happened to me, I generally let the student go for it anxious to see what they would come up with.
* The ASR and FAA Radar specifications sheets are provided as teacher reference. You may choose to share these with your students if you see fit. The FAA specification is interesting to show students as an example of a technical engineering document (in this case a requirements and testing specification) and as a government technical compliance document. Often students think engineers don’t have to write or communicate through documents. This will set them straight.