

Name: Andrew Martinez

School: PSJA Thomas Jefferson T-STEM ECH

Subject: Principles of Engineering

Grade: 9th

Instructional Days: 30-60 Days

Enhancing Teacher Knowledge and Skills in Manufacturing

Overview:

“This NSF-funded program aims to address the increasing demand for a qualified workforce in manufacturing by providing skill training to teachers and supporting school programs with hands-on and manufacturing foci. The enhanced school environment would be suitable and attractive to students, since they can relate the experiences to everyday examples, potential employment, and even advanced STEM study/careers.” Stated on the online website on <https://retmanufacturing.engr.tamu.edu/>. Throughout the six weeks that I have been attending the RET Program, I have learned a great deal of hands on material that I did not know as much in the past years about manufacturing. I do teach an engineering class that consists of 9th graders and its principles of engineering. When getting to the subject of manufacturing, theory is all that the students see, but never getting their hands on a machine. Learning after the first week of the program that the students are missing out on a lot more information on theory but mainly hands on experience.

Once completing the RET Program, I plan on taking the information back to my class and teaching the students what I have learned from the past six weeks. As a stepping stone to the following school year, I would not jump into the subject of manufacturing, but taking the time to make a six weeks program into a two-month subject. Within the two months I would start from the beginning of our six weeks program and towards the end of the two months having final presentations. Why take the two months on the manufacturing subject? Reason why is because every student has one or many different learning styles (Visual, Verbal, Physical, Logical, and Aural) and learning capabilities. Taking the time to have the student learn the subject to the fullest including after school tutoring.

Education Standards:

Now then, how to include a vast information of manufacturing engineering into the class would be great challenge, since now the class would be expanding the information and including hands on activities. To get started on teaching a subject, the school would be needing an outline of the TEKS (Texas Essential Knowledge and Skills) founded on the following website <http://ritter.tea.state.tx.us/rules/tac/chapter130/ch130o.html>. The following TEKS that would be using would be great to implement PBL (Project Base Learning) Projects in the field of manufacturing. Using the section 130.402, section C, and Knowledge and Skills.

130.402. (c) Knowledge and Skills

- (1) The student demonstrates professional standards/employability skills as required by business and industry.
- (2) The student investigates the components of engineering and technology systems.

- (3) The student presents conclusions, research findings, and designs using a variety of media throughout the course.
- (4) The student uses appropriate tools and demonstrates safe work habits.
- (6) The student thinks critically and applies fundamental principles of system modeling and design to multiple design projects.
- (7) The student understands the opportunities and careers in fields related to robotics, process control, and automation systems.
- (8) The student understands the opportunities and careers in fields related to electrical and mechanical systems.
- (9) The student demonstrates the ability to function as a team member while completing a comprehensive project.
- (10) The student demonstrates a knowledge of drafting by completing a series of drawings that can be published by various media. The student is expected to:

Using the following sections of the TEKS, would make the following lesson plan that would outline the manufacturing subject. The text that's highlighted in red would be add-ons to the class but mainly outlining the manufacturing activities.

Lesson/Project:

1. **Outline of Activities:** The following activities would be one to two months long.
 - a. Safety Introduction
 - b. Manufacturing Introduction
 - c. 3D Drawings Introduction
 - d. 3D Drawing Activity
 - e. Precise Measurement Introduction
 - f. Precise Measurement Activity
 - g. Solid Works Introduction
 - h. Solid Works Activity
 - i. Material Removal Processes: Traditional Machining
 - j. Traditional Machining Activity
 - k. 3D Printing Introduction
 - l. 3D Printing Activity
 - m. Surface Engineering Introduction
 - n. Surface Engineering Activity

2. **Student Activities:**
 - a. When starting the new subject there would be a pre-test that would take place that would not be graded. It serves a purpose of seeing if any students have or have not been exposed to the information that is about to be covered.
 - b. When introducing new material, the student would be using their engineering notebook to record the key notes and I would be presenting on PowerPoint the key terms, equations, and outline of what the students is to learn. Providing classroom structure and student involvement through questions, videos, and

scenarios. This would open the minds of the students to start thinking outside the box, asking questions, and visualizing the steps that they are going to be doing.

- c. After presenting the information to the students, the next day would be students activities. Majority of the activities would take place in the classroom and students would be working in pairs. Using their engineering notebook to take down observations, reading, and notes, these activities would be clearing any questions that any students may have. The activities would be hands on to open the doors for all different types of learning visual, verbal, physical, logical, and aural learning students.
- d. At the end of each activity, the following day there would be a post-test that would be give and taken as a grade. Along with an open-ended section that would provide feedback to the teacher from the student's perspective. The post-test would ask the same questions as the pre-test but now including open-ended questions dealing with feedback for the teacher, new knowledge, anything to increase the learning.

3. Methods of Interactions:

- a. As stated student would be given key notes to refer encase they get stuck, then if the students cannot move on from the spot, they would be asking the teacher for help. Implementing that the notes are not clear.
- b. Students would be given that opportunity to learn to read step by step information and follow step by step information to do their activities. Example would be when student is learning how to use the precise measuring tools to measure their items. The student would be given key notes on how to read the measuring tools, then quizzed, and then given the chance to hold the tool and use the tool to measure. Through the process the student would be given more than enough information to use the tool but now actually using the tool to measure. Students would ask questions to make sure that they are on the right track.
- c. Once they have learned how to measure with precise tool they would be tested by paper and by using the tool. The test would make sure that each student did learn the material that was pervaded.

4. Support Needed:

- a. The support that would be needed is from the RET program, CTE, and my school administers.
- b. The RET program would be supporting my students and I to stay on the right track on what the universities are looking for in the engineering field. Also looking into having students apply for summer programs.
- c. CTE would become a key into getting our equipment to follow out our lesson plans on having the students be introducing to manufacturing engineering at a young age.
- d. The administers support would be making sure that they support what I am doing to improve the functions in the engineering field.

5. Material and Equipment Needed:

- a. Precise measuring tools:
 - i. Class Set: Rulers
 - ii. Class Set: Calipers
 - iii. Class Set: Micrometers
 - iv. Class Set: Dial Indicator
 - v. Five: Stylus-Type Contact Profilometers
- b. Machining tools:
 - i. One: Saw Machine
 - ii. Two: Bench Drilling Machines
 - iii. Two: Bench Surface Buffering Rollers
 - iv. Two: Bench Lathe Machines
 - v. Two: Bench Milling Machines: One Vertical and One Horizontal Milling
 - vi. Two: Bench Surface Grinders
- c. University expectations from incoming freshman:
 - i. Material on what Texas A&M recruiters in the engineering field are looking for.

Student Summary:

With everything that is being done, is for the student outcomes, being able to maintain their engineering notebook with all their key notes. Each student should be able to look back at their key notes and be able to explain what they did, explain their results, and being able to understand the basics of engineering. The outcome for the student is to use what they have learned in their everyday life, used the engineering notebook to keep record of their improvement, and ultimately having the experience to get accepted to their future university of engineering.

Pre- Post-Test Outline:

The following questions would be from different pre- and post-test that would be taken place before and after key notes and activities. These tests are to make sure students are on task and learning the material that is given.

1. If there is a student who has cut his finger, what is the first thing that you should do?
 - a. Not tell the teacher
 - b. Run and get help
 - c. Tell the teacher
 - d. Call the front office
2. When drawing in three-dimensional what are the main faces that are looked at?
 - a. Front
 - b. Top
 - c. Side
 - d. All of the above
3. When manufacturing what are the three key terms that are used?

- a. Time
 - b. Money
 - c. Material
 - d. All of the above
4. When using a three-dimensional program such as SolidWorks what axis do they use?
 - a. X-axis
 - b. Y-axis
 - c. Z-axis
 - d. All of the above
 5. To decrease the surface roughness, which of the following would make the surface roughness decrease the most?
 - a. Sanding
 - b. Electrochemical Polishing
 - c. Cutting
 - d. Up milling
 6. What instrument has the most precise measurement?
 - a. Ruler
 - b. Micrometer
 - c. Caliper
 - d. None of the above

Reflection:

After each post-test there would be open ended questions, that would ask for the student's opinion on the subject, what they have learned, if anything is still in question, and how I as a teacher make the lesson clearer. Using these open-ended questions, I would be able to have the student reflect and myself reflect by reading the students responses. There would also be open questions of how the student would teach each other and other student that did not know how to use the machines. That would also give me an understanding if the student has learned how to explain themselves and if the student was paying attention throughout the notes and activities.

Supplemental:

RET program has been great help towards opening doors for the teacher and soon to be students in learning and understanding the manufacturing field. Coming from a mechanical engineering background, I was able to learn a lot more about manufacturing and technology that is used in the industry and I did not know existed. These machines that were introduced and having the experience to do hands on activities in the RET program gave myself confidence to take this material back to the classroom and incorporate it into my lesson plans.

Closing:

The RET experience has been amazing, because I was able to learn and use all the machines that they were teaching us. Seeing the surface finish, seeing the defects, and seeing how technology has come a long way to make out lives easier. I plan to get other engineering, technology, and CTE teachers to come join the RET program the following years. Including my

coworker, he would be very involved in the program and finding ways to implement the information learned into his class. To my students I want to have them join Texas A&M's programs that are offered during the summer, especially in the engineering field. Giving them the opportunity to get out of the region and experience the college life during high school. Using every day to have every student see what is outside the valley we live in and how much opportunities they have in attend a university. Lastly, I want to say thank you to the RET program for giving me this opportunity to deepen my knowledge and understanding of manufacturing engineering. Thank you.