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Opinion

Importance of Teaching Technology and Science Together

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Opinion

Today's technologists are called upon to do many things-from analyzing why a machine or a device or a system is not working properly, to actually fixing it. Too often, reasons for failure are complex and interconnected. The best technologists draw on all aspects of their experience along with basic science to solve these problems, and often rely on experts in specific areas to attack the most complex of problems. Technology is not just computers-this is clear, even though popular use links the two. Technology involves basic science, including the ability to apply concepts related to heat, mechanics and fluid flow to the understanding of materials and processes; the ability to apply mathematics and statistics to problem solving; the use of computer algorithms to understand the basic interactions occurring in a system; and much more [1]. Even the common plumber runs into problems with fluid flow while auto mechanics today are tied directly to computer analysis of engine function.

Science is the basis of today's technology and should be taught in that context. Seeing the need for an understanding of scientific principles is critical for students and practitioners alike. Basic technical skills can be developed in a science lab or in a machine shop, but doing experiments helps students to see direct results of using their hands and their minds in problems solving. Demonstrations of materials properties for example, may seem like magic to the un-initiated, but open the way for student to see relationships. Examples go from the processing of steel by quenching and tempering to the exact hardness needed, to 3D printing of everything from devices to houses [2].

Technology instruction by definition includes basic science principles (Core Competencies for Technicians, National Resource Center for Materials Technology Education,), including

a. Basic mathematics in measurements and use of appropriate units, interpreting drawings, and understanding computer applications,

b. Basic chemistry and physics including appropriate and safe use of handling chemicals, understanding electricity and magnetism and concepts of light and sound,

c. Ability to identify appropriate materials for use in different environments and applications, including not just metals but also composite materials, polymers and ceramics,

d. Understanding mechanical and physical behavior of all classes of solids, liquids and gasses, and how they are applied in engineering and technology.

Technological challenges abound today. Take the case of the new types of batteries being developed and used in transportation as an example. Li-ion batteries are a start but are not the end-the supply of the elements needed for these batteries is insufficient for the future, and methods of recycling and/or reuse of partially depleted batteries will be needed. Materials for use in extreme conditions of temperature, pressure or environment are being developed and technologists need to understand them to be able to use and maintain them [3]. And the development of sustainable materials from renewable resources will become much more important in the future. The case, then, is that the interrelationship of science with technology is becoming not only more important, but in some areas it can be critical to the survival or our planet. Young students are quite familiar with the materials used in their devices and toys, and probably can explain why things don't work or break when they shouldn't. Their interest increases as they do their simple analysis of the problem. They are applying their ability to analyze failures just like a technologist does and their attempts to explain what they experiencing is a form of scientific exploration--at the interface of technology and science [4]. If science curricula in schools could only incorporate real life experience into science lessons, this would enhance student interest in both science and technology and increase interest in further study-and perhaps further career exploration.

What is available in this area in terms of curricula that could be utilized? As I have discussed before [5], a wide variety of resources are available, at least in materials area. At the middle and high school, curricula are available in a many of applied science and technology areas. At the college level and for technology training, the same is true. A listing of projects that have developed such curricula is provided in the reference list. Here are a few examples:

i. MatEdU, the National Resource Center for Materials Technology Education, www.materialseducation.org

ii. NISE, the National Informal Stem Education Network, https://www.nisenet.org/catalog/programs/snowflakes_nano_at_...

iii. Design insight, Torben Lenau, http://www.designinsite.dk/htmsider/inspinfo.htm

The bottom line that science is everywhere in technology is well known to us as professionals in the field. It is not so obvious to those who teach science and technology in the schools. One program I know about is the "Teacher's Camp" program from the ASM Materials Technology Foundation (ASM Materials Education Foundation Teachers Camp, https://www.asminternational.org › foundation › teachers). K-12 teachers who attend these "camps" learn how to teach both science and technology using hands-on experiments and related lessons geared to help teachers develop excitement in

their classrooms [6]. For community and technical college and technician training instructors, the same lessons apply with focus on technology. Can we develop a program where science and technology are taught together? Yes, of course we can. As professionals, we can also provide information on the subject along with references to suitable curricula and training in our own geographical area. In addition, we can provide our expertise to ensure that instructors have access to needed supplies and equipment so they can carry out the lessons. Together we can ensure that students have access to the knowledge and training to ensure their success in the application of science and technology [7,8].

Acknowledgment

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References

1. ATE Central Internet Scout
2. Mineral Education Coalition
3. Materials Science Educational Handbook, US.
4. Materials Education Foundation of ASM International, USA.
5. Stoebe T (2019) Science Education: Our Professional Responsibility, Aspects Min Miner Sci 4(1)
6. Materials Explorers.
7. Smithsonian Science Education Center, USA.
8. Ansys, formerly Granta Design.