Integrating Math Instruction

into

Technical Programs

by

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Abstract

Like many students in colleges across the country, students in the Technology and Industrial programs at Del Mar are struggling with inadequate math skills and this is hindering their ability to succeed. The lack of adequate math skills has many causes; many of our students have been out of school for years or even decades and have forgotten the math they learned in high school. Unfortunately, many never learned enough math when they were in high school to be successful in college.

The obvious solution to this problem is simple, sign the student up for a remedial math class. But like many simple solutions to complex problems this answer does not work as planned because students, especially weak students, have great difficulty transferring knowledge from one setting to another. So the math that they learned in their math classes does not prepare them for solving math problems in their other classes.

By integrating math skills into their technical programs, making it an integral part of the technical material, not an ancillary class, students learn the math as a valuable, necessary tool for solving problems and it becomes a skill that they use through their career.
Implementation of Integrated Math Instruction in Technical Classes

Like many students in colleges across the country, students in the Technology and Industrial programs at Del Mar are struggling with inadequate math skills and this is hindering their ability to succeed. The lack of adequate math skills has many causes; many of our students have been out of school for years or even decades and have forgotten the math they learned in high school. Unfortunately, many never learned enough math when they were in high school to be successful in college.

The obvious solution to this problem is simple, sign the student up for a remedial math class. But like many simple solutions to complex problems this answer does not work.

Several years ago, Del Mar invited Dr. Clair Weinstein to come to the college and to conduct a week long series of talks on student learning and how to enhance that process. Dr. Weinstein is a professor at UT Austin who is a recognized expert on how students learn and how that learning can be enhanced. She developed a course that she called Learning to Learn that research showed significantly improved student learning outcomes and their grades in later courses. One of the major points that she made in her talks is that Knowledge Doesn’t Transfer, especially in weaker students and field dependent learners like many on the students on the West Campus. At the time I did not appreciate what she was saying because I was teaching in a program that was a thirty hour a week block where we taught the students the theory behind a new topic when we introduced that topic along with what ever math skills they needed to solve the problems associated with that topic in an integrated environment. Shortly after Dr. Weinstein’s talk we converted our program into semester hour classes and I saw a vivid illustration of exactly what she was talking about. Pete Flores was teaching theory class on a very common circuit called a common emitter
amplifier and described the operation of this circuit in detail. In the lecture he showed how to calculate the gain of the circuit and illustrated how the gain was affected by various components. When the class was over the students took a short break and then Mr. Flores met with them again in the following class that was devoted to the circuits used in a radio receiver. The topic for the day was a circuit called an Intermediate Frequency Amplifier, which is exactly the same circuit that he had just lectured on in the previous class. One of the students was having a lot of trouble doing the calculations to determine the gain of the amplifier because he did not understand how the amplifier worked. Mr. Flores reminded him that he had just done the exact same calculations earlier but the student was convinced that he had never seen this circuit before. Pete took the student’s notebook, flipped back a few pages and showed him where he had drawn the exact same drawing and made the same calculations. “But that was in the Solid State Circuits Class, not Radio Theory,” explained the student. The knowledge that he learned in the Circuits class did not make it across the hall into the Radio Theory class because to many students, especially weak students, knowledge is tied to a specific class, or location, or environment and it does not readily transfer to even a closely related topic. To these students what they learn in a Math class is MATH and when they see the same type of problem in one of their content classes they act like they have never seen that type of problem before and they are unable to solve the problem. In order to be of maximum use to Technical and Industrial students the math needs to be integrated as deeply and closely into the course as possible. It needs to be taught not as math but simply as a tool used to find the answer to the problem under discussion like a meter or a hand tool.

In the Technical and Industrial programs, we don’t look at the elegance and beauty of mathematics. To us math is no more elegant than a voltmeter, a calculator, a micrometer,
or some other piece of test equipment. It is simply a tool that is useful to calculate an answer that we need for the problem we are working on. The more closely the math is integrated into the program, the more successful it becomes.

Although traditional remedial classes and tutoring do work, (Boylan, Bonham, Bliss, & Claxton, 1992; Cross, 1976; Donovan, 1975; Roueche & Roueche, 1993; Roueche & Snow, 1977) based on Dr. Weinstein's seminar and experience, integrating the math instruction into the course shows promise of increased success. Pairing remedial classes with content classes has been shown to be even more effective than traditional methods (Commander, Stratton, Callahan, & Smith, 1996; Wilcox, delMas, Stewart, Johnson, & Ghere, 1997; Wilcox, delMas, Stewart, Johnson, & Ghere, 1997).

Goals

There are three goals for integrated math instruction:

(1) To improve the ability of students to use math as a tool for solving problems in their Technical classes.

(2) To enhance student success by removing a major impediment to their success, their poor math skills.

(3) To improve completion rates of students in Technical programs.

Integrating additional math into one of their first semester classes by adding an additional one hour block to first semester classes that have significant numbers of under-prepared students would allow the teacher time to devote to calculator usage, math skills required for a new topic, and in-class practice using these new skills. The additional hour should be contiguous with either lab time or lecture time so that the students view it as part of the lesson content, not a remedial math class unrelated to what they are doing. In some
weeks it might be used as time for additional instruction on the class content, some weeks it
might be two hours if a new topic is being introduced that needs more time to master. In
other weeks the time could be used to teach students how to use the increasingly
complicated calculators that our students are using. Modern hand held calculators are
literally more powerful than the microcomputers of the seventies and learning to use them
effectively and to program them requires considerable time.

Because students so often have trouble transferring knowledge from one class or
experience to another, using the tools developed by Dr. Weinstein in her individual learning
skills course (Weinstein, Dierking, Husman, Roska, & Powdrill, 1998) in the additional one
hour lab would be an effective way to help students transfer knowledge from one area to
another. And these skills appear to last throughout the student’s college career, increasing
retention and achievement across all classes that the student takes. (Weinstein, Dierking,
Husman, Roska, & Powdrill, 1998).

**Outcome and Goals**

The goal of integrated math instruction is to improve student learning and success in
their Technical classes by removing a major impediment to their success. Poor math skills in
entering students are a major cause of reduced student outcomes across the nation and this
project will increase the student’s ability to focus his energy on learning the new material, not
on how the teacher got the answer to a problem on the board. Reducing the fear of math
and the failures caused by inadequate math skills will result in improved student outcomes in
our entering students and this increased success will continue to improve their performance
in every class they take. A stronger foundation makes for a more successful student.
Reducing the failures and frustrations in the first semester will increase retention and result in improved student learning outcomes for our students.

**Timeline for Implementation**

Changing established courses requires approval by the Curriculum Committee and changing course descriptions in the College Catalog. In addition, the teachers who are teaching the effected courses would need time to integrate the required math skill instruction into their curriculum. All of these changes could be in place by the Fall of 2008. In order to evaluate the success of the program, the final grades of classes participating in the program can be compared with grades of students completing the courses prior to the integration of the math content into the course.

**Resource Allocation**

Of the four resources required to integrate math into existing course (space, time, materials, and money) money, as always, is the most significant one. Space requirements should be minimal because the instruction will take place in existing classes and labs. The time requirement consists of two components: training the trainer, and time in class. If Dr. Weinstein’s individual learning skills course materials are incorporated then the individual instructors who will be teaching the classes must be trained to use these materials. The one hour class time can be accommodated by increasing the length of a lab period by one hour a week. Materials cost should be minimal because no additional materials need to be purchased to implement the program. Money resources would consist of two components, training the teachers to use Weinstein’s individual learning skills course materials, if desired, and salaries for the additional one hour class time. The cost of the additional salary would be offset by additional contact hours generated by the lengthened class time.
Assessment Schedule

Assessment of the program success can be determined by comparing grades of students taking the classes with the integrated math component with baseline grades of students taking the same classes in prior years. This would be done on a semester by semester basis. In addition, tracking the retention rates of these students over the next few years should indicate that they are retained at a higher rate than students from the baseline years in addition to making better grades.

References


