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Aligning Classroom Instruction with Workplace Skills

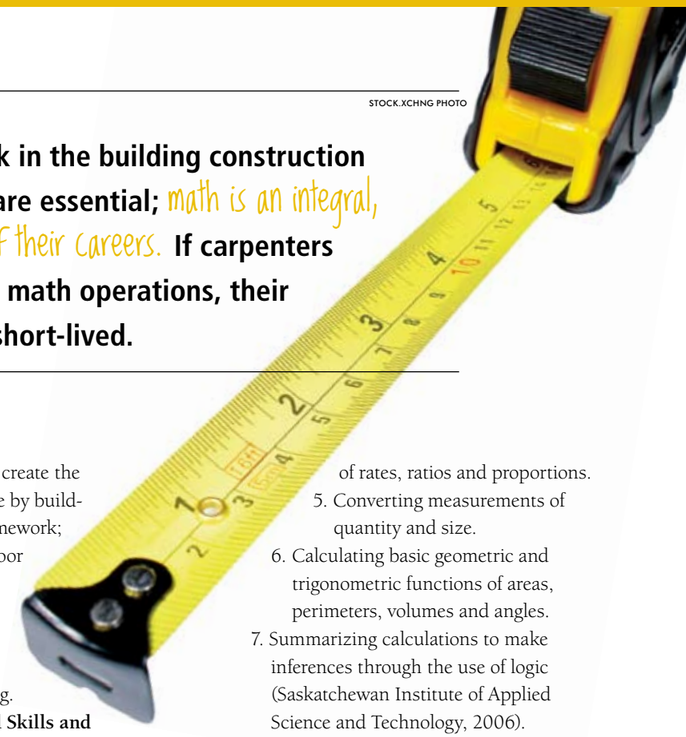
Equipping CTE Students with the Math Skills Necessary for Entry-level Carpentry

BY CORY MOHR

It is safe to say that no matter which job or career individuals may pursue, they will inevitably use math skills learned throughout their primary years of education, and many of those learned during high school. These math skills can be called "basic" skills since they "must be learned as a foundation for all other learning," (Hughes, Moore, & Bailey, 1999, p. 9). However, while learning math in high school, many students often ask: "When am I ever going to use this stuff?"

With approximately 2,500 students dropping out of U.S. high schools every day, there exists a need to align classroom instruction with corresponding "real world" applications. In order to keep students' motivation high and help ensure high levels of validity in instruction, core curriculum instructors and career and technical education (CTE) instructors should work together to connect workplace skills and classroom instruction, especially for traditionally difficult areas of study such as math. Knowing that many choose to enter the workforce immediately after high school, it becomes not just a place to prepare for the next stage of education, but often the primary institution of formal education. It is therefore imperative that high school educators provide these individuals with the skills necessary to be successful in the jobs and careers they choose.

For those who do not attend college after high school, there are many opportunities in CTE that can provide good employment offering a competitive salary, benefits and job security. One example is the construction industry which, for the past few years, has been listed as a high-growth industry and is expected to create nearly one million new jobs between the years 2006 and 2016—an increase of 14 percent (U.S. Bureau of Labor Statistics, 2006). Of the several trades within the building construction industry, carpentry is the largest. However, in some states, it is difficult to find experienced and qualified applicants to hire. As a result of this labor deficiency, it is becoming imperative that training programs be implemented to aid



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For individuals who decide to work in the building construction industry as carpenters, math skills are essential; math is an integral, inseparable part of the daily tasks of their careers. If carpenters cannot perform certain vital math operations, their careers will be short-lived.

those individuals seeking employment in this field.

For individuals who decide to work in the building construction industry as carpenters, math skills are essential. According to Millroy (1992), "…many conventional mathematical concepts are embedded in the practices of the carpenters," (p. 3). To these individuals, math is an integral, inseparable part of the daily tasks of their careers. If carpenters cannot perform certain vital math operations, their careers will be short-lived.

The Challenge

To better prepare students for an entry-level position as a carpenter, educators at the high school level must first learn what math skills and operations are used in the frequent tasks of carpenters in the building construction industry. With this information, these institutions can modify their programs to ensure students are receiving the proper math training.

The Need

Frequent Tasks of Carpenters. Carpenters participate in almost every type of construction performing tasks that include preparatory, foundational, framing, interior and exterior work. Preparatory and foundational work are performed to prepare the job area and building site by constructing preliminary buildings, structures, and forms for foundations that are necessary to begin construction on the primary building. Framing, interior and exterior work are performed to create the primary structure by building a skeletal framework; installing wall, floor and ceiling surfaces; and applying an external covering such as siding and roofing.

Mathematical Skills and Operations Used in the Frequent Tasks of Carpenters. According to a study regarding the basic skills of carpentry, "This is a job requiring strong math skills," (British Columbia Construction Industry Skills Improvement Council, 1992, p. 2). Carpenters must "…gain mastery over the mathematical skills necessary to keep today's carpenter on the leading edge," (Michigan Technical Education Center, 2006).

The Saskatchewan Institute of Applied Science and Technology (2006) identified several key math skills used regularly by carpenters. Those skills were then broken down into several math concepts such as:

1. Reading, writing and performing basic arithmetic using whole numbers, integers, fractions, decimals and percentages.
2. Converting fractions, decimals and percentages.
3. Using equations and formulas to solve problems for unknown quantities and measurements.
4. Comparing quantities through the use of rates, ratios and proportions.
5. Converting measurements of quantity and size.
6. Calculating basic geometric and trigonometric functions of areas, perimeters, volumes and angles.
7. Summarizing calculations to make inferences through the use of logic (Saskatchewan Institute of Applied Science and Technology, 2006).

Other math concepts used by carpenters include the ability to use mental math and make estimations; work with trigonometric and geometric ratios and functions such as the Pythagorean Theorem, sine, cosine and tangent; calculate the perimeter and area of a triangle, rectangle and circle and the volume of a pyramid, rectangular prism, and sphere; and use a protractor to measure and construct angles (Conrad, 2003, Oklahoma Department of Career and Technology Education, 2004).

A Study

The author conducted a study last year to provide further validity to the literature reviewed. The primary goals of the study were to identify perceptions of local carpenters regarding (1) the most frequent tasks performed by carpenters, (2) the processes involved in completing those tasks, and (3) the math operations embedded in those tasks.

Methodology. A group of approximately 35 carpenters employed in the Southern Illinois area was used as a sample. As carpenters arrived for a meeting at the local carpenters' union hall, they were asked to complete a questionnaire voluntarily and anonymously. The questionnaire contained items asking for basic demographic information and feedback regarding the frequency of tasks performed and math skills applied while working. Of the approximately 35 carpenters present for the meeting, 23 chose to complete the questionnaire, yielding a response rate of 66 percent. Once the questionnaires were collected, the data were tabulated to answer the research questions.

Demographics. The majority of the respondents were males (91.3 percent) and were over age 40 (60.5 percent). Only 10 (43.5 percent) had earned some form of college degree (associate degree or higher). The majority (56.5 percent) had not acquired a postsecondary degree and thus their formal education stopped at the high school level. Respondents also identified the math courses they completed while acquiring their education. Of the 23 respondents, 22 (95.7 percent) had completed some type of basic math course, 19 (82.6 percent) had finished Algebra 1, and 12 (52.2 percent) had taken a course in geometry.

Results. In order to identify the tasks performed, respondents were given a list of 13 tasks and asked to indicate the frequency with which they performed the tasks—frequently, occasionally, or never. The three tasks performed "frequently" by the majority of respondents were measure spaces and materials (90.5 percent), lay out walls for construction (63.6 percent), and work from blueprints (60.0 percent). All tasks are listed with their responses in Table 1.

Respondents were then given a list of 11 math skills/concepts as identified in the literature review and asked to mark the frequency of use for each. Five concepts were used "frequently" by the majority of respondents—basic arithmetic (90.9 percent), fractions (76.2 percent), angles (60.0 percent), area (54.5 percent), and pitch (54.5 percent). These and the other concepts are shown in Table 2.

TABLE 1: Frequency of Tasks Accomplished by Respondents

TASK	FREQUENTLY		OCCASIONALLY		NEVER		TOTAL	
	#	%	#	%	#	%	#	%
Work from Blueprints	12	60.0	6	30.0	2	10.0	20	100.0
Measure Spaces/Materials	19	90.5	2	9.5	0	0.0	21	100.0
Construct Concrete Forms	10	45.5	10	45.5	2	9.1	22	100.1
Construct Ramps or Stairs	11	50.0	9	40.9	2	9.1	22	100.0
Layout Walls	14	63.6	6	27.3	2	9.1	22	100.0
Install Floor Systems	10	45.5	9	40.9	3	13.6	22	100.0
Install Interior Wall and Ceiling Surfaces	7	31.8	15	68.2	0	0.0	22	100.0
Install Roof Systems	8	38.1	11	52.4	2	9.5	21	100.0
Install Exterior Wall Systems	8	38.1	12	57.1	1	4.8	21	100.0
Estimate Materials	10	45.5	11	50.0	1	4.5	22	100.0
Estimate Labor Time	8	36.4	8	36.4	6	27.3	22	100.1
Estimate Cost of Materials	7	33.3	9	42.9	5	23.8	21	100.0
Estimate Cost of Labor	6	27.3	8	36.4	8	36.4	22	100.1

NOTE: Total Percentage does not always equal 100.0 due to rounding error.

TABLE 2: Frequency of Math Skills/Concepts Used by Respondents

TASK	FREQUENTLY		OCCASIONALLY		NEVER		TOTAL	
	#	%	#	%	#	%	#	%
Basic Arithmetic	20	90.9	2	9.1	0	0.0	22	100.0
Fractions	16	76.2	3	14.3	2	9.5	21	100.0
Decimals/Precentages	9	50.0	5	27.8	4	22.2	18	100.0
Conversions	8	34.8	9	39.1	6	26.1	23	100.0
Equations	4	21.1	11	57.9	4	21.1	19	100.1
Area	12	54.5	9	40.9	1	4.5	22	99.9
Perimeter	10	47.6	10	47.6	1	4.8	21	100.0
Volume	6	27.3	12	54.4	4	18.2	22	100.0
Angles	12	60.0	7	35.0	1	5.0	20	100.0
Pitch	12	54.5	7	31.8	3	13.6	22	99.9
Ratios	3	14.3	15	71.4	3	14.3	21	100.0

NOTE: Total Percentage does not always equal 100.0 due to rounding error.

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Conclusions and Recommendations

Carpenters are involved with nearly all residential and commercial building projects, so it is important that they have the math skills necessary to perform their duties and tasks. The majority of respondents in the aforementioned study completed their formal education at the high school level. This highlights the need to increase and solidify the basic math skills of high school students. It is also recommended that high schools with carpentry-related programs make sure those students can perform such tasks as measuring spaces and materials, laying out walls, and working from blueprints. In addition, they should make sure students in those programs are comfortable with math skills involving basic arithmetic, fractions, angles, area and pitch in order to better prepare them for future employment. To increase effectiveness in teaching and retention in learning, math educators and career and technical educators should work together to develop an interdisciplinary curriculum designed to teach individuals (1) mathematics through practical examples involving carpentry and (2) how to apply their mathematical knowledge to the carpentry tasks they need to perform. T

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