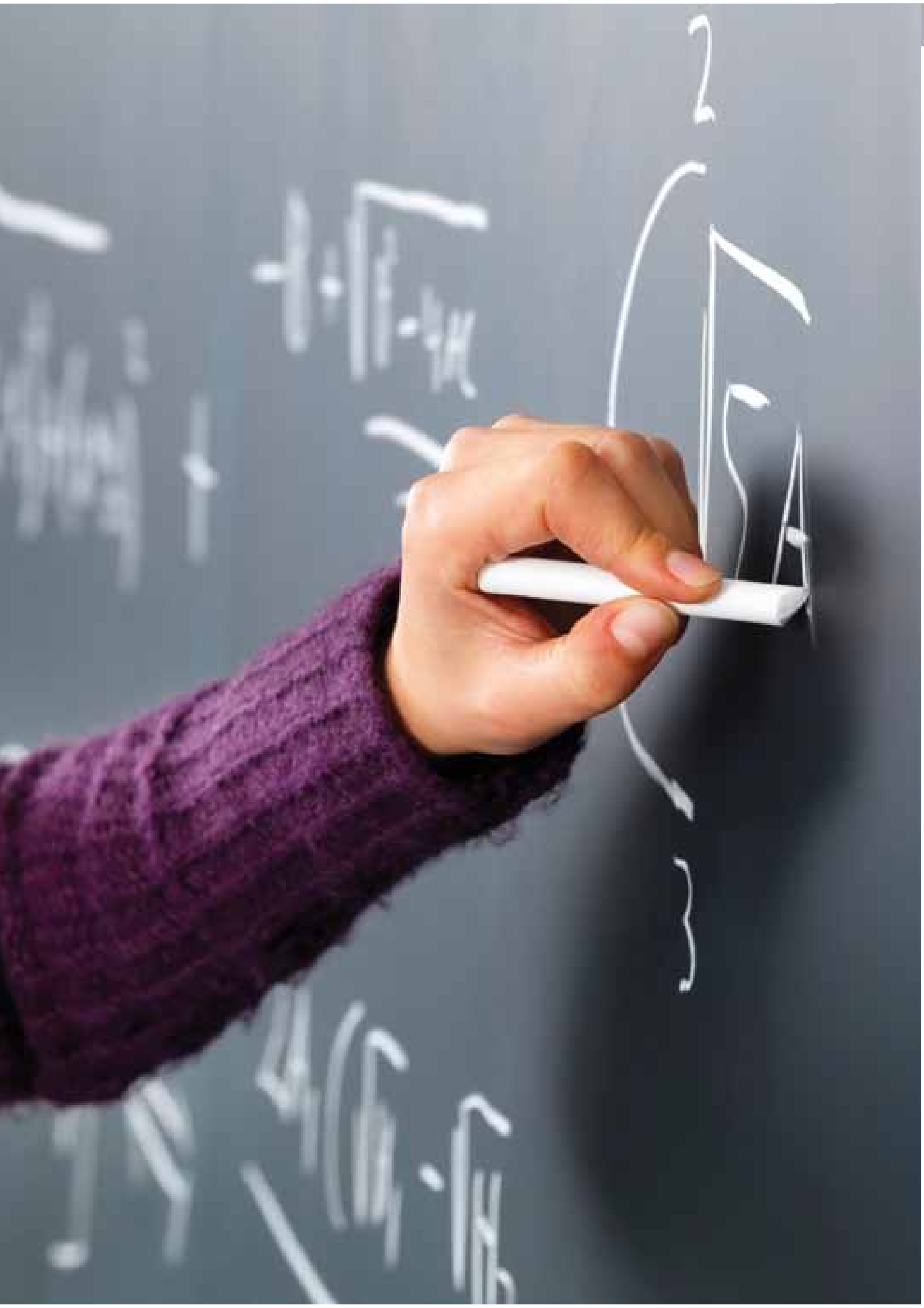
Crosswalks and Quality: Linking Math Language and CTE Standards



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By Elizabeth Often

WE ALL USE MATH EVERY DAY IN CAREER AND TECHNICAL EDUCATION (CTE) areas, in academic areas and in our lives outside of school. Yet recent research done by the International Center for Leadership in Education (ICLE, 2006) found that the math skills required by most entry-level jobs and in day-to-day living was well below the standards of high school-level math courses. Many CTE teachers that I worked with have told me that the math their students are learning and that teachers are being asked to support in the technical areas is math that these instructors were never taught in school (Piper, Estee, personal communication, 2007). So, when CTE instructors are called on to include grade-level standards in their technical area, it can be a real challenge.

However, support of high-level math skills is increasingly required under the most recent Perkins Act. Perkins IV called on the states to "integrate rigorous and challenging academic and career and technical instruction (section 2)." Also, as with No Child Left Behind, Perkins IV demands accountability. States must show that students are reaching proficiency in *both* academic content and technical content (section 113), rather than demonstrating this through standardized testing; however, Perkins IV requires states to complete a series of reports detailing spending and outcomes for CTE concentrators.

The quality of math standards within career paths is an important one, as it can indicate whether CTE students are receiving a rigorous academic and technical curriculum. This is especially important as the CTE field has expanded to include technology and pre-engineering (often called STEM fields) as well as more "traditional" fields, and many CTE concentrators go on to postsecondary education. Finally, the requirements laid out in the standards can have an influence on what CTE instructors choose to teach, and how they use (or fail to use) the standards in planning their instruction.

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Questions and Methods

I was inspired by the work of Castellano, Harrison, and Schneider (2008), who performed a review of CTE standards in all 50 states and the District of Columbia (Puerto Rico, U.S. Virgin Islands, Guam, and the Mariana Islands, while covered by Perkins IV, were not included). They concluded that there was a large variation in the quality and consistency of career and technical standards across states, and that while many states had developed standards, a much smaller number had cross-walked these standards—that is, explicitly linked them to academic standards. It is interesting to note from Castellano *et al.*'s (2008) research that some states which had only partly completed the development of statewide CTE standards, had done so while concurrently linking academic and CTE standards. They noted that Mississippi, Louisiana, Ohio and North Carolina were leaders in the development of CTE state standards (Castellano *et al.*, 2008).

Using their research as a jumping off point, I reviewed the embedded academic standards in CTE disciplines in eight states—Nebraska, Georgia, New Hampshire, Massachusetts, Connecticut, Maine, Alabama and Louisiana. Through a review of state CTE standards, state academic standards, and crosswalk documents, the amount and type of state math standards linked to CTE was evaluated. These standards were compared with the Common Core (2010) academic standards to determine whether the requirement for academic rigor that Perkins IV requires was being met.

Overall, I wanted to answer the following questions: Are states now, four years after the passage of Perkins IV, more thoroughly aligning CTE and academic standards? Does the academic language of math used in the alignment represent the teaching and learning of a "rigorous" curriculum? And, finally, what is the implication of including the academic language directly within the embedded academics frameworks for CTE? Who serves to gain or lose from this academic language?

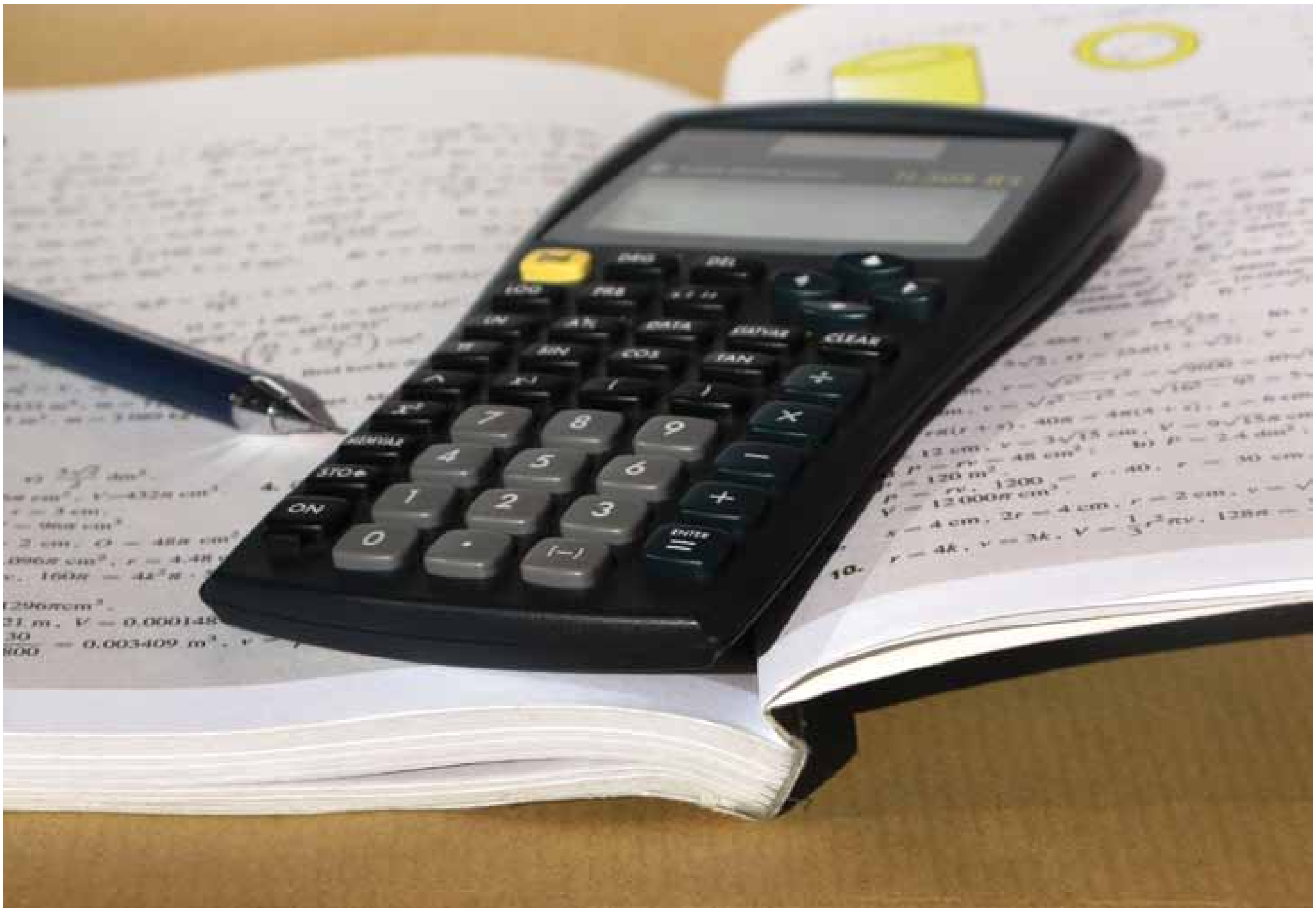
Data Review Outcomes

The data revealed a wide variation in presentation of state standards, and the levels of math knowledge linked to CTE areas. Nebraska's CTE standards are cross-walked, linking math standards from grades four, eight and 12 into the CTE standards (Nebraska Department of Education, 2003). The specific math language of the standards is used, and there is a clear connection between the CTE standard and the academic standard.

In New Hampshire, the applied math is at a low level (fractions, decimals, percentages), and may not accurately reflect the complexity of problems encountered within a technical area. As of August 2009, the New Hampshire CTE frameworks have only been linked to science, which impacts the ability of researchers to evaluate the type of math that can be emphasized in CTE programs, and the level of academic rigor provided. The New Hampshire Department of Education, however, indicated that the standards did not truly reflect the commitment to high math standards. The state is in its third year of implementing the National Research Center for Career and Technical Education's Math-in-CTE program, which partners academic math instructors with CTE instructors to create integrated lessons, and a representative from the state education department reported "success" with this program. In addition, at all levels, both Nebraska and New Hampshire said that integration of other academic areas into the CTE curriculum is required, and gave specific examples of integrated activities (Nebraska Department of Education, 2003; New Hampshire Department of Education, 2009).

In contrast, the CTE curriculum in Georgia is much more structured and rigorous (Georgia Department of Education, 2008). The CTE courses have been thoroughly cross-walked, so that it is clear to see which standard in the Plumbing I course links to a math course at the high school level (Georgia Department of Education, 2008). Georgia is slightly different from some of the other states surveyed by including process standards within its math standards, and referencing these in the cross-walked CTE documents (Georgia Department of Education, 2009). These can serve as reminders that, as one Massachusetts Department of Education employee said, "You cannot teach technical standards without also teaching other content" (Russell, personal communication, April 2010).

In Connecticut, the standards for CTE are not cross-walked with academic standards, and the language used is strictly



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the language of the trade being studied. This does not exempt the students from high-level math achievement. The state requires technical high school graduates to complete Algebra II, complete an approved project or elective course, or show proficiency on either a state or nationally normed exam (Connecticut Technical High School System graduation requirements). One such elective, Applied Math I and II, which links trade math with academic math, is offered for upperclassmen. Although it lacks the documentation of linkage between CTE and academics, by its graduation requirements, Connecticut certainly appears to be meeting the call from Perkins IV to increase rigorous academic content.

Massachusetts had developed a set of statewide standards in each of the technical areas in 2005, but in 2007, the trade language was removed from the embedded academics portion of each CTE standard and replaced with appropriate academic curriculum standards. There is currently no cross-walking of academic and technical standards. An administrator at one technical school said that the sheer number of standards, covering everything from safety to general work skills, and including academic standards, was "overwhelming," but that the lack of cross-walking was not controversial because schools could choose to address those in a variety of courses, including math, technical programs and related classes (Lussier, personal communication, April, 2010).

Maura Russell, from the Massachusetts Department of Elementary and Secondary Education, said that academic and CTE educators worked together on the embedded academic standards, in contrast with the earlier standards, which were created by CTE instructors (Russell, personal communication, April 2010; Traill, personal communication, April 2010). She admitted that some teams, in an effort to emphasize the very real connections that exist between academic math and technical math, may have created connections that were "tenuous," and that in upcoming standards reviews, there were plans to ensure that academic standards were more clearly linked with the technical area.

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Overall, the results of the data review show that states are making progress toward defining a curriculum that is both rigorous and integrated. The level of math achievement in CTE continues to be a problem, though, with many standards not truly reaching the levels set forth in the Common Core curriculum for high school math courses (Council of Chief State School Officers, 2010).

Integration Models and Stakeholders

There are some program models, such as High Schools That Work, and Math-in-CTE, that encourage collaboration between academic and technical instructors. As some of these programs have moved past the pilot stage, it has been possible to review the experiences of teachers who participated in full pilot studies or in less intensive experiences.

One follow-up study, *Sustaining the Impact* (Lewis and Pearson, 2007), found that more than 15 percent of CTE instructors who attended a two-day workshop on the Math-in-CTE approach were not teaching explicit math because they felt they "lacked the background [or] experience" (p. 13). The same number were not teaching explicit math because they lacked the support of a math teacher. This may indicate that only including the academic language of math within the CTE frameworks is not enough to encourage the teaching of explicit math. It may even discourage those teachers who feel they lack the qualifications.

However, this is no reason for states to avoid making clear links between academic and technical standards. Many CTE instructors who responded to Lewis and Pearson's (2007) follow-up surveys indicated that they either planned to teach explicit math in the following year, or that they wanted to be able to work more closely with a math teacher. Many of these instructors expressed a desire to have the time to understand the math embedded in their technical area in a more detailed way.

It is clear that even though many entry-level jobs do not require a high level of math, and daily living may not require math at the pre-calculus level (ICLE, 2006), students still stand to benefit from a rigorous math education. It then is the job of schools and districts to develop the programs that will aid not only students, but also teachers, in developing their math knowledge.

Conclusions and Suggestions for Further Research

Most of the states reviewed stated in their CTE documentation that the future of CTE lay within an integrated education, one that blends CTE instruction with instruction in the academic areas. The quality and consistency of cross-walked state standards in CTE education still varies from state to state, reflecting the more localized control of education that has long been a hallmark of American education (McGuinn, 2006). However, it appears that most states are working to include higher levels of math knowledge within the integrated CTE frameworks. There are many avenues of future research, both in general educational policy and in math education policy. T

For more information on Math-in-CTE visit **www.nrccte.org**. For more information on High Schools That Work visit, **www.sreb.org**.

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