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ABSTRACT

During the past decade, standards have become a central aspect of reforms in both academic and vocational education. Thus far, academic and industry skill standards have been developed independently of each other. Only sometimes do documents concerning academic standards discuss using standards in ways that have relevance to work, and most industry standards that mention academic skills fail to specify required levels of achievement in those skills. Process-oriented skills are the area with the most overlap between academic and industrial skill standards. A 1996 conference brought together individuals who had worked on developing the two types of standards. The following were among the seven recommendations to emerge from the conference: promote collaboration among employers and academic and vocational educators in the development and use of standards; improve the definition and measurement of the levels of academic skills within the industry of skill standards; develop academic standards so that meeting those standards will indicate individuals' ability to apply the relevant academic skills outside the classroom; systematically experiment with different approaches to coordination of the two sets of standards; and focus on developing appropriate teaching strategies and associated curricula and effective ways to prepare teachers to use them. (Contains 20 references.) (MN)

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INTEGRATING ACADEMIC AND INDUSTRY SKILL STANDARDS

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During the last decade, standards have become a central aspect of reforms in both academic and vocational education. Academic teachers have developed standards in many subject areas, and employers and educators are working together to develop industry and occupational skill standards. But until recently, there has been little communication between those who have been working on these two types of standards.

This report explores the relationship between academic and industry skill standards and assesses the current state of coordination between them. It also suggests ways that better integration between the two could strengthen both and ultimately have a positive influence on education as a whole. This Brief draws on the discussions at a 1996 conference, sponsored by the National Center for Research in Vocational Education, that brought together individuals who had worked on developing the two types of standards.

IMPORTANCE OF BETTER COORDINATION BETWEEN ACADEMIC AND INDUSTRY SKILL STANDARDS

Why should we care about the relationship between academic and industry skill standards? One could argue that they serve different purposes. Academic standards define what all educated citizens should know in particular subject areas, while industry skill standards indicate what skills are necessary to work effectively in particular occupations or industries. Education reformers are often reluctant to design curricula explicitly to prepare young people for work because many believe that the short-term needs of employers can be in conflict with the broad goals of education. They fear that a curriculum designed primarily to prepare students for work might not include subjects such as the humanities, art, music, and history and would, therefore, result in a narrow and impoverished education.

The call for better coordination between academic and vocational skills is based on several arguments that support the idea that more interaction among the groups developing these standards could strengthen both academic preparation and preparation for work. First, the traditional separation between academic and vocational education has been judged to have negative social and pedagogic effects. Changing technology and work organization have transformed the jobs that have traditionally been filled by graduates of vocational education programs. In the past, many employers wanted entry-level workers who would simply follow orders. Now, however, many want workers who can solve problems, work in less well-defined circumstances, and take initiative and responsibility (Bailey, 1995; Murnane & Levy, 1996; Stasz, Ramsey, Eden, Melamid, & Kaganoff, 1996). In the past, these types of activities were expected only from workers who had a solid academic foundation, often including college. Academic preparation for workers at many levels has become more important.

Second, cognitive research suggests that relating learning to work can strengthen academic learning. The purpose is not necessarily to prepare a student for a particular job, but to use an industry or occupational context to motivate a deep understanding of the relevant academic skills (Raizen, 1994; Resnick, 1987). Well-chosen experiences in an industry context can give a coherence to academic studies that is difficult to create when subjects are taught independently and in the abstract.

Third, economic and technological changes have created a need for skills that are often not well represented in traditional academic programs. For example, knowledge of probability and statistics has become much more important for many jobs. Forman and Steen (1995) argue that the mathematics used in the workplace today is likely to involve sophisticated applications of elementary mathematics principles rather than the elementary applications of advanced mathematics often found in traditional materials.. If this is true, educators and employers, working together, could develop a mathematics curriculum that would not only be oriented towards the actual uses of mathematics in the workplace, but would be as challenging as the current curriculum.

Fourth, while educators are likely to have a poor understanding of skills used in the workplace, employers are not in the best position to specify the academic content necessary to support the skills that they need. For example, employers might believe that their workers do not need to know algebra and yet complain that they cannot work effectively with spreadsheets, thus failing to understand the algebraic basis of many spreadsheet operations. Similarly, employers may think that their workers need only simple mathematics, not realizing that modern quality control methods depend on a sophisticated understanding of statistics. By working together, employers might come to a better understanding of the needed academic skills, and educators may begin to understand that work-related applications offer opportunities to teach sophisticated mathematics.

CURRENT STATE OF COORDINATION BETWEEN INDUSTRY AND ACADEMIC STANDARDS

So far academic and industry skill standards have been developed almost entirely independently of each other. While some of the academic standards make reference to skills needed for "the workplace" or "the real world," and all of the industry skill standards refer in some way to required academic skills, there has been almost no coordination across the industry-academic divide.

There have been several indications that the isolation of the two groups is slowly beginning to change: In late 1995, the National Governors Association convened a conference in Kansas City that was attended by a variety of individuals working on school reform and industry skill standards as well as a small number of individuals who had worked on the academic frameworks. The National Council of Teachers of English and the International Reading Association (1997) are planning to extend the discussion of their standards into the areas of workplace literacy, career education, and school-to-work. In early 1997, the National Skill Standards Board, the U.S. Department of Education's Office of Vocational and Adult Education, and the School-to-Work Office of the U.S. Departments of Labor and Education initiated Building Linkages, a project

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designed to develop linkages between state vocational and academic standards and national industry skill standards.

Work Connections in the Academic Standards

All the documents dealing with academic standards include suggestions on how the standards might be used, and in some cases these activities have relevance to work. For example, the language arts standards describe an elementary-level project about water purification after the pollution of a community's water supply. Students and the teacher decide together on the best sources of information, including books, print media, interviews, or other sources. The students then prepare written material and a presentation, which leads to a debate on the best remedy for the problem (National Council of Teachers of English & International Reading Association, 1996, pp. 50-51).

The mathematics standards include many references to work. The authors of the standards suggest an emphasis on the use of "real-world problems to motivate and apply theory" (National Council of Teachers of Mathematics, 1989, p. 126). The Mathematical Sciences Education Board (1997) has put together a collection of work applications that illustrate the sophisticated use of different levels of mathematics in realistic settings.

Although the standards for each discipline include skills that have potential workplace applications, these applications are rarely made explicit. While students who meet the academic standards may have learned skills that could be useful at work, many will not have had opportunities to apply them to realistic work-related problems.

Moreover, while most educators, parents, and policy makers generally favor "higher standards," there is no normative measure against which to set the standards. What will students be able to do if they meet these standards that they will not be able to do if they fail to meet them? Most of the academic standards were set by educators based on their judgment about what students should know, usually in order to proceed to the next level of education. For the most part, these judgments are not based on objectives from outside the discipline or the education system. Although preparation for work is only one of several educational objectives, it would be useful to have more conscious discussion of work applications as part of the general discussion of the intent and design of academic standards.

Academic Skills in the Industry Standards

Some of the industry skill standards simply list tasks that workers are expected to be able to perform for the relevant occupations. No particular work context is included. Where academic skills are necessary, these are also simply listed. At the other extreme, some skill standards focus on the critical functions required for the job and define them within the context of the industry. Particular academic skills are embedded within these functions, and academic and industry skills are integrated within the industrial context.

Academic skills in various forms appear throughout the industry skill standards. Some simply call for knowledge of academic skills. For example, the Electronic Industries Association and the Electronic Industries Foundation (1994) standards require entry-level electronic technicians to be able to solve algebraic expressions and formulas, understand fundamental principles of mechanics and hydraulics, and demonstrate other proficiencies in physics. But no level of knowledge is specified. Other standards tie academic skills to particular work tasks. For example, the National Automotive Technicians Education Foundation (1995) lists the ability to use Centigrade or Fahrenheit scales to determine the temperature of coolants and lubricants.

The standards developed by the American Electronics Association (1997) include such academic skills as reading, writing, listening, and speaking/presenting and such everyday mathematics skills as estimating discounts, monitoring expenditures, and using statistical process and control procedures. The bioscience standards explicitly tie academic skills to a series of scenarios, each of which presents a real-life work situation consisting of a routine procedure and an unanticipated problem that must be solved. In these scenarios, the academic skills are embedded in the tasks themselves (Education Development Center, 1995).

Thus, although academic skills are clearly called for in the industry skill standards, in most cases they are simply listed at an abstract level. Moreover, the levels of academic skills tend to be rather low–often significantly below the high school graduation level. For example, with the exception of photonics (which recommends two to three years of high school mathematics), virtually all the mathematics specified in the eight sets of industry skill standards examined corresponds to about two years of middle school mathematics. The level of academic science called for by the industry skill standards may be slightly higher, although in most cases the standards are so general that it is difficult to assign them a level. For example, the metalworking standards call for an understanding of material properties. Biochemistry, microbiology, molecular biology, and organic chemistry are included in the list of skills in the bioscience standards, but these standards are so vague that they provide little guidance to students and teachers. How much organic chemistry should a prospective bioscience worker learn? Progress can be made in this area only through collaboration between industry personnel and teachers and leaders from the various discipline-based communities.

Defining the levels of English, social studies, or history specified in the industry skill standards is even more difficult. There is little mention of social studies or history, and, not surprisingly, none of the industry standards call for knowledge of literature or literary analysis. Most industry standards call for writing and communication skills, but it is impossible to determine required levels of achievement in these fields from the published standards.

Generic, Process, or SCANS Skills

Process-oriented skills are the area with the most overlap between the two types of standards. In workplace applications, these are referred to as SCANS skills or generic skills (Secretary's Commission on Achieving Necessary Skills, 1991; Stasz et al., 1996). The New Standards Project refers to a similar collection of cross-functional skills as applied learning skills (National Center on Education and the Economy, 1997). Put simply, SCANS skills include the ability to solve problems, to find and use information, and to work with others, as well as basic academic skills, thinking skills, and personal qualities.

Each of the eight industry standards considered at the conference contains some subset of SCANS-like skills. Problem solving and teamwork are the most common. The health standards list communication, systems, employability skills (conduct and appearance), ethics, and teamwork (Far West Laboratory, 1995, pp. 15-16). The metalworking standards include decision making, problem solving, group skills, and personal qualities (National Tooling and Machining Association, 1994).

The academic standards include similar sets of skills. The English standards are dominated by process-oriented skills that could easily fit into the SCANS list. The emphasis of the science standards is also consistent with the SCANS perspective. Understanding scientific concepts and developing inquiry skills are now emphasized more than simply knowing scientific facts (National Research Council, 1996, p. 113)

The mathematics standards call for increased attention to the active involvement of students in constructing and applying mathematical ideas and to problem solving as a means as well as a goal of instruction (National Council of Teachers of Mathematics, 1989). The history standards emphasize the development of historical thinking skills and historical understanding as well as knowledge of historical events (National Center for History in the Schools, 1996).

Since both types of standards call for strengthening problem solving, teamwork, inquiry, and communication, generic skills provide the most explicit common ground. This recognition is only a first step. Although context matters in acquiring skills and knowledge, the precise relationship between generic and specific skills is a puzzle. Problem solving, for example, is a complicated set of skills and processes that varies in different situations (Stasz et al., 1996). Further, much more needs to be done to establish appropriate measures and assessments for generic skills. The performance criteria developed by the New Standards Project to assess student progress in relation to its applied learning skills represent a promising start.

Using Standards to Facilitate the Integration of Academic and Vocational Education

One of the most interesting outcomes of the conference was that many participants developed ideas about using the two types of standards to design curricula that integrate academic and work-related education. One representative of a technical industry initially stated that he had very little to discuss with the developers of the history standards. He thought that his interest would be limited to science and mathematics. But after participating in a discussion of the history standards, he became convinced, much to his surprise, that the process of historical analysis called for in the history standards was much the same as the process of analytical problem solving that is required of a skilled technician in his field.

Many left the conference convinced that prior collaboration might have led to valuable improvements in both types of standards. Thoughtful interaction among academic teachers, vocational/technical teachers, and industry representatives can make the academic standards more concrete and raise the industry skill standards beyond the entry-level focus that has typified most efforts. Moreover, participants left the conference with the conviction that neither academic nor industry groups needed to compromise their standards in order to bring them into closer alignment with the each other.

RECOMMENDATIONS AND FUTURE DIRECTIONS

1. *Promote collaboration among employers and academic and vocational educators in the development of standards and in the use of standards to develop curricula.*

   When academic standards are divorced from the workplace context, they miss the motivational and pedagogic benefits that come from being embedded in a broad and coherent application. A better understanding of the workplace could help academic teachers plan curricula that would be both academically sophisticated and more closely related to the needs of the workplace. Teacher internships in business and other forms of exposure to the workplace are an important component of collaboration.

2. *Improve the definition and measurement of the levels of academic skills within the industry skill standards.*

   The low level of academic skills defined in the industry skill standards gives ambiguous messages to students. Employers state that they prefer high school graduates, yet the academic skills that they list can be learned short of high school graduation. Employers may not understand the specific benefits that students gain from high school and are, therefore, incorrectly specifying the academic content of skill needs. This is precisely the type of problem that improved collaboration could address.

   In many cases, the academic components of the industry skill standards are stated in such vague and abstract terms that they provide little guidance to educators and students. Thus, defining the academic content of the industry skill standards is an area that clearly needs much more work.

3. *Develop academic standards so that meeting those standards will indicate that a person is able to apply the relevant academic skills outside the classroom.*

   The National Skill Standards Board provides an institutional direction for the industry skill standards; the academic standards lack an equivalent national organization that can guide a general reevaluation. Some conference participants criticized the academic standards for being too focused on skills needed for a student to proceed to the next level of education rather than on the ultimate usefulness of those skills.

4. *Encourage the use of standards to promote the integration of academic and vocational education.*

   An integrated approach to teaching and learning can strengthen the academic base of work-related skills and can provide a context and motivation for learning academic skills. In the exercises conducted at the conference and in subsequent workshops, participants were able to develop integrate projects using standards that were not written with this goal in mind.

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5. ***Systematically experiment with different approaches to coordination of the two sets of standards.***

The bioscience and auto technician standards include matrices in which relevant boxes were checked when a given academic skill was used in a particular vocational task. A more difficult approach develops scenarios, or complex examples, that make use of academic and generic skills to accomplish tasks within the context of a given industry. The scenarios naturally integrate academic and vocational material and can lead easily to curricula and projects that can be used by teachers.

A more comprehensive approach would be to design the academic and industry skill standards together. It might make sense for academic teachers to develop a general framework for each discipline and then work with representatives from broad industry groups to develop comprehensive standards for each group. Some parts of the academic standards might not be affected, but the academic standards might evolve as teachers gained insights into how academic skills are actually applied in the workplace.

6. ***Use the development of standards and collaboration among standard setters to refine our understanding of generic skills and to develop better means to teach and assess them.***

Since generic skills vary in different contexts, it is important to go beyond the general descriptions and language of SCANS and understand the nature of generic skills in the different disciplines and industry settings. Without this specific information, it is difficult to translate the need for skills into a process that has meaning and application in the classroom. One productive strategy would be for representatives from the different groups to work together to develop more consistent methods of articulating, measuring, and assessing generic skills.

7. ***Focus on the development of appropriate teaching strategies and associated curricula and on effective ways to prepare teachers to use them.***

Standards can help define required skills and important teaching tools. Current pedagogy has been organized around compartmentalized curricula that preserve sharp distinctions among the disciplines, between academic and vocational learning, and even among different vocational areas. Neither the integration of academic and vocational education nor the development and use of standards have had a strong educational tradition in this country.

Combining an integrated educational approach with standards is even less common. A great deal of work remains to be done to determine the optimal form of the different sets of standards and the best ways to use them for teaching and learning. The reforms suggested here are unlikely to have any effect or even to be implemented unless we have a better understanding of the teaching strategies that would be required and unless we develop and use appropriate methods for preparing teachers to use these new strategies.

This Brief was developed at the Institute of Education & The Economy, Teachers College, Columbia University. It was drawn from a National Center for Research in Vocational Education (NCRVE) report of the same title, reference number MDS-1001. For copies of the report, contact NCRVE at (800) 637-7652.

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