

Summary

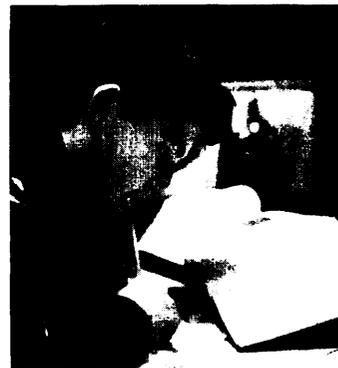
1

In 1990, Congress enacted amendments to the Carl D. Perkins Act requiring states **to measure the effectiveness of** vocational education and to set performance standards for vocational programs. The law requires using these standards to evaluate the effectiveness of local vocational education programs and stimulate “program improvement” efforts where deficiencies are found.

The requirements for standards and measures are part of a larger thrust in the 1990 amendments to strengthen accountability for vocational programs. Other reforms advocated in the legislation include integrating academics and vocational education, and creating “tech prep” programs. At the high school level, both involve reorganizing vocational programs around broader sets of academic and technical skills leading to advanced training and highly skilled jobs.

The requirements for standards and measures are likely to have a significant impact on the amount and type of *testing and assessment* occurring in vocational education. High-quality assessments are crucial; incomplete or inaccurate assessment results could lead to unfair or misleading conclusions about which local programs need improvement. And depending on which type of tests are used and how they are applied, the implementation of performance standards could either promote or impede the other reform goals of the 1990 law.

To help Congress determine whether better assessment instruments should be and can be developed for vocational education, section 423 of the Perkins Act directed the Office of Technology Assessment (OTA) to study tests used in vocational programs, particularly those designed to measure broad technical



2 Testing and Assessment in Vocational Education

skills. Congress asked OTA to analyze the uses of these tests, identify trends in vocational assessment, and identify policy issues relevant to improving test development and quality.

PURPOSES OF THE BACKGROUND PAPER

This background paper responds to the congressional request by providing a picture of general progress in vocational education assessment instruments and policies. The paper has six major purposes, each explored in greater detail in a subsequent chapter:

- to trace the evolution of federal accountability requirements in vocational education law and to explain the intent of the 1990 provisions (ch. 2);
- to profile current state testing and assessment policies in vocational education (ch. 3);
- to analyze how state assessment policies and practices are changing in response to Perkins Act requirements and to consider how these changes could affect both other reforms in vocational education and the nature of learning and instruction in vocational education itself (ch. 3);
- to describe some of the testing and assessment resources available to measure various kinds of occupational skills, including tests developed by three main vendors (ch. 4);
- to explore alternative approaches for defining, teaching, and measuring broad technical skills and to highlight issues that should be considered in moving toward assessments that meet needs identified by Congress (ch. 5); and
- to describe how the Department of Education has implemented performance standards (ch. 6).

In the course of describing this progress, the paper also raises a number of broader issues of how the policies of testing and assessment adopted by states and localities may turn out to

affect the implementation of performance standards, accountability in the federal legislation, and ultimately the nature and content of vocational education. Understanding these relationships is particularly important, because the purpose of the standards is to make decisions about the effectiveness of programs at the state and local levels.

It is also important to note that testing and assessment is conducted in vocational education for many purposes. These include instructional diagnosis, grading student performance, certification of student competence for employers, and various other policy purposes at the state and local levels. OTA's survey covered all practices of testing and assessment affected by state policy; not just testing and assessment tied to performance standards.

Defining Types of Skills

Several kinds of skills can be assessed in vocational programs, reflecting the multiple goals of vocational education. For purposes of this paper, OTA has grouped them into four types (see box 1-A). The first type are *academic skills*, primarily the areas of reading, writing, and mathematics. The other three types are various kinds of occupational skills: *vocational skills*, which tend to be job specific; *generic workplace skills*, which encompass employability skills such as positive work attitudes, as well as teamwork, effective communication, and other kinds of general workplace competencies; and *broad technical skills*, which are the core skills and understandings of technology, information, and organization needed to perform effectively within an industry or range of occupations.

Methodology and Limitations of This Study

This background paper draws on several resources. Although assessment practices in vocational education have not been the subject of much prior research, OTA reviewed the available studies. Of particular relevance were a 1992 study of state implementation of performance standards

Box I-A—Types of Skills Assessed in Vocational Education

Academic Skills

The knowledge and skills in the traditional academic subject areas of **English, mathematics**, science, history, and so forth that students are expected to acquire in school. In vocational programs, these skills may be tested for or assessed directly using standard methods or in the context of occupational problems or situations.

Occupational Skills

As used in this report, occupational skills refer to knowledge and skills other than academic needed to perform effectively in jobs; in other words, either vocational, generic workplace, or broad technical skills

Vocational Skills—The specific knowledge and skills required in the performance of particular jobs or groups of jobs within a certain occupational area.

Generic Workplace Skills—There are two types: employability skills, such as positive work attitudes and knowledge of how to find a job; and general competencies, such as ability to work in teams, communicate well with others, and solve problems. One definition of these general competencies is the five workplace competencies of the Secretary's Commission on Achieving Necessary Skills (SCANS).¹

Broad Technical Skills—The core skills and understandings of technology, information, organization, and economics needed to perform effectively within an industry or group of industries.

¹The five workplace **competencies** identified by SCANS are that effective workers can productively use resources, interpersonal skills, information, systems, and technology. Secretary's Commission on Achieving Necessary Skills *What Work Requires of Schools* (Washington, DC: U.S. Government Printing Office, June 1991).

by MPR Associates;¹ a survey of state competency testing in vocational education by Mississippi State University;² and a survey of state initiatives for industry skill standards by the National Association of State Directors of Vocational Education.³

To obtain more information on current state testing practices and proposed changes, OTA conducted a survey of the 50 states and the District of Columbia, following up with telephone interviews. OTA also conducted case studies of three major test vendors in vocational education.

This paper is exploratory, intended to provide basic descriptive information and point to direc-

tions for future policy analyses. Many of the issues raised are complex and will require further study. For example, data on test use are not available for special populations of students, an area of keen congressional interest. More extensive study of local assessment practices in vocational education would also be beneficial. Because states vary greatly in their influence on local assessment practices, state surveys can provide only a partial view of local practices.

Over time, the testing and assessment approaches and instruments chosen by states and localities will vary. Careful attention to the effects of these choices on the implementation of performance standards and on the nature of curricu-

¹ Mikala L. Rahn et al., MPR Associates, Inc., "State Systems for Accountability in Vocational Education," prepared for the U.S. Department of Education, Office of Vocational and Adult Education, December 1992.

² Rebecca Love-Wilkes and Ronda Cummings, Research and Curriculum Unit for Vocational, Technical, and Adult Education, Mississippi State University, "1990 State of the Art Report on Statewide Student Competency Testing in Vocational and Technical Education," prepared for the National Network for Curriculum Coordination in Vocational-Technical Education and the Southeast Curriculum Coordination Center, October 1990.

³ Barbara Border, *Education-Driven Skill Standards Systems in the United States*, prepared for the U.S. Department of Education (Washington, DC: National Vocational Technical Education Foundation, October 1993).

4 Testing and Assessment in Vocational Education

lum and instruction in vocational education will be required to determine whether the legislative goals have been reached.

EVOLUTION OF PERFORMANCE-BASED ACCOUNTABILITY IN FEDERAL VOCATIONAL EDUCATION LAW

The current requirements for performance standards and outcome measures are the most recent stage in the evolution of accountability requirements in the federal vocational education law. Every major vocational education law since the Smith-Hughes Act of 1917 has included accountability requirements, but the tools for achieving accountability have become more outcome-oriented over time.

In the early years of federal support, when the primary goal was to encourage growth in vocational education, accountability was enforced by regulating program “inputs.” States were directed to establish and adhere to minimum requirements for vocational teacher qualifications, classroom equipment, and instructional hours per week. These requirements gave federal program administrators a tool that they wielded aggressively to shape the growth of vocational education, thereby helping to establish the concept of federal funds as carrot and stick.

The first attempt to define and look systematically at outcomes of vocational education occurred with the Vocational Education Act of 1963, which introduced a requirement for periodic evaluation of local programs. Program offerings were to be reviewed in terms of “. . . current and projected manpower needs and job opportunities . . .” in relevant occupational fields; however, the law did not specify how these reviews were to be conducted. The 1968 amendments took another step toward defining outcomes by limiting federal support to local programs that could be demonstrated “. . . to prepare

students for employment . . . or be of significant assistance [to students] in making an informed and meaningful occupational choice.’ In this way the amendments emphasized that the primary purpose of vocational programs was to provide students with the specific skills needed for real jobs, not just with general learning in the manual arts.

The 1976 law further sharpened the focus on outcomes by specifying that the mandated local program reviews should examine the extent to which program completers and leavers: a) found employment in occupations related to their training, and b) were considered by employers to be well trained.

The Perkins Act of 1984 explicitly directed states to develop measures of program effectiveness, such as the occupations to be trained for, the levels of skills to be achieved, and the “. . . basic employment competencies to be used in performance outcomes, which will reflect the hiring needs of employers . . .” (section 11 3). Foreshadowing the current movement to define skill standards for various industries, the 1984 law also required states to establish technical committees of business and industry representatives; these committees were to develop inventories of skills for “priority occupational fields,” which could be used to ‘define model curricula.

By 1990, Congress had concluded that prior calls for change had not spurred significant improvements in the quality of vocational education. Influenced by experiences with outcome-based accountability in other federal education and training programs, Congress amended the Perkins Act to require states, within 1 year, to develop and implement statewide systems of “core standards and measures” that defined the student outcomes expected in local programs.

In delineating the types of outcomes that states could select, Congress endorsed a broad view of the purposes of vocational education that encom-

⁴ 77 Stat. 406.

⁵ 82 Stat. 1076.

passed academic achievement, dropout prevention, and preparation for higher education, as well as job preparation. Thus, the law states that the standards must include a minimum of two outcome measures: 1) a measure of learning and competency gains, including student progress in basic and more advanced academic skills; and 2) a measure of one or more of the following—job or work skill attainment or enhancement, school retention or secondary school completion, placement into a job, additional training or education, or military service. State systems also are required to include incentives or adjustments that encourage service to special populations, although the legislation offers no guidelines on how this should be done.

By including academic outcomes in the performance standards and placing priority in other parts of the legislation on integrating academic and vocational education, Congress signaled a major, new direction of federal policy on vocational education. The intent of the policy is that students who take vocational education should have the same academic knowledge and skills as other students. It is a statement that students who graduate from vocational programs should be as well equipped for their future lives of work and learning as other students.

The 1990 legislation marks a significant turning point in federal accountability by explicitly tying the process of state and local review to standards based on outcomes. Beginning after 1993-94, each local recipient of Perkins Act basic grant funding must use the statewide standards and measures to evaluate annually the effectiveness of its vocational programs. (Local recipients may use federal funds, to a reasonable extent, to conduct these reviews.) Eventually, local recipients who are not making substantial progress toward the standards must develop a “program improvement” plan identifying changes to be made in the following year.

The requirement for standards is also significant as much for what it does *not* require as for what it does. First, Congress did not authorize the Secretary of Education to issue national standards and measures, but instead gave states considerable flexibility to design their own systems and select from a range of outcomes. Only two outcome measures are required. (In practice, however, most states have adopted multiple standards and measures.)

Second, the main purpose of the performance standards is to make decisions about programs. The results of the performance standards are specifically tied to the annual review requirement, which has been in the federal legislation for some time. The standards are not intended to certify or credential individuals. (This is in contrast to current proposals for industry skill standards, which would be used for individual credentialing.) Although testing of students will be necessary to satisfy some of the performance standards developed by the states, the law makes clear that the results are to be used primarily to evaluate and improve local programs. It is up to the state to decide whether to implement performance standards as a system of student certification or to incorporate student certification functions into their overall plan. According to the OTA state survey, at least two states, Pennsylvania and New Jersey, have chosen to implement performance standards as systems of student certification.

Third, Congress chose not to link the vocational education performance standards to federal funding or any other incentives or sanctions. As House and Senate reports make clear, no authority exists for states “. . . to apply sanctions in connection with the utilization of measures and standards at the local level.”⁶ The mild consequence that was attached to the local program evaluations—state intervention through joint state-local program improvement plans—was not intended “. . . to be punitive in nature, but rather to

⁶ U.S. Congress, House Committee on Education and Labor, “Applied Technology Education Amendments of 1989,” H. Rept. 101-41, Apr. 28, 1989, p. 4.

6 Testing and Assessment in Vocational Education

encourage an infusion of resources from the state [for] programs that are in need of assistance and improvement.

Fourth, the legislation is not intended to position Congress as the distant, final judge of local processes. Thus, the local level, not the federal level, is the primary arena for conducting evaluations, reviewing evaluation data, and carrying out program improvement (with the involvement of the state if needed). The act does not require recipients to submit the results of evaluations to the Secretary, nor does it direct evaluation results to be structured so as to yield a national database on program effectiveness or a national system of performance standards. National information needs are to be met through other mandated studies and research.

In passing the legislation, there was some support in Congress for encouraging or even requiring the development of a national system of performance standards for vocational education based on the performance standards to be developed by the states. Congress decided to provide states with a great deal of flexibility in defining their performance standards and not require the development of a national system. The issue was resolved by including in the final legislation a study to evaluate the quality and comparability across states of the performance standards and measures adopted by the states. The presence of the study suggests that, in the future, consideration could be given to forming a national system of performance standards for vocational education. In considering such a step, two of the important criteria could well be the extent of agreement among the states on vocational outcomes and their capabilities for measuring those outcomes.

Both the flexibility given the states and the possibility of expanding the performance standards into a national system lead to a number of

important future policy questions. States will have to make difficult decisions on outcomes with a great deal of latitude and not much experience. It is an open question whether information from student testing and assessment will prove to be useful for making decisions about improvements in local programs. It is also an open question whether the performance standards and measures developed for local program improvement could or should be used to develop a common core of competencies and indicators at the national level. Finally, it is an open question what the effects on the nature and content of vocational education may be from using testing and assessment information for purposes of accountability, especially given the imperfect quality of the available methods and instruments of testing and assessment. At this point, the effects are impossible to predict.

TESTING AND ASSESSMENT RESOURCES IN VOCATIONAL EDUCATION

The federal legislation is silent about the types of testing and assessment resources needed to measure student outcomes and implement performance standards. Nevertheless, the new requirements will place substantial burdens on state and local testing and assessment instruments, programs, and practices. It seems clear that the capacity for testing and assessment must increase in response, but by how much and in what direction is uncertain. Because there has been little systematic research on vocational education testing and assessment issues, it is not even clear what resources currently exist, what the range of testing practices is, and how these practices compare with the rest of education. As a starting point, OTA pulled together existing information on testing resources in vocational education and conducted a survey of state practices.

⁷U. S. Congress, **Senate Committee on Labor and Human Resources**, "Carl D. Perkins Vocational Education Act Amendments of 1989," **S. Rept.** 101-221, Nov. 21, 1989, pp. 22-23.

Overview of Testing in Vocational Education

After reviewing evidence from its state survey and other research, OTA concludes that **testing and assessment practices in secondary vocational education differ considerably from the rest of education in their features, origins, and applications. In fact, the best assessment practices in vocational education resemble the alternative forms of assessment just now being explored for the rest of education.** However, the quality of these assessment practices varies greatly among states and localities.

Like the rest of education, vocational education programs use both written, short-answer forms of testing and diverse methods of performance assessment, but vocational education relies much less heavily on short-answer methods of testing and more on assessment. The answer formats of the written tests are typically matching or multiple choice. A growing amount of this written *testing*, as it will be called, is done using either instruments that are centrally developed by states or test vendors, or locally adapted forms of those instruments (see box 1 -B). The centrally developed instruments are produced through iterative cycles of writing and revision, but the resulting instruments are typically much less standardized and easier to adapt than are the highly standardized and secure tests that are so common in academic education. Further complicating the picture, most of these centrally developed instruments include both written and performance exercises: however, when they are used, the written portions generally predominate. At the local level, teachers may also prepare and use their own written tests. The centrally developed written tests and the adapted versions of them produced at the state and local levels are the focus of this report rather than locally produced written tests.

The diversity of assessment methods utilized is broad. The range includes the preparation of student profiles and portfolios, structured teacher ratings of student capabilities demonstrated in the course of regular classroom work, evaluated student projects, and even organized competitive events.

In contrast to the rest of education, both the written testing and the diverse forms of assessment used in vocational education are nearly all *criterion-referenced* rather than *norm-referenced*—meaning that they are designed to measure whether students have the knowledge and skills needed for particular jobs rather than how they perform relative to other students.

The testing and assessment done in vocational education stems from very different origins than testing and assessment in academic education. The roots of standardized academic testing lie in the mental testing movement in psychology and education.⁸ The source of testing and assessment in vocational programs is the *competency-based* movement in vocational training. In properly conducted competency-based vocational education, the curriculum content, test items, and performance exercises are derived from analyses of actual tasks performed by people in specific jobs or occupational areas. Ideally, there is a very close alignment of instruction, assessment, and job tasks. As a result, teachers have a much more central role in judging student performance than in standardized academic testing.

In the best competency-based programs, it is skills learned, not time spent, that drives the pace of instruction for individual students. In this respect, the philosophy of competency-based instruction and assessment is wholly different from the philosophy of whole-class instruction with mass testing at fixed points in the curriculum. **In vocational education, testing and assessment are not after the fact, external processes of inspection but integral parts of the**

⁸U.S. Congress, Office of Technology Assessment, *Testing in American Schools: Asking the Right Questions*, OTA-SET-5 19 (Washington, DC U.S. Government Printing Office, February 1992), ch. 4.

Box 1-B--Glossary of Testing Terms

Competency Testing

Competency testing is the administration of written tests to determine whether students have the knowledge and skills required to perform effectively in a job or occupational area. The individual items of the test are derived from analyses of the specific tasks involved in performing those jobs. The answer format of these tests is typically closed ended, that is, multiple choice or matching. The results of the testing maybe used for purposes of improving instruction or instructional programs, documenting or reporting student achievement, or certifying student capabilities to employers.

competency Assessment

This type of assessment uses one or more methods of observation, rating, and recording of actual performances to determine the **capabilities of students** for performing well in a job or occupational area and conveying the results to others. The **performances** observed and rated may be part of the student's regularly assigned classroom or project work, an organized event of some kind, or occur in response to a problem or task situation especially assigned for the purpose of assessment. Student performances are typically rated or evaluated according to a structure of valued competencies derived from the analyses of the tasks actually performed on the job and a scale of performance levels. The preparation of student profiles, portfolios, or other forms of documenting the results of the assessment and explaining the students' performances maybe part of the assessment process. The results of the assessment may be used for purposes of improving instruction or instructional programs, documenting or reporting student achievement, or certifying student capabilities to employers.

Academic Testing

In academic testing, written instruments are used to measure the knowledge and skills of students in the traditional academic subject areas of mathematics, writing, science, literature, history, and so forth. The answer format of these tests is typically multiple choice, matching, or some other such closed-ended form of response.

process of education—a goal only now being advanced in academic education.

In the competency-based tradition, assessment includes carefully designed performance exercises or tasks, instructor or juried assessment of completed student projects, and teacher assessment of regular classroom work using systematic methods of rating. There is also a strong tradition of organized events in which students compete for recognition and reward. The competency-based model attempts to systematize these various forms of performance assessment by providing the instructor or judge with performance scales and lists of valued competencies that can be “checked off” or rated as students perform various tasks on demand or over a period of time.

For a number of years, interest has also been **growing** in vocational education in the idea of providing students with profiles of their competencies and encouraging them to build portfolios of their accomplishments to use in job seeking.

Conclusions cannot yet be reached about whether these various methods of performance assessment used in vocational education are more or less reliable or valid than the written testing that is done. Before conclusions can be drawn about which methods are best for which purposes, closer investigations must be conducted in vocational education of the consistency and relevance of different assessment methods, and their actual applications in vocational education.

Standardized Testing

Standardized tests use written instruments that are developed according to principles of test theory and administered according to uniform procedures to provide comparability of results among test takers. Standardized testing is principally used to measure academic achievement.

Performance Assessment

In performance assessment, student performances are rated in response to an “on-demand” task; that is, all students respond to the same task (or prompt) that has been given to them expressly for the purpose of observing and evaluating their capabilities for performance in certain areas. The tasks are developed through iterative cycles of trial and revision. Performance assessments may be academically or occupationally oriented. The tasks imposed are generally situated to simulate real environments and are *open ended* in that students may respond to them in many different ways. They also typically involve more complex levels of thinking and doing than are possible with closed-ended testing.

Criterion-Referenced Tests or Assessments

These tests or assessments focus on “... what test takers can do and what they know, not how they compare to others.” Criterion-referenced tests or assessments are designed to show how a student is doing relative to competencies required on the job or specified educational goals or objectives.¹

Norm-Referenced Tests

These tests are designed to compare one student’s performance with the performances of a large group of students. Norm-referenced tests are developed to make fine distinctions between students’ performances and accurately pinpoint where a student stands in relation to a large group of students. Assessment is almost by definition not norm referenced.²

¹ U.S. Congress, Office of Technology Assessment, *Testing in America’s Schools: Asking the Right Questions*, OTA-SET-519 (Washington, DC: U.S. Government Printing Office, February 1992), pp. 169-170.

² *Ibid.*, pp. 168-169.

The critical issues in *performance assessment* are the comparability of judgments from instructor (or to instructor and program to program, and the correspondence of those judgments with any standards that have been set. In some cases, business representatives or parents may be involved. With sufficient training for judges, group methods of judging, and statistical checks on the consistency of ratings, it is possible to achieve satisfactory levels of consistency in rater judgment across units in performance assessment.

The critical issues in *written testing* are the relevance of test items to capabilities for actual job performance and the long-term effects of the testing method on teaching and learning in vocational programs. Written test formats are

generally thought to be best for measuring factual knowledge and certain forms of cognition and reasoning, which may or may not be closely related to ‘know-how’ and capabilities needed for complex and extended performance in the workplace (and in life).

Resources From Test Vendors

Test vendors supply some of the testing and assessment materials used in vocational education. Three of the best known testing organizations in vocational education are the Vocational-Technical Consortium of the States (V-TECS), the National Occupational Competency Testing Institute (NOCTI), and American College Testing (ACT). NOCTI produces the Student Occupa-

10 Testing and Assessment in Vocational Education

tional Competency Achievement Testing (SOCAT) materials. ACT is in the early stages of marketing a new testing program called Work Keys, which measures general workplace competencies. The testing and assessment products of these three organizations are distinctly different.

V-TECS and NOCTI utilize structured methods of job analysis to develop competency-based materials for vocational education assessment. Both organizations produce performance exercises as well as short-answer written test items, although more extensive resources are available for written testing.

NOCTI is the more conventional of the two. The tests it develops and sells to states and local programs are secure, consisting of fixed sets of items derived from job analyses in relevant fields. The SOCAT tests produced by NOCTI are available for 71 specific occupations.

V-TECS, by contrast, does not sell “tests,” but instead provides its 23 state members and constituent local programs with 35 different “test item banks,” which they may use to construct tests reflecting their own state or local priorities. (V-TECS testing materials are also available for purchase by nonmembers.) Each V-TECS item bank is specific to a job area or occupation. Items are scrutinized for occupational relevance and possible bias and pilot-tested for consistency of response. The initial development of V-TECS materials is done by vocational education agencies in member states.

V-TECS also makes available lists of competencies and performance standards by occupation. These V-TECS catalogs, as they are called, are available for over 200 occupations.

In the OTA state survey, state personnel frequently reported devoting substantial efforts to adapting, redeveloping, and expanding V-TECS catalogs and item banks, or using them in conjunction with competency lists, tests, or items from other sources. The most common reason given for doing so is that neither the V-TECS

materials nor those from other sources adequately reflect state and local priorities among different areas of knowledge and skills. Whether this reinvention and adaptation is genuinely useful or merely duplicative is impossible to say from the data available. Local priorities undoubtedly differ from state and national ones. Moreover, several studies have found that the process of reinvention is essential to the thorough implementation of innovations—’ ‘to understand is to invent.’ Still, questions remain about whether this reinvention affects the comparability of assessment results from place to place and how much of it is really necessary.

The new battery of Work Keys tests being developed by ACT differs from the V-TECS materials in some important respects. The Work Keys tests generally fit the basic model of “‘written testing,’ because of the thoroughness with which they are being developed, their requirements for standardized administration, and their centralized scoring and secure nature.”⁹ But several of the Work Keys tests involve innovative methods of response, such as listening to audiotapes and transcribing what is heard, viewing videos to provide a context for extended forms of multiple-choice questions, and watching demonstrations to assess learning from observation. The Work Keys system is just now being implemented in several states and local programs.

The main innovation of Work Keys is its focus on general workplace competencies, such as “‘applied technology” and “‘teamwork,” rather than on job-specific skills. ACT plans to provide a means to compare profiles of skills needed in different job areas with profiles of knowledge and skills demonstrated by test takers. In short, Work Keys uses a different approach from V-TECS and SOCAT to link test content with job skill requirements.

How much influence do these three major vendors have on testing and assessment practices in vocational education? Available evi-

⁹ ACT plans to offer local scoring of the Work Keys tests as an option in the future.

dence suggests that their impact is limited so far. V-TECS currently appears to be having the greatest influence through its deliberate strategy of modeling good competency testing practices and providing resources that states and local programs can use to develop their own assessment programs. Not all states belong to V-TECS, however, and V-TECS has tests for only 35 of the more than 200 occupational areas in which job competencies have been defined.

The most concrete estimates of the number of students taking vendor tests are available for the SOCAT tests, which are returned to NOCTI for scoring. Although NOCTI has many other clients for its testing products, the number of SOCAT test takers in schools is not large. For 1992, NOCTI reports that 9,015 secondary and post-secondary students took SOCATs; in that same year about 720,000 high school seniors were vocational students.¹⁰

Work Keys is too new to say how extensive its impact will be, but at least two states, Ohio and Tennessee, have adopted portions of it for state-wide use, and many more are considering it.

CURRENT STATE ASSESSMENT POLICIES IN VOCATIONAL EDUCATION

State vocational education agencies are another source of testing and assessment resources for vocational programs. Through its survey and other studies, OTA has collected basic descriptive information about state assessment policies for vocational education as another means of determining the resources available for vocational education assessment.

Based on its survey and other evidence, OTA finds that state testing policies for vocational education are quite different from state testing policies for elementary and secondary education in general.

At the elementary and secondary levels, state Departments of Education commonly fund and

operate programs for mass testing of students at various grade levels in various subjects. The purpose of much of this testing is to demonstrate accountability, and results are reported to the public.

By contrast, no state vocational education agencies directly administer a program of mass testing or assessment of all students at a fixed point in time. In most states, the primary assessment responsibility of the agency is to set policies for local programs to follow. Most state agencies also provide assessment resources to local programs, such as competency lists, test item banks, and tests with instructional materials. The main purposes of these state policies are to evaluate programs and courses, and assess and certify student progress—not to demonstrate accountability.

Categories of State Policies

Responses to the OTA survey reveal a variety of testing instruments and policies among the states. The 50 states and the District of Columbia reported a total of 92 different components of testing or assessment for academic skills and the 3 different kinds of occupational skills in their state programs, or an average of about 2 per state. Generally one of these components is for academic skills and the other is for occupational skills. Some states have more than one component of testing or assessment in each of these areas.

OTA finds that state assessment policies can be grouped into four distinct categories:

1. Eighteen states *mandated or strongly encouraged written forms of competency testing* for occupational skills in local programs in the 1992-93 school year.
 - All of these states favor written methods of testing over alternative forms of assessment for occupational skills.
 - All provide local programs with competency tests or access to a competency test item bank.

¹⁰ Vocational students are defined as students who took more than four credits of vocational education in [their high school careers.

1 2 Testing and Assessment in Vocational Education

- These states enroll about one-half of all high school students.
 - Approximately one-half of them are known as leaders in the development of competency-based testing in vocational education.
 - The sophistication and comprehensiveness of the testing programs in these 18 states varies greatly. Some have comprehensive programs of testing and assessment consisting of three or four components, such as a competency-based test item bank and supporting resources for over 50 occupations; student profiles or portfolios; and a strategy for obtaining the test scores of vocational students from the statewide academic testing program. Other states in the category may only offer local programs a single written test of employability skills.
2. Fifteen states *mandate assessment* of occupational skills in local programs without specifying how this should be done.
- These states tend to encourage a diversity of approaches to assessment without favoring some methods over others. Various forms of *assessment*, rather than written testing, are generally encouraged.
 - All of these states require assessment of the occupational skills of students, but allow local programs to choose their own method or methods.
 - These states are much less likely to provide local programs with competency tests or item banks than states in category 1, and are more likely to provide materials for developing student profiles or portfolios.
 - These states enroll about one-quarter of all high school students.
3. Ten states *encourage assessment* of occupational skills in local programs without specifying how this should be done.
- Like the previous category, these states encourage diverse approaches to assessment rather than written testing.
- Testing and assessment are only encouraged, not required. The encouragement given to testing and assessment is generally not strong.
 - The only assessment resource that these states are likely to provide local programs is testing or assessment materials that come with instructional resources for a competency-based curriculum.
 - These states enroll about one-eighth of all high school students.
4. Eight states had *no specific policy or program* in school year 1992-93 to encourage or require testing or assessment of occupational skills.
- In 1992-93, these states provided no resources to local programs for assessing occupational skills.
 - Most of these states have established performance standards to comply with the Perkins Act through using measures that do not require information from testing or assessment, or by deferring adoption to their local programs.
 - These states enroll about one-eighth of all high school students.

Types of Skills Assessed

State assessment policies for vocational education cover the four types of skills described earlier—academic, vocational, generic workplace, and broad technical skills (see box 1-A).

Vocational skills—in other words, job-specific skills—are the type most commonly assessed, followed by academic skills. All 43 states with an occupational assessment policy (those in the first three categories above) have a policy for requiring or encouraging assessment of vocational skills.

In the first three categories, 31 states also have in place a policy for assessing the academic skills of vocational students. In addition, all eight states in the fourth category have policies for assessing the academic skills of vocational students. States have apparently responded rapidly to the Perkins

Act requirements for academic outcome measures. The OTA survey was conducted in 1992-93, the school year when most states began implementing standards and measures as directed under the Perkins Act.

Far less frequently addressed are generic workplace skills. Only seven states in the first three categories had policies for assessing generic workplace competencies, and these assessments were typically administered along with assessments of vocational skills rather than being conducted separately.

Broad technical skills are scarcely addressed at all in state policies; only one state emphasized assessment of these skills in the 1992-93 school year.

Use of Assessment Results

States use the results from assessments of occupational skills differently than they use results from assessments of academic skills, according to respondents to the OTA survey. For occupational skills, testing and assessment information are used most often to evaluate instruction and progress in learning, or assess student attainment for course or program completion or certification. The second most frequent use is for accountability, including accountability under the Perkins Act. The third most frequent use is for making decisions about the improvement of courses, programs, or schools.

For academic skills, information from testing and assessment is used most often to meet accountability requirements included under the Perkins Act; second most often for student assessment or credentialing; and third most often to improve programs, courses, or schools. Virtually no assessment components for either academic or occupational skills are being used to meet accountability requirements other than those under the Perkins Act.

There are two important conclusions here. First, for-both academic and occupational skills, **the least likely use of testing and assessment**

information is to improve programs-even though this is the main purpose of the Perkins performance standards. The reason is unclear; perhaps the information being used is not in a useful form for program improvement or there may be a lack of knowledge about how the information can be used and experience in doing so. Also, data from performance standards will not start to become available in most states until 1993-94, after the first year of operation.

Second, **information about students' academic skills is substantially more likely to be used for purposes of accountability alone than it is for assessing student progress or improving programs. This** finding suggests that state policies for assessing academic skills may have been adopted primarily to comply with the Perkins Act. This indicates that either policies of testing and assessment for academic skills are still in the early stage of implementation, or the academic information being obtained is even less useful than the occupational results for improving programs.

Strategies for Obtaining Assessment Information

Strategies to obtain assessment information vary among states and according to whether academic or occupational skills are being tested. In general, assessments of occupational skills are much more closely tied to local vocational curricula and instruction than assessments for academic skills.

To obtain information about academic skills of vocational students, most states have chosen to use scores from their centrally administered statewide testing program rather than develop new, locally based strategies more closely related to their vocational programs. Of the 31 states that test for academic skills, most use either a state minimum competency exit examination or another test administered statewide at a particular grade level; 26 of the 40 different state academic testing components reported in the OTA survey

were of these two types. Typically these exams are administered in the 9th, 10th, or 11th grade; however, some states are using test score information from the 8th grade. Under these circumstances, it is very hard to see how one could use the information about students' academic skills to improve vocational programs. Most vocational courses are in the 11th and 12th grades.

In contrast, information about occupational skills comes from assessment programs that are either tied to students' completion of a course or course sequence, or are ongoing in the vocational curriculum; 31 of the 54 occupational testing components reported in the OTA survey fit this model.

The relationship between the occupational assessment program and the vocational curriculum varies significantly by state. States that encourage occupational testing—those in category 1 above—strongly tend to focus their testing on completion of courses or course sequences (mostly the latter). States that mandate occupational assessment—category 2—are split between those that focus on the course completion and those in which assessment is ongoing. States that encourage occupational assessment—category 3—tend to use ongoing assessment.

Questions arise as to how states will coordinate dissimilar information from academic and occupational testing to carry out the new program improvement requirements.

EMERGING STATE RESPONSES TO PERKINS PERFORMANCE STANDARDS

The OTA survey also asked states about their plans for expanding, contracting, or continuing their current assessment policies for all four kinds of skills over the next 3 years. Questions elicited details on new components to be added, changes in skills to be assessed, and populations and programs to be tested or measured. The states were also asked about the extent to which they are responding in their expansion plans mainly to the Perkins mandate for performance standards, state

educational reform initiatives, state workforce initiatives, or other sources. Questions were structured to determine whether the plans are definite or tentative.

Expansion of Testing and Assessment

The results show that states clearly are planning substantial expansion of their assessment programs and policies. Most of the increase will be due to expansion of existing testing and assessment components, although some states will also add new components. Forty-eight of the 92 testing and assessment components currently in effect are slated for expansion by 1995 and 20 new components will be added. The remaining components will stay the same or nearly the same.

The nature of the changes proposed varies greatly. Some states are planning only minor additions or modifications to existing programs, while others are planning comprehensive new systems. Ohio, for example, will implement an ambitious expansion of its 28-year-old Ohio Vocational Competency Assessment Program (OVCAP). OVCAP will be expanded to include three new tests for generic workplace skills from the Work Keys system (which the state piloted in 1992-93), along with new or revised competency-based tests in at least 63 occupational areas. Ohio is also changing its policy to strongly encourage competency-based tests in all local programs; in the past, these tests have been made available only to local programs that requested them. In addition, the state office of vocational education will obtain scores of vocational students on the Statewide Ninth Grade Proficiency Exam. At the other end of the spectrum, several states are planning only to increase the number of occupational areas covered by their current assessment programs.

Changes in Written Testing and Performance Assessment

Several states intend to shift to written testing for occupational skills and away from

assessment. This trend may be a significant and apparently unintended consequence of the Perkins Act mandates for performance standards.

There will be eight new components of written testing for occupational skills among the states and three new components of assessment; however, two existing occupational assessment components will be eliminated for a net gain of one new component of assessment and eight of written testing. Essentially this means that occupational skills will be measured more like academic skills are now, largely through short-answer tests.

A major issue is how this shift toward written testing will affect the character and content of vocational education. Vocational programs are one of the last places where written testing would seem to provide better information than performance assessment for most purposes. For example, the results of performance assessment consistently have been found to be more directly related to competence on the job than competency testing.

Research also has shown that the imposition of high-stakes, standardized testing for basic skills can narrow the range of skills taught by teachers and learned by students in regular academic classrooms. **Presumably the same kinds of effects could occur in vocational education over the long term, with the content of teaching and learning shifting away from development of more complex skills toward acquisition of factual knowledge, and away from active student production toward classroom lecture. The effects on the character of vocational education could be profound.**

There is very little good research on the instructional effects of written testing versus performance assessment in learning environments like those found in vocational programs, so it is not possible to come to any firm conclusions about the issue. One of the best known pieces of research is an article on training in the military, which gives examples of dramatic effects on

learning goals and activities that occurred when performance assessment was substituted for written testing in training environments. When this happened, classroom lecturing on topics such as the muzzle velocity of guns greatly diminished, desks were removed, and students spent much more of their time repairing equipment than they were supposed to be learning how to repair. The performance of students in repairing equipment sharply increased.

It is ironic that written testing methods appear to be expanding in vocational education at the very time questions are being raised about the effectiveness of standardized testing in the rest of education, and experimentation with performance assessment is flourishing. One of the reasons for this is to assess more complex cognitive skills than can be assessed with written testing. Another important issue is how states will coordinate dissimilar information from academic and occupational testing for purposes of program improvement.

Changes in Skills Assessed

State policies are also changing with regard to the types of skills to be measured (see box 1 -A). **The greatest expansion will occur in testing or assessment of vocational skills—the job-specific skills conventionally taught in vocational programs.** Testing for vocational skills will expand in 35 of the 50 state components that addressed these skills in the 1992-93 school year. In addition, five new components for vocational skills will be added by 1995.

Assessments of generic workplace skills are expected to increase at a high rate from 8 components to 22, although 17 of the 22 will assess generic workplace skills in combination with other occupational skills.

Assessment of broad technical skills will expand five-fold but will still be the smallest category of testing. There are several reasons for this. One is the lack of clarity about the nature of these skills and the scarcity of instruments and

methods for assessing them. Another is that more emphasis has been placed on integrating academic and vocational education than on reorganizing vocational curricula around broad technical skills. Interest in broad technical skills is mounting, however. The 1990 amendments identified “applied technology, ’ or applied academics, as a theme for vocational education and stressed the need for vocational students to learn about “all aspects of industry. ’ The strongest indication is in the legislation pending before Congress to develop voluntary national industry skill standards, where emphasis would be placed on orienting skill training around clusters of broad occupational skills; supporters contend that this will improve the quality of training, with long-term payoffs for workers and the economy as a whole.

The area with the slowest growth of testing and assessment will be academic skills. Ten states will add academic skills for the first time, but in states that already assess academic skills, expansion is planned for only 17 of 41 components; the other 24 components are not slated for change. This is somewhat surprising, in light of the new Perkins provisions, especially the directive for performance standards to measure gains in student academic skills over time. Test score gains are generally much more difficult to measure than achievement at a single point in time, especially in a mass testing program. It is hard to see how, as many states are doing, test score data from a minimum competency exam given at one point in time or from a state test administered in a single grade can be used to show gains in student academic skills.

■ Effects of New Policies on Vocational Reform

A key issue is how these state changes in testing and assessment changes will promote or impede the other reform goals of the revised Perkins Act, such as integrating academic and vocational education and broadening preparation in technical skills. **It may well be the case that**

academic and vocational education are being driven further apart rather than closer together by the responses of states to performance standards. Resolving this problem will require efforts by the states to develop assessment methods that are more compatible and consistent with the goal of academic integration.

As noted above, states are using different approaches to measure academic and occupational skills. Most states are relying heavily on norm-referenced, standardized tests to measure academic skills, and on locally adapted and criterion-referenced tests to assess occupational skills. Testing for academic skills is also predominantly written, while occupational skills are being measured through a mix of performance assessment and written testing. Academic testing is centralized and conducted statewide at fixed grade levels, while occupational testing is highly decentralized and tied to the local structure of course and program completions. In addition, most of the academic testing occurs in the 9th, 10th, and 11th grades, while the majority of occupational testing occurs as students complete courses or programs, mostly in the 11th and 12th grades. It is hard to see how academic test information collected in grades 9 through 11 can be used to monitor and/or support the integration of academic and vocational education at grades 11 and 12.

In addition, the information from standardized academic tests is often in the form of “rank in class, ’ while the information on occupational skills may be much more performance oriented and competency specific. It is hard to see how such information can be used systematically for the highly localized school-by-school, program-by-program, and teacher-by-teacher nature of the efforts required to integrate academic and vocational education.

In short, there are formidable problems in reconciling and properly interpreting test scores for purposes of monitoring and improving vocational-academic integration. Inattention to these difficulties could lead to serious misuse of test

results. If the content of the statewide academic tests does not reflect the academic content of the programs being integrated, the tests results could give a misleading impression of the success of the efforts.

DEFINING AND ASSESSING BROAD TECHNICAL SKILLS

The implications of organizing vocational programs around broad technical skills are far reaching. Large segments of vocational education are now competency based and oriented to preparing students for specific jobs or job areas. Broad technical skills, by contrast, tend to be clustered around an industry or industry group—examples include health care, financial services, manufacturing, hospitality, and agribusiness. Broad technical skills could even be defined to include historical knowledge of the social and economic development of the industry. Thus, organizing vocational education around broad technical skills could direct more of the vocational education effort to preparing people for careers and on-the-job learning, rather than for specific entry-level jobs.

Data from the OTA survey indicate that organizing vocational education around broad technical skills is a relatively low priority among state and local programs; most vocational programs continue to be oriented toward occupationally specific competencies. Only 1 state assessment component out of 92 current components is oriented primarily to broad technical skills; by comparison, 51 components focus on vocational skills. Only four more components in broad technical skills are planned for the next few years.

A major reason for this low priority is the lack of existing models to illustrate what broad technical skills are and how they can be taught. There are no clear alternatives to the job competency model, which drives prevailing perceptions of the nature of skill, provides the basis for developing

curricula and tests, and generally frames vocational education and much of the training enterprise. Concepts of broad technical skills must be defined before assessment programs and methodology can be developed and validated.

As a first step toward developing concepts of broad technical skills, OTA has identified five alternative approaches, founded on substantially different assumptions about the relationships between general and specific skills and between foundation and more advanced skills. These five alternatives are vocational aptitudes, core occupational skills, occupational maps, design and technology, and cognitive skills.

■ Vocational Aptitudes

Vocational aptitude methods reflect a theory that people perform best in jobs for which they have strong abilities, and that these abilities are identifiable through tests. Vocational aptitude tests have been developed by commercial publishers, the military, and others; these tests are used to select people for jobs or training programs or to guide career counseling. They are developed by postulating general and specific abilities that might be good predictors of performance or career outcomes in a range of occupations, and then selecting tests measuring those abilities. Certain domain-specific abilities used in the final test can be viewed as definitions of broad technical skills.

A good example of this type of test is the Armed Services Vocational Aptitude Battery (ASVAB). The ASVAB consists of seven major content areas of general academic and intellectual ability and three content areas of technical ability. The general abilities include verbal comprehension, arithmetic reasoning, and coding speed. The technical abilities are mechanical comprehension, electronics information, and auto and shop information. The three measures of technical skills have been shown through validation research to be significantly related to performance.

■ Occupational Maps

A second concept of broad technical skills is emerging in some of the industry skill standards projects being supported by the U.S. Departments of Education and Labor. Grantees are urged to organize their standard-setting efforts around “broad occupational areas.” The skill definitions are task-oriented, as in the job competency approach used by V-TECS, but are defined across a broad range of similar jobs within an industry.

The American Electronics Association, for example, is considering a structure for its skill standards project that would organize 60 percent of electronic industry jobs that do not require a bachelor’s degree into three areas: manufacturing specialist, pre- and post-sales analyst, and administrative/information services specialist. The mapping process involves identifying the major purpose of work in each broad area and defining a limited number of critical functions. For each of these critical functions, generic activities and explicit criteria for good performance are specified. These activities and criteria provide a clearer basis for setting performance-level standards than the job competency method. Categories of knowledge and cognitive skills underlying job performance can be defined as well. For example, for manufacturing specialists, the purpose of the job is to develop, manufacture, deliver, and improve electronics products and processes that meet or exceed customer needs. The initial functions are to:

- . ensure the production process meets business requirements,
- . initiate and sustain communications,
- . establish customer needs,
- . determine design manufacturability,
- . use human resources to manage work flow,
- . select and optimize equipment to meet requirements, and
- . make products that meet customer specifications.

■ Core Occupational Skills

In vocational education, the basic approach to broadening technical skills has been to group vocational programs into clusters of occupations and adopt a guiding common core of required occupational knowledge and skills. At the introductory levels of instruction, all students in all occupational areas take the same courses, which are directly organized around the core skills. At each more advanced level, students take courses in one of the cluster areas. Instruction is organized around the same set of core skills but they become more specialized and embedded in more specific occupational content. In New York, where core occupational skills strategy has been implemented, the skill areas are: a) personal development, b) social/economic systems, c) information skills, d) resource management, and e) technology.

■ Design and Technology

A fourth approach focuses on development capability for designing technological systems. Advocates assert that all students would benefit from becoming proficient in the design of systems, not only those headed for work or 2-year college programs. The view is that the development of proficiency in designing and building technological systems and learning about technology as a product of human civilization should begin in the early grades. A few such content-oriented concepts could provide a competency-oriented but comprehensive definition of broad technical skills.

Some design and technology courses are taught in the United States at the high school and college levels, but at the high school level the concept has been developed much further in Great Britain and other foreign countries. Over the past 20 years, the British have developed a sequence of courses that now are among the 10 major strands in the new national curriculum, along with mathemat-

ics, science, foreign languages, and other subjects. Design and technology is taken by boys and girls and high and low ability students, beginning in 1st grade. It is conducted to appeal both to students who are interested mainly in the humanities and those who are more scientifically or technically inclined.

Design is the more significant of the two components; students become designers. They acquire the procedural knowledge of learning how to design; the capability to communicate complex ideas with clarity, confidence, and skill; and the conceptual knowledge and understanding of materials, energy, aesthetics, and people and their needs required to create and build effective technological systems.

The procedural knowledge of learning how to design involves learning how to think concretely in complex situations, make choices, and use knowledge to produce better designs. Students weigh the desirability of alternative designs from social, economic, aesthetic, and human standpoints, as well as from the perspective of producibility.

■ Cognitive Skills

A fifth approach defines broad technical skills in terms of cognitive skills. This approach is based on research from cognitive science that identifies skills needed to troubleshoot equipment and solve problems in a range of occupations, apprenticeship situations, and academic learning.

Much of this research focuses on explaining the differences between the cognitive skills of experts and novices. Research has shown that people who are expert in a domain have acquired large collections of schematically and meaningfully organized factual, conceptual, and procedural knowledge that bears on the technological devices or complex systems in their field. Much of this knowledge is highly specific to these devices and the contexts in which they are used. These structures of knowledge enable experts to understand the complex relationships necessary for

skilled performance. Experts differ profoundly from novices in the speed and flexibility with which they can a) access these structures of knowledge, and b) think “metacognitive y”—that is, set goals, apply procedural skills flexibly, and learn from experience in solving problems.

Cognitive skills are acquired in stages. Initially a skill is heavily dependent on declarative, or verbal, knowledge. In the declarative stage, the learner either encounters or is taught the facts and procedures relevant to executing a particular skill. These facts are stored in memory as “state-merits,” which can be verbalized and recalled one-by-one in the steps required by the cognitive skill. The second stage is skill automation, or compilation of the cognitive skill. In this process, the factual and conceptual knowledge acquired in the declarative stage is transformed gradually into a highly organized procedural form that can be accessed and used with minimal conscious reasoning activity. The third stage is skill refinement, or proceduralization. In this stage, performance of the skill is speeded up by weeding out nonessential steps and strengthening associations between possible occurrences and effective responses. As a result, performance of the skill becomes much more sensitive to small but critical situational differences, and the flexibility of response to unexpected situations or new data greatly increases. This model has been applied in a wide range of domains, from power plant control to financial planning to tennis.

These basic concepts from cognitive science begin to suggest how the various approaches to broad technical skills are related to each other; they also begin to point the way toward potentially more powerful definitions of broad technical skills. The concepts imply that broad technical skills could be defined in terms of the attributes of thinking and performance that enable individuals to perform in expert-like ways within suitably defined occupational domains in comparison to individuals who are not so expert.

Broad technical skills might be described as skills that are deep in selected areas, but robust

20 | Testing and Assessment in Vocational Education

and flexible across broader domains. They consist of tightly integrated structures of contextual, conceptual, and procedural knowledge that are demonstrated and expressed through a variety of verbal, visual, behavioral, and other more tacit ways.

The ability to utilize expertise in novel situations and in new domains needs to be measured by both capacity for responding to new tasks and evidence of general learning aptitudes.