



# MATH IN CTE ANALYSIS PROCESS



Arizona Department of Education in Partnership with Arizona State University

## The Analysis Process

### Identifying Arizona Advanced Mathematics Associated With CTE Programs

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The Arizona academic skill identification process relies on the recognition of specific academic skills that are related to the learning or performance of each Measurement Criterion attached to a CTE (Career Technical Education) Program Standard.

In many projects of this type, company human resources representatives and content experts are asked to identify academic courses students should take, as opposed to the identification of specific academic skills required to perform job tasks. Obviously, this process is less precise than a standard by standard analysis, and the results have potential reliability issues.

The analysis process for this project, the identification of specific academic skills, has the precision required for policy recommendations. The Arizona process is shown below.

1. Assure the use of a set of standards that have content validity as determined by content experts.
2. Assemble teams that include both CTE content experts in the area of interest, and academic experts familiar with the academic content standards to be identified.
3. The academic experts lead a review of the academic standards to assure CTE expert familiarity with the academic standards.
4. The CTE experts review the CTE standards to identify the academic standards that
  - a. are required to provide instruction/learning of the standard, or
  - b. required to perform the standard on the job.
5. The academic experts provide clarification of the meaning of the academic standards.
6. The results of the analysis are recorded and presented to policy makers and teacher in-service coordinators.

In Arizona, teams of experts in both the CTE program area and expert teachers of Mathematics were brought together to analyze CTE programs for related or embedded mathematics skills. These teams were tasked with identifying the math skills that are

required to either (a) teach and learn the concepts related to performance of the specific CTE program measurement criterion or (b) perform the CTE criterion.

An industry-validated list of skills performed by incumbent workers in the field related to the CTE program is basic to the analysis process. These sets of skills are generally performance based, or in some instances, may identify a set of cognitive skills required for multiple performance tasks. For Arizona CTE purposes, these are called “Standards” and “Measurement Criteria,” and are stated in the terminology of the industry.

To determine these skill sets, groups of incumbent workers, including supervisors of incumbent workers, were convened to verify that in fact the proposed sets of skills are actually performed in the occupation related to the CTE program being reviewed. The team members are asked to indicate whether or not the task/skill is performed, how critical it is to overall job competence, and how frequently the task/skill is performed. In addition, the team members are asked to consider the level of performance (whether the performance is simply recall of rules or more complex cognitive performance), and where possible, use verbiage that is at the higher levels of cognitive performance. Team members are also asked to consider if the task/skill can be tested, if it is clearly stated, and if all team members have the same understanding of the statement.

Once it has been affirmed that the standards set has content validity and define what workers in that occupation actually do on the job, then the set is assumed to be valid for the development of both assessment and instructional material.

The analysis team uses two documents to complete their work. The first document is the validated CTE standards set, reflecting actual work performance in the occupation(s) being review. The second document includes the academic standards approved by the State Board of Education. This document identifies the requirements for student performance at various levels of schooling in subjects at the elementary and high school level.

The academic skill identification team consists of approximately 10 members. Two or three individuals are teachers from the academic discipline of interest (mathematics, science, language arts, etc.). These teachers are the academic content experts. The remainder of the team, five to seven individuals, has expertise in the CTE or occupational area being reviewed. These are also instructors, and when available, incumbent workers are included as part of the five- to seven-member team.

The first step in the team-based analysis process is a review of the academic standards that are to be related to a CTE program. This review is led by academic experts knowledgeable of the standards, and is conducted to familiarize the CTE representatives with the content. In many, if not most instances, the academic standards are stated in such a manner that non-academics cannot determine the meaning of the standard. The CTE experts must understand the academic standard before they can adequately state that the standard is used to instruct or perform the CTE skill in question. It is helpful, but not mandatory, for the academic expert team to include experts that were involved

in the development of the academic standards. In some cases, the academic teachers might not be clear as to the meaning or interpretation of a given standard. In these cases, the standard is not included in the listing of related academic skills. It is suggested that as the review of the academic standards is conducted, the CTE experts mark those academic standards they think might relate to the CTE Standards under review.

To facilitate the recording of applicable academic skills, a coding structure is assigned to the academic skills. Although there are numerous coding structures that can and have been used for this purpose, this project uses the following structure for the Arizona academic standards:

**Strand #; Concept #; Grade Level (A= 9-10, B= 11-12), Performance Objective #**

Once the initial review of the academic standards has been completed, the actual analysis of the CTE program standards can commence. Prior to the actual analysis, however, a critical rule is given to the CTE content experts.

*Rule: If you believe that an academic skill is used to either provide instruction relative to a related concept, or if the academic skill is used to perform the CTE skill, then you must be able to explain how this academic skill is applied in the instructional program. The academic experts must understand and agree with the example given before the academic skill can be included as a related academic skill.*

This rule provides validity to the skill identification product. Rather than simply stating that the academic content is included, it must be provable with a valid example. In other words, it is verifiable, not simply an opinion or belief.

At this stage of the analysis process, although there are still numerous questions relative to the academic skills and how they relate in a meaningful manner, the analysis proceeds. Initially, the team operates as a unit to assure that the thought process and product is consistent across team members. This process provides opportunity for the CTE experts to learn more about the academic skills, and in many cases, return to an earlier CTE skill to add academic skills that were not initially understood.

If the CTE program content is lengthy or subdivided into sub-programs, and there are an adequate number of team members, the teams can work independently once they are familiar with both the academic content and thought processes of fellow team members. Given the variance in CTE program content, this is sometimes crucial for completion of the work.

Upon completion of the team analysis work, the results are placed in a matrix for review by non-team members. The matrix includes the CTE program skill, called a “measurement criteria,” which in turn is directly associated with a set of academic skills that have been determined to relate to either instruction of concepts related to or the performance of the specific CTE measurement criteria. The length of this document is related, obviously, to the number of CTE measurement criteria in a given program, and

in addition, the quantity of academic skills related to each measurement criteria. As would be expected, many academic skills are used in multiple measurement criteria, and are shown as such in the matrix.

In some instances, no Arizona academic standards are shown to be required for measurement criteria teaching or performance. In these instances, either no mathematics is required, or the complexity of the mathematics required is at a lower level than that required for the AIMS or higher level. However, most occupations do not require high levels of mathematics, so this outcome is predictable to knowledgeable practitioners.

Experience in this type of analysis and the review of the related products indicates that occupations have sets of academic skills that are related to performance of specific job skills. During the analysis process, these skill sets are identified, coded and shown to be related to multiple skills. Some of these sets relate to problem analysis, some relate to maintenance tasks, and other relate to various tasks performed by workers in multiple occupations.

For ease of review of the product of the analysis, unduplicated lists of the academic skills are provided for the development of instruction and for the use of policymakers. One of the most valuable products of this type of analysis is the identification of context for academic content. One of the consistent comments of participants is the fact that neither the academic experts nor the CTE experts realized the extent of coverage of academic skills, and the potential for continuing work together to improve the performance of all students through the use of occupational example of academic skill application.

This analysis process, although complex and time consuming, provides a valid basis for policy decisions relative to potential academic credit for CTE programs. In addition, the basis for contextual instruction is valuable for improvement of learning across disciplines.

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