



**Incorporating Skill Standards into Curriculum:
A User's Guide**

***For Community and Technical Colleges Applying for Program
Recognition from the Texas Workforce Investment Council***

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Introduction

Incorporating Skill Standards into Curriculum: A User's Guide (User's Guide) is designed to help community and technical colleges understand and integrate skill standards content into workforce education programs. Skill standards are an ideal source of the industry-driven skills, knowledge and outcomes required in a competency-based curriculum in Texas. By documenting the incorporation of skill standards in a program, colleges demonstrate to employers that they are teaching the industry's skill and knowledge requirements.

The *User's Guide* helps to translate skill standards elements and terminology into curriculum components through suggestions and examples, without prescribing a standardized approach. It leaves curriculum development to the experts—college faculty and administrators. The following section, understanding skill standards, defines skill standards and explains the two types of standards. The rest of the guide is divided into two main sections:

- 1) What do skill standards look like – describes the elements and format of recognized and conditionally recognized skill standards.
- 2) Incorporating skill standards elements into workforce education curriculum – suggests how the standards' elements may be used to develop curriculum components.

For examples of community and technical colleges that have integrated skill standards into their curricula, see the recognized programs page of the Texas skill standards website at: www.tssb.org/colleges-0.

Understanding Skill Standards

What are Skill Standards?

Skill standards tell us what workers do on the job and how well they must perform to succeed in the workplace. Skill standards also identify the skills and knowledge required to do the work.

Skill standards are developed for an occupational area. A group of employers within an industry, often a professional or trade association, leads the development effort. Front-line workers—those who actually perform the job—and their immediate supervisors define the skill standards. The standards are then validated with workers across the industry to ensure the content is representative of the work it describes.

Recognized vs. Conditionally Recognized

The Texas Workforce Investment Council (TWIC) recognizes industry skill standards that meet established development criteria and stores them in the Texas skill standards website repository. Two categories of recognition are granted to skill standards: recognized and conditionally recognized.

To be granted either category of recognition, an industry group must provide evidence that both the skill standards content and development process are valid and reliable. To be awarded the recognized category, the development and validation process must be conducted with Texas statewide industry representation. In addition, the occupational data must be organized into the Texas skill standards elements and format. The recognized category applies primarily to skill standards developed for occupations where no standards previously existed.

The conditionally recognized designation is granted to skill standards developed and validated by industry outside the state of Texas. These standards are not required to be formatted into the Texas elements. This category applies to skill standards that have already been developed for an occupation.

The two categories of recognition simply distinguish the two types of skill standards. Conditional recognition does not indicate a lesser or temporary status for standards that will eventually be upgraded to recognition status. Standards in either category have been “fully” recognized, are equal in value, and are valid, reliable and representative of the work they describe.

Different Formats

All recognized skill standards look the same. They are composed of the same seven elements organized into a standard format. Conditionally recognized skill standards vary in elements and format depending on the industry group that developed them. The next section illustrates the elements and format of recognized and conditionally recognized skill standards. How to integrate those elements into the curriculum is addressed in the last section, Incorporating skill standards elements into workforce education curriculum.

What Do Skill Standards Look Like?

What Do Recognized Skill Standards Look Like?

All recognized skill standards are composed of seven elements. Three work-oriented elements describe the work being performed:

- Critical work functions
- Key activities
- Performance criteria

Three worker-oriented elements describe the skills and knowledge required to perform the work:

- Occupational skills, knowledge and conditions
- Academic knowledge and skills
- Employability knowledge and skills

The last element advises on the best method to evaluate performance in the work:

- Statement of assessment

Each element is described in greater detail below and illustrated with the Geographic Information Systems (GIS) Technician skill standards. The GIS Technician skill standards represent an occupational area encompassing a cluster of related job titles such as environmental science and protection technicians; surveying and mapping technicians; and life, physical, and social science technicians.

Every set of recognized skill standards also has a key purpose. The key purpose summarizes the work-related goal of the occupational area, as in the GIS Technician example on the following page. All seven skill standards elements are related to the key purpose.

Element 1: Critical Work Function

First, skill standards break down an occupation into its principal responsibilities or critical work functions. A number of these work functions are required to accomplish the key purpose of the occupation. Each critical work function is assigned a discrete number. In the example of the GIS Technician skill standards on the following page, 10 critical work functions are needed to achieve the key purpose.

Occupational Title: Geographic Information Systems (GIS) Technician

Key Purpose: Creates software and data solutions to assist in the visualization, measurement, and analysis of features or phenomena that occur on earth that integrates acquisition, modeling, analysis, and management of spatially referenced data.



Critical Work Functions

1. Create and/or acquire GIS data.
2. Create image data.
3. Maintain GIS data.
4. Conduct spatial/non-spatial analysis.
5. Generate GIS products.
6. Develop software applications.
7. Manage GIS data.
8. Provide technical support.
9. Perform administrative tasks.
10. Pursue professional development.

Element 2: Key Activity

Each critical work function is divided into several major tasks, or key activities. The key activities are listed sequentially with a numbering system that links them to the relevant critical work function (e.g., 1.1, 1.2 or 2.1, 2.2, etc.). In this system, the first number represents the critical work function and the second number indicates the key activity. For the GIS Technician skill standards, four key activities are required to perform critical work function 2, as illustrated in the example below.

Occupational Title: GIS Technician

Critical Work Function
2. Create image data.



Key Activities

- 2.1 Scan hard copy images into digital format.
- 2.2 Geo-reference digital imagery.
- 2.3 Rectify images to meet data standards.
- 2.4 Perform image analysis (classification).

Element 3: Performance Criteria

What does successful performance of a key activity look like? To what standard must workers perform? These questions are answered with the performance criteria. The performance criteria specify the type, quality and level of output (demonstrable behavior or product) required to successfully perform the key activity. The performance criteria are also numbered sequentially (1.1.1, 1.1.2, 1.1.3, etc.). Again, the first and second numbers indicate the related critical work function and key activity, respectively, while the last number represents the performance criterion.

In the example below, six performance criteria indicate the standards to which a GIS technician must perform key activity 2.4.

Occupational Title: GIS Technician		
Critical Work Function 2. Create image data.		
Key Activity	Performance Criteria	
2.4 Perform image analysis (classification).	2.1.1	Outputs of the thematic raster layer should keep the commission and omission errors within acceptable limits and should include class values, class names and/or color table.
	2.1.2	Vector data is created based on classification analysis.
	2.1.3	Image classification conforms to the project standards.
	2.1.4	Different types of surfaces are currently identified from remote sensing bands.
	2.1.5	A field check of what was classified verifies that surfaces are correctly identified.
	2.1.6	New vector layer derived from the reclassification accurately reflects field phenomena.

Element 4: Occupational Skills, Knowledge and Conditions

The occupational skills, knowledge and conditions are those skills and knowledge specific to the work context and the tools, resources and equipment needed to perform the key activity and its related performance criteria. An example of occupational skills, knowledge and conditions for key activity 2.4 and its associated performance criteria is:

Occupational Title: GIS Technician			
Critical Work Function 2. Create image data.		Occupational Skills, Knowledge & Conditions	
Key Activity	Performance Criteria	Occupational Skills & Knowledge	Conditions
2.4 Perform image analysis (classification)	2.1.1 Outputs of the thematic raster layer should keep the...	<ul style="list-style-type: none"> GIS principles Photogrammetry Database skills Computer skills Keyboarding skills 	<ul style="list-style-type: none"> Personal computer GIS software Image display and manipulation software Geospatial imaging products

Elements 5 and 6: Academic and Employability Knowledge and Skills

The academic knowledge and skills and the employability knowledge and skills are the basic, underlying competencies that enable a worker to perform the key activities. Academic and employability knowledge and skills are similar to the SCANS competencies¹. There are four academic, and 13 employability, knowledge and skills, listed on the next page:

¹ The Secretary's Commission on Achieving Necessary Skills (SCANS) identifies entry-level workforce skills described in a 1991 Department of Labor report, *What Work Requires of Schools*. SCANS is referenced in the THECB's *Guidelines for Instructional Programs in Workforce Education (GIPWE)* as a source for identifying program competencies.

Academic Knowledge and Skills

Mathematics
Science

Reading
Writing

Employability Knowledge and Skills

Adaptability
Analyzing and solving problems
Building consensus
Gathering and analyzing information
Leading others
Listening
Making decisions and judgments

Organizing and planning
Self and career development
Speaking
Using information and communications technology
Using social skills
Working in teams

For each critical work function, only the pertinent academic and employability knowledge and skills for the corresponding key activities are listed in a matrix. Each of those academic and employability knowledge and skills is assigned a rating. The rating indicates the level of skill, from a high of 5 to a low of 1, required to perform that activity. Below is an example of selected academic and employability knowledge and skills, and the associated rating level, needed to perform the key activities of critical work function 2 in the GIS Technician skill standards:

Occupational Title: GIS Technician

Academic and Employability Knowledge and Skills Matrix

Critical Work Function 2. Create image data.

Listening	Speaking	Using Information & Communications Technology	Gathering & Analyzing Information	Analyzing & Solving Problems	Writing	Reading	Mathematics
3	3	3	4	4	3	3	3



The ratings for each knowledge and skill are explained in the former National Skill Standards Board’s (NSSB) *Skill Scales Companion Guide (Companion Guide)*.² The *Companion Guide* can be accessed on the Texas skill standards website at: www.tssb.org/developing-skill-standards-0.

Element 7: Statement of Assessment

The statement of assessment notes the industry’s recommendation of how to evaluate performance of each critical work function and its related key activities and performance criteria. The statement of assessment includes both the method(s), whether written test or performance-based, for example, and the required tools and equipment for assessing performance. The GIS Technician skill standards include the following statement of assessment for critical work function 2.

² To facilitate portability of credentials and transferability of individuals’ skills, the Texas skill standards elements and format were designed to promote the linkage of state and national skill standards efforts. As part of the skill standards elements required for program recognition, the academic and employability knowledge and skills and common nomenclature endorsed by the NSSB were adopted. The academic and employability knowledge and skills and associated skill scales and *Companion Guide*, were developed by the NSSB and are subject to copyright laws at the time of publication (2000).

Occupational Title: GIS Technician

Critical Work Function 2. Create image data.

Statement of Assessment

- A. Written tests could include:
- (1) Multiple choice and/or essay questions that demonstrate an understanding of image acquisition and implementation.
- B. Hands-on exercises or simulations to demonstrate acquisition of knowledge, skills, and attitude that could:
- (1) Describe the types of Scanners (drum, flat bed, back-lit) and their purposes.
 - (2) Demonstrate proper control of scanner including choosing an appropriate resolution (scale and accuracy), adjust contrast, brightness, gamma correction.
 - (3) Ability to operate the scanner to acquire image and save it to an appropriate .TIFF or .JPG image file.
 - (4) Demonstrate ability to geo-reference image using a minimum of 3-4 recognizable features.
 - (5) Create a cartographically correct map using the new image file and additional layers.
 - (6) Ability to rectify images to meet data standards.
 - (7) Perform image analysis using classification.

Each of these elements can be incorporated into curriculum using the step-by-step process described in the section, Incorporating skill standards elements into workforce education curriculum.

What do Conditionally Recognized Skill Standards Look Like?

Elements and Format Vary by Authorizing Entity

The elements and format of conditionally recognized skill standards vary by the authorizing organization. Authorizing organizations eligible for conditional recognition of their skill standards are national industry groups and state or international skill standards recognition authorities. Examples of skill standards that have been conditionally recognized include those approved or endorsed by the:

- Manufacturing Skill Standards Council (MSSC) – manufacturing and logistics;
- National Workforce Center for Emerging Technologies (NWCET) – information technology clusters;
- National Institute for Metalworking Skills and Precision Manufacturing Association (PMA) – metalworking specialties.

NSSB and NWCET – Nearly Identical to Texas Skill Standards Elements

The elements of skill standards previously approved by the NSSB³ and the NWCET, although worded differently, are nearly identical to the recognized skill standards in Texas, as indicated below. The statement of assessment is the only exception; it is unique to the Texas system.

Comparison of Skill Standards Elements		
Texas Skill Standards	NSSB	NWCET
• Critical work functions	• Critical work functions	• Critical work functions
• Key activities	• Key activities	• Key activities
• Performance criteria	• Performance indicators	• Performance indicators
• Occupational skills, knowledge and conditions	• Occupational and technical knowledge and skills	• Technical knowledge (skills, abilities, tools)
• Academic knowledge and skills	• Academic knowledge and skills	• Employability skills (SCANS skills and foundation abilities)
• Employability knowledge and skills	• Employability knowledge and skills	• Employability skills (SCANS skills and foundation abilities)
• Statement of assessment	• No equivalent	• No equivalent

For conditionally recognized skill standards with nearly identical elements to the Texas recognized skill standards, the process for incorporating the elements into the curriculum is straightforward. Using the equivalencies in the table above, simply follow the steps in the last section.

PMA and Other Entities – Different from Texas Skill Standards Elements

Other conditionally recognized skill standards differ significantly from recognized standards in elements and format, as illustrated by the PMA standards on the following page.

³ The NSSB no longer exists. However, NSSB-endorsed skill standards developed by its voluntary partnerships including the MSSC, which have been conditionally recognized in Texas, are still valid. They are available for usage in the repository on the Texas skill standards website at www.tssb.org/texas-skill-standards-repository.

➤ **SAMPLE**

Elements and Format for PMA Metalforming Level I skill standards

Duty Area: 2. **Quality Control and Inspection**

Duty Title: 2.1 **Part Inspection**

Duty:

Inspect sample parts using precision tools and techniques. Prepare reports on compliance of the parts.

Performance Standard:

Given the necessary job process sheets for a part and verbal instructions, identify and select the required measuring instruments and conduct the required inspection procedure(s). Complete required written inspection report and make a decision to accept or reject component parts. Provide brief verbal explanation of inspection procedures, results, and decisions.

Other Evaluation Criteria:

1. N/A

Accuracy Level:

Within a 1/64th for fractions, within .001" for decimals

Assessment Equipment and Material:

Workstation: A common workbench with a small surface plate.

Material: A finished part and a matching part inspection blueprint.

Tooling: Inspection tools and or inspection fixtures

Measuring Instruments: An appropriate assortment of basic, fixed, precision, and surface plate inspection tools.

Reference: Geometric Dimensioning and Tolerancing reference book

Skills and Knowledge for PMA Skill Standards, Duty 2

	1. Written and Oral Communication		5. Engineering Drawings
X	1.1. Reading	X	5.1 Standard Orthographic Blueprints
X	1.2 Writing		6. Measurement
X	1.3 Speaking	X	6.1 Basic Measuring Instruments
X	1.4 Listening	X	6.2 Precision Measuring Instruments
	2. Mathematics		7. Safety
X	2.1 Arithmetic	X	7.1 OSHA Regulations
	2.2 Applied Statistics		8. Metalforming Theory
	3. Decision Making & Problem Solving		8.1 Metalforming Equipment
X	3.1 Applying Decision Rules	X	8.2 Material Properties
X	3.2 Basic Problem Solving		8.3 Lubricants and Cutting Fluids
	4. Group Skills and Personal Qualities		8.4 Identify Types of Tooling
	4.1 Group Participation		8.5 Material Delivery Systems
X	4.2 Personal Qualities		

Before incorporating the PMA and other such conditionally recognized skill standards into the curriculum, the equivalencies to the Texas skill standards elements must first be determined. Depending on their particular configuration, the standards may be translated into Texas skill standards elements in different ways. However, a number of key considerations can help in the process.

In the example on the following page, the PMA skill standards are labeled with the equivalent Texas skill standards elements. Six considerations were used to arrive at those equivalencies. Those considerations are explained below and following the example on pages 12 and 13.

1. Critical work functions are broad work responsibilities

Most skill standards, regardless of source, identify a hierarchy of work responsibilities, usually at two levels. The broadest or highest of the two levels will most likely correspond with a critical work function.

In the PMA example on page 11, the duty area, “quality control and inspection,” is equivalent to a critical work function. The duty area is written as a category of work. However, by adding an action verb to the beginning of the title, it can be converted into a critical work function statement as follows:

“Perform quality control and inspection functions.”

2. Behavioral statements with action verbs indicate key activity

The most obvious indicator of a key activity equivalent is the sentence structure. A key activity is typically written as a behavioral statement with an action verb. For example, in the PMA standards, the duty is written as two related behavioral statements beginning with action verbs. To create a key activity, the two sentences can be joined as follows:

“Inspect sample parts and prepare reports on parts compliance.”

(Note: The phrase, “using precision tools and techniques” can be omitted because it is included in the performance criteria and conditions. See 3. and 4. below.)

3. Conditions may be signaled by “given” clause

Often the equivalency for the conditions is obvious, especially when that element is labeled as “tools, resources, equipment or materials.” However, the conditions may also be embedded in a performance statement since they indicate the circumstances required to perform a behavior. The conditions are indicated with a clause beginning with the word “given.”

In the PMA example, the category “assessment equipment and material” clearly corresponds with the conditions element. However, note that the performance standard begins with a “given” clause. This clause is also part of the conditions. It indicates the resources the worker must be “given,” or be required to have, to perform the duty.

Elements and Format for PMA Metalforming Level I skill standards, Duty 2

Duty Area: 2. Quality Control and Inspection
Duty Title: 2.1 Part Inspection

1. Critical Work Function

2. Key Activity

Duty:
 Inspect sample parts using precision tools and techniques. Prepare reports on the compliance of the parts.

3. Conditions

Performance Standard:
 Given the necessary job process sheets for a part and verbal instructions, identify and select the required measuring instruments and conduct the required inspection procedure(s). Complete required written inspection report and make a decision to accept or reject component parts. Provide brief verbal explanation of inspection procedures, results, and decisions.

Other Evaluation Criteria:
 1. N/A

4. Performance Criteria

Accuracy Level:
 Within a 1/64th for fractions, within .001" for decimals

Assessment Equipment and Material:
Workstation: A common workbench with a small surface plate.
Material: A finished part and a matching part inspection blueprint.
Tooling: Inspection tools and or inspection fixtures
Measuring Instruments: An appropriate assortment of basic, fixed, precision, and surface plate inspection tools.
Reference: Geometric Dimensioning and Tolerancing reference book

3. Conditions

6. Statement of Assessment

Knowledge, Skills, Abilities & Other Characteristics for Metalforming Level I, Duty 2			
	1. Written and Oral Communication		5. Engineering Drawings
X	1.1. Reading	X	5.1 Standard Orthographic Blueprints
X	1.2 Writing		6. Measurement
X	1.3 Speaking	X	6.1 Basic Measuring Instruments
X	1.4 Listening	X	6.2 Precision Measuring Instruments
	2. Mathematics		7. Safety
X	2.1 Arithmetic	X	7.1 OSHA Regulations
	2.2 Applied Statistics		8. Metalforming Theory
	3. Decision Making and Problem Solving		8.1 Metalforming Equipment
X	3.1 Applying Decision Rules	X	8.2 Material Properties
X	3.2 Basic Problem Solving		8.3 Lubricants and Cutting Fluids
	4. Group Skills and Personal Qualities		8.4 Identify Types of Tooling
	4.1 Group Participation		8.5 Material Delivery Systems
X	4.2 Personal Qualities		

5. Academic & Employability Knowledge & Skills

5. Occupational Knowledge & Skills

4. Performance criteria can be identified by type, quality and level of output

The performance criteria element can be easily recognized if its equivalent has a similar label or title such as performance indicators or performance standards. Other possible terms might refer to *evaluation criteria* or performance *levels*. Sometimes, however, the wording of the element, even if it is labeled appropriately, can be misleading. If it's written like a behavioral statement, for example, it could be confused with the key activity.

Keep in mind that performance criteria provide greater detail on what performance of the key activity should look like. In particular, they indicate the type, quality and level of output required for successful performance of the key activity.

The PMA standards example illustrates these considerations. The performance criteria equivalents are clearly labeled performance standard, other evaluation criteria, and accuracy level. However, the performance standard is written like a key activity in behavioral statements with action verbs. It can be rewritten to indicate the results or output of the related duty, as follows:

PMA Metalworking Skills, Level I	
Duty	Performance Standards
2.1 Inspect sample parts and prepare reports on compliance of parts.	2.1.1 Required measuring instruments are identified and selected. 2.1.2 Required inspection procedures are conducted. 2.1.3 Required written inspection report is completed. 2.1.4 Decision is made to accept or reject component parts. 2.1.5 Brief verbal explanation of inspection procedures, results and decisions is provided.

5. Identify equivalent types of skills and knowledge

Most skill standards have some variation of the three types of skills and knowledge identified in the Texas skill standards:

- Academic
- Employability or workplace
- Occupation specific

However, the range of employability knowledge and skills in most conditionally recognized skill standards will not be as extensive as in the Texas skill standards framework. Nor will the *complexity level* typically be provided for either the academic or employability knowledge and skills. The Texas skill standards' academic and employability knowledge and skills ratings indicate to educators what level of, mathematics or speaking for example, a student will need to perform the key activities in the related critical work function.

In the PMA example, the employability skills include the following six:

- Applying decision rules
- Basic problem solving
- Group participation
- Speaking
- Listening

This compares to the Texas skill standards' 13 employability knowledge and skills.

The PMA skill standards also indicate which academic, employability and occupational knowledge and skills are needed for each duty. (See items marked with an X in the example.) This linking to the duty allows the sequencing of the skills and knowledge in the curriculum, as in the incorporation process for the recognized skill standards.

6. Use performance criteria & conditions to derive statement of assessment

As indicated earlier in this *User's Guide*, the statement of assessment is a unique element to the Texas recognized skill standards. However, usually a review of the performance criteria and conditions (tools, resources and equipment) can provide essential information to determine how the industry would recommend the student be assessed on that duty.

In the PMA example, the assessment equipment and material (conditions) provides evidence of the need to *demonstrate* the duty (on a common workbench with specific tools and equipment). In addition, the performance standard indicates that successful completion of the duty requires a written report and verbal explanation.

Follow steps to incorporate equivalent elements into curriculum

Once the equivalencies for all Texas skill standards elements have been determined, the conditionally recognized skill standards may be incorporated into the curriculum by following the steps for the Texas skill standards elements in the following section, Incorporating skill standards elements into workforce education curriculum.

Incorporating Skill Standards Elements into Workforce Education Curriculum

Incorporating Skill Standards Elements into Workforce Education Curriculum

Skill standards elements directly relate to curriculum components, as shown below. Incorporating all elements into a program signals to employers that their skill and knowledge requirements are being addressed.

Relationship between Skill Standards Elements and Curriculum Components

Skill Standards Elements	Curriculum Components
Critical work functions	Program structure (course selection)
Key activities	Learning outcomes
Performance criteria.....	Proficiency level to which students are expected to perform the learning outcomes and upon which they will be assessed.
Occupational skills, knowledge & conditions	Subject-area specific skills and knowledge, and the tools, resources & equipment that students need to perform the learning outcomes
Academic and employability knowledge and skills	General academic and workforce skills
Statement of assessment	Methodology and instruments for assessment of learning outcomes

Skill standards elements may be incorporated into new or existing workforce education curriculum in a variety of ways, depending on the configuration of the particular standards and the judgment and preferences of the program administrator or instructor. This *User's Guide* suggests a six-step integration process. The process describes how to use each element and provides examples.

STEP 1: Use critical work functions to consider appropriate courses

To integrate skill standards into curriculum, it can be helpful to start with a high-level look at the skill standards to determine what courses are needed to encompass all of the content. The first skill standards element, the critical work function, can provide that perspective. All the critical work functions, taken together, represent the principal responsibilities of the occupational area defined by the skill standards. These work functions divide the skill standards content into broad categories. At a glance, the list of critical work functions provide a convenient way, in developing a new program, to choose appropriate courses that cover the skill standards content.

When incorporating skill standards into an *existing* program, comparing the list of work functions to a list of the program's courses can be used to initially assess any obvious, significant gaps in the curriculum. Often, this first step will reveal that the major areas of the skill standards are being addressed in the program. It is at the next level of analysis, when the key activities are examined in step two, that detailed gaps in content are more likely to be identified.

➤ **EXAMPLE:**

The figure below lists the critical work functions for the GIS Technician skill standards in the left-hand column and the course titles for an existing GIS associate of applied science (AAS) program in the right-hand column. As suggested, this pairing allows a comparison of the broad skill standards content against the program's subject matter. At this point, matching the work functions to specific courses in which they

may be taught—whether across several courses or encompassed within only one—may also be considered.

GIS Technician Critical Work Functions	GIS AAS Program Courses
Create and or acquire GIS data	GISC 1311 – Introduction to GIS
Create image data	GISC 1421 – Introduction to Raster-Based GIS
Maintain GIS data	GISC 1491 – Special Topics in Cartography
Conduct spatial/non-spatial analysis	GISC 2301 – Data Acquisition & Analysis in GIS
Generate GIS products	GISC 2311 – GIS Applications
Develop software applications	GISC 2420 – Intermediate GIS
Manage GIS data	GISC 2459 – Web-Served GIS Applications
Provide technical support	
Perform administrative tasks	
Pursue professional development	

STEP 2: Match key activities to course learning outcomes

After listing the Workforce Education Course Manual (WECM) courses that appear to encompass the skill standards, the next step is to ensure that all the key activities in each critical work function are addressed in the curriculum. Key activities, the major tasks performed by workers, are roughly equivalent to course learning outcomes. Like learning outcomes, they are written as behavioral statements starting with an action verb. By the end of the program, a student should be able to demonstrate the successful performance of all the key activities.

To determine whether all the key activities are included in the program’s courses, a matrix or crosswalk should be developed. The matrix should list all the key activities vertically in the left-hand column and the program’s WECM courses horizontally across the top. For each key activity, an X should be placed in the appropriate box to indicate the course(s) in which it will be assessed as a significant learning outcome.

➤ **EXAMPLE**

The table below shows a sample of key activities from the GIS Technician skill standards assigned to WECM courses.

Matrix Sample of Key Activities to WECM Courses for GIS Technician Skill Standards							
	WECM Course Rubric/ #	GISC 1311 1411	GISC 1421	GISC 1391 1491	GISC 2301	GISC 2311	GISC 2320 2420
	Course Title	Introductory Geography in GIS and GPS	Introduction to Raster-Based GIS	Special Topics in Cartography	Data Acquisition & Analysis in GIS	GIS Applications	Intermediate GIS
Key Activity #/Statement							
1.1 Define the data requirements, research sources of available data, and purchase data from reputable source.		X		X	X		
1.2 Develop (and document with metadata) database(s) including: defining geometry, attributes, relationships, topology rules, feature behaviors such as types and domains, incorporating data schema models.				X	X		X
1.3 Determine data compatibility (projection), perform data conversion, populate feature attributes.			X			X	X
1.4 Perform both tablet, COGO, and on-screen digitization with attribution.					X	X	
1.5 Collect field attribute and location data via GPS (Tablet PC/PDA).		X			X		X
1.6 Geocode data.		X			X		
1.7 Perform quality control (QC) and quality assurance (QA) of GIS databases.			X		X		X
2.1 Scan hard copy images into digital format.			X		X		

STEP 3: Enhance, add or create course(s) to address key activities

Once the matrix is completed, it may reveal that some key activities are not covered in any of the program's courses. In such cases, one of three options should be taken:

- **Enhance the learning outcomes** of one or more of the program's courses to include the missing key activities.
- **Use a different course (or courses) in the WECM inventory** that could incorporate the missing key activities.
- **Create a local needs course** if no existing courses in the WECM inventory are appropriate to address the key activities.

➤ EXAMPLE

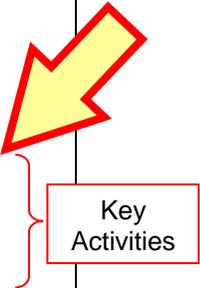
The example below shows how the learning outcomes of the WECM course, Introduction to GIS, were enhanced to include key activities from the GIS Technician skill standards. (See shaded area in table.)

WECM Course Enhanced with Key Activities from GIS Technician Skill Standards							
Introduction to Geographic Information Systems (GIS)							
CIP	Rubric	Number	Course Title	Status	Semester Credit Hrs	Min Cont Hrs	Max Cont Hrs
45.0702	GISC	1311	Introduction to Geographic Information Systems (GIS)	Active	3	64	96

Course Description: Introduction to basic concepts of vector GIS using several industry specific software programs including nomenclature of cartography and geography.

End-of-Course Outcomes: Explain basic concepts of using GIS in mapping the earth in spatial terms and populating the GIS's system to access data; create and access data in the GIS's system using an appropriate software package; and develop and print maps with industry standard legends. Operate industry standard GIS packages on a personal computer; capture positional and attribute information with correct and accurate geographic referencing; convert geographic information among several coordinate systems; acquire GIS's system information from databases, existing maps, and the Internet; and annotate output for finished maps, documents, and reports. Define the data requirements, research sources of available data, and purchase data from reputable source (key activity 1.1); determine data compatibility (projection), perform data conversion, and populate feature attributes (key activity 1.3); collect field attribute and location data via GPS (tablet PC/PDA) (key activity 1.5); and geocode data (key activity 1.6).

Lab Recommended



Once all the key activities have been assigned to courses, the remaining skill standards elements should be incorporated into the curriculum. Those elements include performance criteria; occupational skills, knowledge and conditions; academic knowledge and skills; employability knowledge and skills; and statement of assessment. These elements are linked to the key activities or critical work functions, and thus, can be logically sequenced into the curriculum relative to the learning outcomes. Steps 4 through 6 provide considerations to help incorporate the remaining elements.

STEP 4: Use performance criteria, conditions, statement of assessment, and related skills and knowledge to develop assessments

Performance criteria provide the proficiency levels to which students are expected to perform the learning outcomes. The performance criteria indicate the type, quality, and level of output required of the worker, and provide instructors with detailed information to develop assessments of the learning outcomes.

The conditions (tools, resources and equipment) required to carry out the key activity and its related performance criteria are also critical for developing assessments. The conditions indicate the materials and equipment that instructors must supply for the student to be able to properly perform the learning outcomes.

Finally, the statement of assessment explicitly states the industry’s recommended method(s) and instruments to assess performance of the key activities in each critical work function. It can be used to determine the type of assessment to use—whether written test (multiple choice, true/false or essay), oral presentation or performance-based simulation or observation (project, portfolio, external learning experience, etc.)—to evaluate students’ performance of the learning outcomes. The information from the statement of assessment can be added to the course syllabus to indicate to students how they will be evaluated.

➤ EXAMPLE

The example on the following page using the GIS Technician skill standards shows how the performance criteria, conditions, and statement of assessment can be used to develop assessments for key activity 1.1, which addresses the identification and acquisition of data. The four performance criteria provide more detail about what this data identification and acquisition should look like, including that findings and recommendations should be summarized and presented (1.1.2).

The assessment method used in the classroom can often be gleaned from such worker-output information contained in the performance criteria. For example, performance criterion 1.1.2 further states that the findings and recommendations must be presented in an oral or written format, which suggests an oral presentation or written report as an effective way to measure students’ mastery of the key activity. At the same time, performance criterion 1.1.1, which describes the characteristics of the data requirements—attributes, coordinate systems, and map projections—that must be identified, suggests that a performance-based assessment or project is appropriate to evaluate the students’ competence.

In addition, the conditions list the specific tools and materials needed to perform key activity 1.1. And finally, the statement of assessment suggests types of evaluation tools, such as written tests and hands-on exercises or simulations, which can be used to evaluate all the key activities in critical work function 1. These recommendations reinforce the implied assessment methods embedded in the performance criteria.

Occupational Title: GIS Technician			
Critical Work Function 1. Create and/or acquire GIS data.		Occupational Skills, Knowledge & Conditions	
Key Activity	Performance Criteria	Occupational Skills & Knowledge	Conditions
1.1 Define the data requirements, research sources of available data, and purchase data from reputable source.	1.1.1 Data requirements for the project are identified such that data types, data attributes, data coordinate systems, datum, and map projections are properly identified. 1.1.2 Project findings are presented, recommendations are made, and data summarized in an <u>oral</u> and/or <u>written</u> format per company policy. 1.1.3 Data sources are identified and listed. 1.1.4 Data sets related to the project are located, identified, and listed.	GIS principles Data exchange procedures Computer skills Database skills Census data Facilitation skills Keyboarding skills	Personal computer GIS software Word processing software Spreadsheet software Database software

Performance-Based Assessment

Oral Presentation

Written Report

Statement of Assessment

- A. Written tests could include:
 1. Multiple choice and/or essay questions that demonstrate an understanding of relational database design and implementation.
 2. Produce graphic representation of database design, such as Entity-Relationship Diagrams (ERD), etc.
- B. Hands-on exercises or simulations to demonstrate acquisition of knowledge, skills, and attitude that could:
 1. Demonstrate ability to assess end-user data requirements through interviews, email, or other communication methods.
 2. Ability to create database planning documents such as E/R diagrams, Object-Role Modeling (ORM), or Unified Modeling Language (UML).
 3. Demonstrate ability to locate alternate geo-data sources using the Internet FTP and online GIS databases.
 4. Ability to create ArcCatalog entries for new geodatabases.
 5. Demonstrate ability to new Shapefile in ArcCatalog.
 6. Create new Shapefile features using the editing tools.
 7. Create a cartographically correct map using the new features and other map layers.
 8. Demonstrate ability to locate existing address information for geocoding.
 9. Ability to geocode location information into a new or existing geodatabase.
 10. Ability to classify and list data by data formats.
 11. Identify and list all the coordinate systems, datum, and map projections in the data set.
 12. Demonstrate ability to compare and contrast compatibility of available data.
 13. Import CAD file to GIS feature class.
 14. Convert between shapefile and geodatabases.
 15. Demonstrate quality assurance and quality control by compare and contrast the new edited data with the project's requirements, attributes with data requirements, and spatial geometry with data requirements.
 16. Ability to describe the metadata requirements for a project, research any missing metadata fields, and update the metadata.
 17. Demonstrate correct GPS setup according to instructions, including coordinate systems.
 18. Ability to record GPS satellite strength and positional accuracy from GPS units and download into ArcMap.

In the rare occupational area, a student may not be expected to perform the key activity in the classroom to the level required in the related performance criteria. For example, the Chemical/Refining Process Technician skill standards describe the responsibilities with which an incumbent worker is entrusted after being on the job for a period of time. An entry-level worker is not expected to assume control over an entire refining plant immediately. Nor can students demonstrate their performance of the key activities to the proficiency level in the related criteria because no college could possibly possess the required equipment (i.e., a petroleum refining plant) upon which that competence would be assessed.

However, employers do expect graduates of petrochemical process technology AAS programs to be prepared in advance of hiring with the related occupational and technical skills and knowledge required to ultimately assume the key activities in the skill standards. In the case of such occupations, the related skills and knowledge may also be used to develop assessments that demonstrate students' preparation to perform the key activities once on the job. (*Note:* This exception to what graduates are expected to perform from the skill standards at entry-level may be indicated by the industry in the Assumptions Related to the Standards part of the application packet submitted to the Texas Workforce Investment Council with the standards.)

➤ **EXAMPLE**

The example on the following page using the Chemical/Refining Process Technician skill standards shows how the occupational skills and knowledge, along with the statement of assessment and conditions, can be used to develop assessments that evaluate students' readiness to perform key activity 1.1, once on the job. The statement of assessment lists many types of evaluation tools and strategies that use simulations. These simulations allow instructors to measure students' grasp of the various skills and knowledge underlying the ability to monitor and regulate a distillation system, in the absence of being able to demonstrate that key activity in a refining plant. The conditions list the tools and equipment needed to demonstrate performance of key activity 1.1.

Occupational Title: Chemical/Refining Process Technician			
Critical Work Function		Occupational Skills, Knowledge and Conditions	
1. Control separation systems.			
Key Activity	Performance Criteria	Occupational Skills & Knowledge	Conditions
1.1 Monitor and regulate distillation system.	1.1.1 Production rates meet desired production level per company specifications.	Process Variables – Knowledge of effects and relationships of process variables such as pressure, composition, temperature, level, and flow.	Drums Hoses Compressors Extruders Flares
	1.1.2 Production costs which are controlled by operators indicate efficient use of equipment, raw materials, utilities, and other resources.	Operating Parameters – Knowledge of normal operating procedures and design limits, and the differences between them.	Boilers Cryogenic unit Economizer Switch gears Skimmers
	1.1.3 Product/process meets established process specifications.	System Components – Knowledge of system components and their functions (e.g., stationary equipment, rotating equipment, instrumentation and controls.)	Steam traps Gloves Respirator Acid suit Ear muffs SCBA (Self-Contained Breathing Apparatus) Face shield Motor control centers
	1.1.4 Equipment is monitored and maintained according to manufacturer/company operational parameters, safety standards, and government regulations.	Heat and Material Balances – Calculate heat and/or material balance for quality and cost optimization.	Reverse osmosis unit Safety goggles/glasses Drum dolly Pumps, etc.)
	1.1.5 Equipment maintenance is coordinated according to mechanical requirements, maintenance schedule or equipment malfunction.	Distillation – Understanding of distillation fundamentals (e.g., boiling points, vapor pressures, latent heat, sensible heat, viscosity, applied pressure, flash points, and distillation curves) and batch and continuous distillation systems (e.g., atmospheric, vacuum, and azeotropic).	
Statement of Assessment			
Tools & Strategy: The assessment process should include one or more of the following:			
A. Written tests could include:			
(1) Multiple choice and essay questions that demonstrate an understanding of knowledge being assessed.			
(2) Graphic representations (e.g. P&IDs and loop drawings) that reveal an understanding of symbology and connections between processes and devices.			
(3) Preparation and justification of a reasonable solution to a problem scenario.			
B. Hands-on exercises or simulations to demonstrate acquisition of knowledge, skills and attitudes that could:			
(1) Represent a real-life scenario, problem or challenging situation in the context of a work environment.			
(2) Apply relevant knowledge or skills.			
(3) Focus on the application of knowledge and skills to a new situation.			
(4) Demonstrate an ability to plan, organize and create a product or an event.			
(5) Illustrate by individual performance the attained levels of knowledge, skills and attitudes.			
(6) Include observation of events, groups and individuals that focuses on the relevant traits of the skill or attitude being observed.			

STEP 5: Sequence occupational skills & knowledge relative to learning outcomes

The occupational skills and knowledge indicate the technical or occupation-specific skills and knowledge that must be taught to prepare students to perform the learning outcomes. If a student demonstrates the ability to perform a learning outcome, he or she is successfully applying the related occupational skills and knowledge. Because they are linked directly to key activities, the occupational skills and knowledge can be sequenced in the curriculum in relation to the learning outcomes.

Depending on the organization of the skill standards and the instructor's judgment, the occupational skills and knowledge may be taught in the same course as the related learning outcome(s) or in a prerequisite or introductory course. When the same occupational skills and knowledge are required for multiple critical work functions and key activities, as in the example of the Chemical/Refining Process Technician skill standards on the next page, a prerequisite or introductory course could be designed to teach them. This would especially be true if the relevant critical work functions and key activities are taught in different courses.

When the occupational skills and knowledge are different for every key activity, it may make more sense to teach them in the same course as the related learning outcome. (See example with Webmaster skill standards in the appendix.)

The occupational skills and knowledge can be incorporated into the course description on the syllabus to indicate where they will be taught.

➤ EXAMPLE

Same Occupational Skills and Knowledge Across Multiple Key Activities

A cross section of the Chemical/Refining Process Technician skill standards shows the same occupational skills and knowledge across multiple Critical Work Functions and key activities. In this case, an introductory or prerequisite course could be designed to teach these occupational skills and knowledge.

Occupational Title: Chemical/Refining Process Technician			
Critical Work Function		Occupational Skills, Knowledge & Conditions	
1. Control separation systems			
Key Activity	Perf. Criteria	Occupational Skills & Knowledge	Conditions
1.1 Monitor and regulate distillation system.	1.1.1 Production rates meet desired production level...	Process Variables – Knowledge of effects and relationships of process variables such as pressure, composition, temperature, level, and flow. Operating Parameters – Knowledge of normal operating procedures and design limits, and the differences between them.	Drums Hoses Compressors Extruders Flares Boilers, etc.
1.2 Monitor and regulate stripping system.	1.2.1 Production rates meet desired production level...	System Components – Knowledge of system components and their functions (e.g., stationary equipment, rotating equipment, instrumentation and controls.) Etc.	Drums Hoses Compressors...
3. Control reaction systems.			
Key Activity	Perf. Criteria	Occupational Skills & Knowledge	Conditions
3.1 Monitor and regulate continuous reaction system.	3.1.1 Chemical reaction rates meet desired production level... 3.1.2 Production costs which are controlled by operators indicate efficient use of...	Process Variables – Knowledge of effects and relationships of process variables such as pressure, composition, temperature, level, and flow. Operating Parameters – Knowledge of normal operating procedures and design limits, and the differences between them. System Components – Knowledge of system components and their functions (e.g., stationary equipment, rotating equipment, instrumentation and controls.) Etc.	Drums Hoses Compressors Extruders Flares Boilers, etc.
5. Monitor and regulate waste incineration system.			
Key Activity	Perf. Criteria	Occupational Skills & Knowledge	Conditions
5.1 Monitor and regulate waste incineration system.	5.1.1 Process variables meet/do not exceed company/government... 5.1.2 Production costs which are controlled by operators indicate...	Process Variables – Knowledge of effects and relationships of process variables such as pressure, composition, temperature, level, and flow. Operating Parameters – Knowledge of normal operating procedures and design limits, and the differences between them. System Components – Knowledge of system components and their functions (e.g., stationary equipment, rotating equipment, instrumentation and controls.) Etc.	Drums Hoses Compressors Extruders Flares Boilers, etc.

Different Key Activities

Same Occupational Skills & Knowledge

STEP 6: Integrate academic and employability knowledge and skills

Skill standards provide the underlying academic and employability knowledge and skills required to perform each critical work function and its related key activities, or learning outcomes, in a skill standards based curriculum. This direct link enables the academic and employability knowledge and skills to be sequenced in the curriculum so that students will be prepared to achieve the learning outcomes. The academic and employability knowledge and skills are comparable to the SCANS skills referenced in the THECB's *GIPWE*, as mentioned previously. The equivalencies are listed in the following table.

Comparison of SCANS and AEKS	
SCANS Foundation Skills and Competencies	Academic and Employability Knowledge & Skills (AEKS)
Basic Skills: reads, writes, performs arithmetic & mathematical operations, listens and speaks.	<ul style="list-style-type: none"> • Reading • Writing • Mathematics • Listening • Speaking
Personal Qualities: displays responsibility, self-esteem, sociability, self-management, integrity and honesty.	<ul style="list-style-type: none"> • Self and career development • Adaptability • Using social skills
Resources: identifies, organizes, plans and allocates resources.	<ul style="list-style-type: none"> • Organizing and planning
Information: acquires and uses information.	<ul style="list-style-type: none"> • Using information and communications technology • Gathering and analyzing information
Interpersonal	<ul style="list-style-type: none"> • Works with others
Systems: understands complex interrelationships.	<ul style="list-style-type: none"> • Using information and communications technology • Analyzing and solving problems
Technology: works with a variety of technologies.	<ul style="list-style-type: none"> • Using information and communications technology

Academic and employability knowledge and skills may be integrated into prerequisite courses, technical core or related WECM courses, or in academic core or related Academic Course Guide Manual courses. Capstone and external learning experience courses offer other strategies for integrating these cross-functional skills in a technical program.

Appendix

Occupational Skills & Knowledge Sequencing

➤ **EXAMPLE**

Different Occupational Skills and Knowledge for Each Key Activity

In the cross section of Webmaster skill standards below, each key activity has different occupational skills and knowledge. This suggests that they could be taught within the same course as the related learning outcomes.

Occupational Title: Webmaster			
Critical Work Function 1. Perform Content and Technical Analysis		Occupational Skills, Knowledge & Conditions	
Key Activity	Performance Criteria	Occupational Skills & Knowledge	Conditions
1.1 Gather data to identify customer requirements.	1.1.1 Audience and mission of project ...	<ul style="list-style-type: none"> • Knowledge of customer interview techniques regarding requirements. • Ability to identify key sources of information. • Knowledge of the subject matter. 	<ul style="list-style-type: none"> • Computer workstation/ server with adequate processing...
1.2 Research content.	1.2.1 Content is properly indexed and weighted by importance...	<ul style="list-style-type: none"> • Knowledge of indexing and weighting techniques. • Knowledge of mapping techniques. • Knowledge of sources for content. • Ability to relate content to mission. 	<ul style="list-style-type: none"> • Computer workstation/ server with adequate processing...
1.3 Define scope of work.	1.3.1 Features and functions of the product are properly utilized. 1.3.2 Project objectives are identified and agreed upon...	<ul style="list-style-type: none"> • Knowledge of the types of features and functions and their implementation. • Ability to define measurable criteria for completion of work. • Ability to identify key sources of information. • Ability to assess skill sets. • Ability to assess resources required for scope of work. 	<ul style="list-style-type: none"> • Computer workstation/ server with adequate processing ... • Relevant graphics, animation, database... etc.

Different Key Activities

Different Occupational Skills & Knowledge