Appendix

Building Competencies for Careers: Linking Occupational Elements with Deeper Learning

Table of Contents

Introduction **2**

Study Design **2**

Methods **3**

Sampling **3**

Coding **5**

Analysis **14**

Limitations **16**

Analysis Tables **17**

References **25**

Introduction

This appendix presents the study design, study methods, and limitations of the Center on Education Policy (CEP) report, *Building Competencies for Careers: Linking Occupational Elements with Deeper Learning Competencies*. The appendix concludes with two analysis tables of additional data not included in the main report.

Study Design

CEP sought to expand the research base around the Hewlett Foundation's deeper learning initiative by linking their six competencies (see **table 1**) with the Occupational Information Network's (O*NET) knowledge, skills, abilities, and work styles (KSAWs) needed for a wide range of occupations.

Table 1. Deeper learning competencies

Deeper learning competency	Definition
Master core academic content	Students develop and draw from a baseline understanding of knowledge in an academic discipline and are able to transfer knowledge to other situations.
Think critically and solve complex problems	Students apply tools and techniques gleaned from core subjects to formulate and solve problems. These tools include data analysis, statistical reasoning, and scientific inquiry as well as creativity, nonlinear thinking, and persistence.
Work collaboratively	Students cooperate to identify and create solutions to academic, social, vocational, and personal challenges.
Communicate effectively	Students clearly organize their data, findings, and thoughts.
Learn how to learn	Students monitor and direct their own thinking.
Develop academic mindsets	Students develop positive attitudes and beliefs about themselves as learners that increase their academic perseverance and prompt them to engage in productive academic behaviors. Students are committed to seeing work through to completion, meeting their goals, and doing quality work, and thus search for solutions to overcome obstacles.

Source: Hewlett Foundation, 2013.

This research was conducted using information from the O*NET 21.0 database, which includes detailed information for 963 occupations. The database is continually updated by surveying "job incumbents and occupational experts" (O*NET, n.d.). The database's descriptors (categories of information) include the main tasks and activities performed in a given occupation, along with the knowledge, skills, and abilities required. O*NET OnLine, which is created using information from the O*NET database, classifies occupations in several different ways, including Bright Outlook jobs and Job Zones (see **table 2** and **table 3**). For this study, an occupation was considered a Bright Outlook occupation if it met any of the three criteria in the O*NET definition for this term, shown in table 2. An occupation that did not meet any of the three criteria was considered a non-Bright Outlook occupation.

An example of how the classifications can be seen with the occupation Automotive Engineers which require "considerable preparation" (placing them in Job Zone 4). Automotive Engineer is also a Bright Outlook occupation because it is (a) expected to have large numbers of job openings and (b) is considered a new and emerging occupation.

Table 2. O*NET OnLine classifications

Classification	Definition
Bright Outlook	Occupations that 1) are expected to grow rapidly in the next several years, 2) will have large numbers of job openings, or 3) are new and emerging occupations.
Job Zones	Occupations grouped into one of five categories based on levels of education, experience, and training necessary to perform the occupation (with zone 1 the lowest and zone 5 the highest).

Source: O*NET OnLine. Retrieved from https://www.onetonline.org/

Table 3. O*NET OnLine categories for the Job Zone classification

Classification	Category	Definition
Job Zone	1	Little or no preparation needed
	2	High school diploma
	3	Training in vocational schools, related on-the-job experience, or an associate's degree
	4	Four-year bachelor's degree
	5	Graduate school (e.g., a master's, Ph.D., M.D. or J.D.)

Source: O*NET OnLine. Retrieved from https://www.onetonline.org/

Methods

Sampling

The study includes a purposefully representative sample with replacement of occupations included in the O*NET database. To draw our sample, we designed a sample frame that accounted for:
1) approximately 300 occupations, or roughly 30% of all occupations in O*NET,
2) approximately equal percentages of occupations by Career Cluster (jobs in the same field of work),[1] and
3) approximately representative percentages of occupations by Bright Outlook classification and Job Zone categories.

To generate approximately equal percentages of occupations by Career Cluster, we used Excel to create a random number for each occupation, sorted the random numbers in ascending order, and took the first 15% of the occupations. We then removed duplicate occupations within the same Career Cluster[2]

[1] CEP researchers used approximately equal percentages of occupations by the 16 Career Clusters to ensure that our sample did not exclude one or more clusters while over-representing another.

[2] A single occupation could be presented under the same cluster but under different pathways. For example, the occupation "Art, Drama, and Music Teachers, Postsecondary" is listed in the "Arts, Audio/Video Technology, and Communications" Career Cluster twice: once for the "Performing Arts" pathway and once for the "Journalism and Broadcasting" pathway.

and replaced them with the next non-duplicated randomly listed occupation within the same Career Cluster. When an occupation was selected with insufficient information for our analysis,[3] we replaced it with the next randomly listed occupation in the same Career Cluster. Our randomly generated sample by Career Cluster did not meet our third condition for our sample frame—therefore, we did not analyze the data using Career Clusters.

To complete the third condition of the sample frame, we used our random sample by Career Cluster as a base for a purposeful sample that achieved approximately representative percentages of occupations by Bright Outlook classification and Job Zone categories. We made a matrix with Job Zone categories on one axis and Bright Outlook and non-Bright Outlook classifications on the other axis. The matrix demonstrated the percentage of each Job Zone category/Bright Outlook classification that was needed to complete our sample frame. Trying to maintain balance in the already drawn Career Cluster categories, we removed occupations from over-sampled matrixes cells and replaced them with occupations that met the requirements of under-sampled matrixes cells. Table 4 provides our final sample and shows that we were able to closely match the approximately representative percentages of Bright Outlook classification and Job Zone categories while maintaining approximately equal percentages of occupations by Career Cluster category.

Table 4. Sample frame and finalized sample

Classification	Category	O*NET population	Total O*NET population	% of total O*NET population	Sample	Total sample	% of total sample	% of sample to population
Bright Outlook	-	388	974	39.8%	120	301	39.9%	30.9%
Non-Bright Outlook	-	586	974	60.2%	181	301	60.1%	30.9%
Job Zone	Zone 1	44	955	4.6%	13	301	4.3%	29.5%
	Zone 2	275	955	28.8%	86	301	28.6%	31.3%
	Zone 3	255	955	26.7%	83	301	27.6%	32.5%
	Zone 4	224	955	23.5%	70	301	23.3%	31.3%
	Zone 5	157	955	16.4%	49	301	16.3%	31.2%
Career Cluster	Agriculture	171	974	17.6%	28	301	9.3%	16.4%
	Architecture	134	974	13.8%	22	301	7.3%	16.4%
	Arts	127	974	13.0%	20	301	6.6%	15.7%
	Business	144	974	14.8%	24	301	8.0%	16.7%
	Education	89	974	9.1%	15	301	5.0%	16.9%
	Finance	50	974	5.1%	8	301	2.7%	16.0%
	Government	74	974	7.6%	12	301	4.0%	16.2%
	Health Sci	211	974	21.7%	35	301	11.6%	16.6%
	Hospitality	66	974	6.8%	11	301	3.7%	16.7%
	Human Services	98	974	10.1%	16	301	5.3%	16.3%
	Information Tech	58	974	6.0%	9	301	3.0%	15.5%
	Law	74	974	7.6%	12	301	4.0%	16.2%
	Manufacturing	196	974	20.1%	30	301	10.0%	15.3%

[3] O*NET OnLine may include a military occupation title but does not provide any detailed information on the occupation. The O*NET database does not include military positions.

	Marketing	72	974	7.4%	12	301	4.0%	16.7%
	Science	170	974	17.5%	28	301	9.3%	16.5%
	Transportation	113	974	11.6%	19	301	6.3%	16.8%

Coding

Once CEP researchers drew the sample, the specific occupational elements[4] that comprise the knowledge, skills, abilities, and work styles for occupations in the O*NET database needed to be connected or "linked" to deeper learning competencies. To do this, CEP researchers relied on a two-stage coding system. Coffey and Atkinson (1996) point out two uses of codes: a) to simplify or reduce data and b) to "expand, transform, and reconceptualize data" (p. 29). In our study, the two-stage coding process allowed us to do both. The first stage reduced the data and the second stage helped us reconceptualize O*NET's occupational elements.

In the first stage of coding, for data reduction, CEP researchers used a set of preselected binary codes (see **table 5** for a list of all codes used both stages of the coding process). Using O*NET occupational descriptors as a point of reference (see **table 6**) three CEP researchers selected any descriptor with at least one O*NET occupational element applicable to K-12. Researchers then used O*NET definitions to review over 250 occupational elements to identify those that were applicable to K-12 education,[5] using the broadest possible scope so as to capture the greatest number of O*NET occupational elements and therefore the greatest number of O*NET descriptors. Researchers independently selected O*NET occupational elements that they considered relevant to K-12 education. The researchers then met as a group to compare codes and resolve any discrepancies (as suggested by Bryman & Burgess, 1994, p. 222). **Table 7** includes the 89 O*NET occupational elements selected for the second stage of coding.

Table 5. Codes used in stage one and stage two of the coding process

Stage	Code	Definition
1	K-12	Any O*NET occupational element that is *likely* to be included in the explicit or implicit curriculum in a typical K-12 education experience
	Non-K-12	Any O*NET occupational element that is *likely* to be outside of the explicit or implicit curriculum in a typical K-12 education experience
2	1*	Master core academic content
	2*	Think critically and solve complex problems
	3*	Work collaboratively
	4*	Communicate effectively
	5*	Learn how to learn
	6*	Develop academic mindsets
	7**	Not applicable to codes 1-6

[4] The O*NET database includes a list of "elements," or *specific* knowledge, skills, abilities, and work styles. For example, the broad area of "basic skills" includes the specific occupational elements of "active listening" and "writing," as well as several other elements. Similarly, the broad area of "cognitive abilities" includes the specific occupational elements of "deductive reasoning," "information ordering," and several others.

[5] For example, knowledge of "biology" was considered to be relevant to K-12, but knowledge of "medicine and dentistry" was not.

*Preselected codes are numerical representations of the six deeper learning competencies and taken from Hewlett (2013). The numbers do not represent a hierarchy or indicate significance.

**This code was created post-coding in response to multiple coders marking N/A. See the discussions below of the second stage of coding and limitations for further discussion.

Table 6. O*NET occupational descriptors selected for the matching stage

Descriptor	Definition
Abilities	Enduring attributes of the individual that can influence performance.
Knowledge	Organized sets of principles and facts applying in general domains.
Skills	Developed capacities that facilitate learning or the more rapid acquisition of knowledge.
Work styles	Personal characteristics that can affect how well someone performs a job.
Work values	Global aspects of work that are important to a person's satisfaction.

Table 7. O*NET occupational elements selected for the matching stage

Descriptor	Element	Definition
Knowledge	Biology	Knowledge of plant and animal organisms, their tissues, cells, functions, interdependencies, and interactions with each other and the environment.
	Building and construction	Knowledge of materials, methods, and the tools involved in the construction or repair of houses, buildings, or other structures such as highways and roads.
	Chemistry	Knowledge of the chemical composition, structure, and properties of substances and of the chemical processes and transformations that they undergo. This includes uses of chemicals and their interactions, danger signs, production techniques, and disposal methods
	Computers and electronics	Knowledge of circuit boards, processors, chips, electronic equipment, and computer hardware and software, including applications and programming.
	Customer and personal service	Knowledge of principles and processes for providing customer and personal services. This includes customer needs assessment, meeting quality standards for services, and evaluation of customer satisfaction.
	Design	Knowledge of design techniques, tools, and principles involved in production of precision technical plans, blueprints, drawings, and models.
	Engineering and technology	Knowledge of the practical application of engineering science and technology. This includes applying principles, techniques, procedures, and equipment to the design and production of various goods and services.
	English language	Knowledge of the structure and content of the English language including the meaning and spelling of words, rules of composition, and grammar.
	Fine arts	Knowledge of the theory and techniques required to compose, produce, and perform works of music, dance, visual arts, drama, and sculpture.
	Food production	Knowledge of techniques and equipment for planting, growing, and harvesting food products (both plant and animal) for consumption, including storage/handling techniques.

	Foreign language	Knowledge of the structure and content of a foreign (non-English) language including the meaning and spelling of words, rules of composition and grammar, and pronunciation.
	Geography	Knowledge of principles and methods for describing the features of land, sea, and air masses, including their physical characteristics, locations, interrelationships, and distribution of plant, animal, and human life.
	History and archaeology	Knowledge of historical events and their causes, indicators, and effects on civilizations and cultures.
	Mathematics	Knowledge of arithmetic, algebra, geometry, calculus, statistics, and their applications.
	Mechanical	Knowledge of machines and tools, including their designs, uses, repair, and maintenance.
	Philosophy and theology	Knowledge of different philosophical systems and religions. This includes their basic principles, values, ethics, ways of thinking, customs, practices, and their impact on human culture.
	Physics	Knowledge and prediction of physical principles, laws, their interrelationships, and applications to understanding fluid, material, and atmospheric dynamics, and mechanical, electrical, atomic and sub- atomic structures and processes.
	Production and processing	Knowledge of raw materials, production processes, quality control, costs, and other techniques for maximizing the effective manufacture and distribution of goods.
	Sociology and anthropology	Knowledge of group behavior and dynamics, societal trends and influences, human migrations, ethnicity, cultures and their history and origins.
	Telecommunications	Knowledge of transmission, broadcasting, switching, control, and operation of telecommunications systems.
Skills, Basic	Active learning	Understanding the implications of new information for both current and future problem-solving and decision-making.
	Active listening	Giving full attention to what other people are saying, taking time to understand the points being made, asking questions as appropriate, and not interrupting at inappropriate times.
	Critical thinking	Using logic and reasoning to identify the strengths and weaknesses of alternative solutions, conclusions or approaches to problems.
	Learning strategies	Selecting and using training/instructional methods and procedures appropriate for the situation when learning or teaching new things.
	Mathematics	Using mathematics to solve problems.
	Monitoring	Monitoring/Assessing performance of yourself, other individuals, or organizations to make improvements or take corrective action.
	Reading comprehension	Understanding written sentences and paragraphs in work related documents.
	Science	Using scientific rules and methods to solve problems.
	Speaking	Talking to others to convey information effectively.
	Writing	Communicating effectively in writing as appropriate for the needs of the audience.

	Complex problem solving	Identifying complex problems and reviewing related information to develop and evaluate options and implement solutions.
Skills, Social	Coordination	Adjusting actions in relation to others' actions.
	Instructing	Teaching others how to do something.
	Negotiation	Bringing others together and trying to reconcile differences.
	Persuasion	Persuading others to change their minds or behavior.
	Service orientation	Actively looking for ways to help people.
Skills, Technical	Equipment maintenance	Performing routine maintenance on equipment and determining when and what kind of maintenance is needed.
	Equipment selection	Determining the kind of tools and equipment needed to do a job.
	Installation	Installing equipment, machines, wiring, or programs to meet specifications.
	Operation and control	Controlling operations of equipment or systems.
	Operation monitoring	Watching gauges, dials, or other indicators to make sure a machine is working properly.
	Operations analysis	Analyzing needs and product requirements to create a design.
	Programming	Writing computer programs for various purposes.
	Quality control analysis	Conducting tests and inspections of products, services, or processes to evaluate quality or performance.
	Repairing	Repairing machines or systems using the needed tools.
	Technology design	Generating or adapting equipment and technology to serve user needs.
	Troubleshooting	Determining causes of operating errors and deciding what to do about it.
Skills, Systems	Judgment and decision making	Considering the relative costs and benefits of potential actions to choose the most appropriate one.
	Systems analysis	Determining how a system should work and how changes in conditions, operations, and the environment will affect outcomes.
	Systems evaluation	Identifying measures or indicators of system performance and the actions needed to improve or correct performance, relative to the goals of the system.
Skills, Resource Management	Management of financial resources	Determining how money will be spent to get the work done, and accounting for these expenditures.
	Management of material resources	Obtaining and seeing to the appropriate use of equipment, facilities, and materials needed to do certain work.
	Management of personnel resources	Motivating, developing, and directing people as they work, identifying the best people for the job.
	Time management	Managing one's own time and the time of others.
Abilities, Cognitive	Category flexibility	The ability to generate or use different sets of rules for combining or grouping things in different ways.
	Deductive reasoning	The ability to apply general rules to specific problems to produce answers that make sense.
	Flexibility of closure	The ability to identify or detect a known pattern (a figure, object, word, or sound) that is hidden in other distracting material.
	Fluency of ideas	The ability to come up with a number of ideas about a topic (the number of ideas is important, not their quality, correctness, or creativity).

	Inductive reasoning	The ability to combine pieces of information to form general rules or conclusions (includes finding a relationship among seemingly unrelated events).
	Information ordering	The ability to arrange things or actions in a certain order or pattern according to a specific rule or set of rules (e.g., patterns of numbers, letters, words, pictures, mathematical operations).
	Mathematical reasoning	The ability to choose the right mathematical methods or formulas to solve a problem.
	Memorization	The ability to remember information such as words, numbers, pictures, and procedures.
	Number facility	The ability to add, subtract, multiply, or divide quickly and correctly.
	Oral comprehension	The ability to listen to and understand information and ideas presented through spoken words and sentences.
	Oral expression	The ability to communicate information and ideas in speaking so others will understand.
	Originality	The ability to come up with unusual or clever ideas about a given topic or situation, or to develop creative ways to solve a problem.
	Perceptual speed	The ability to quickly and accurately compare similarities and differences among sets of letters, numbers, objects, pictures, or patterns. The things to be compared may be presented at the same time or one after the other. This ability also includes comparing a presented object with a remembered object.
	Problem sensitivity	The ability to tell when something is wrong or is likely to go wrong. It does not involve solving the problem, only recognizing there is a problem.
	Selective attention	The ability to concentrate on a task over a period of time without being distracted.
	Speed of closure	The ability to quickly make sense of, combine, and organize information into meaningful patterns.
	Time sharing	The ability to shift back and forth between two or more activities or sources of information (such as speech, sounds, touch, or other sources).
	Written comprehension	The ability to read and understand information and ideas presented in writing.
	Written expression	The ability to communicate information and ideas in writing so others will understand.
Work Styles	Achievement/effort	Job requires establishing and maintaining personally challenging achievement goals and exerting effort toward mastering tasks.
	Adaptability/flexibility	Job requires being open to change (positive or negative) and to considerable variety in the workplace.
	Analytical thinking	Job requires analyzing information and using logic to address work-related issues and problems.
	Attention to detail	Job requires being careful about detail and thorough in completing work tasks.
	Concern for others	Job requires being sensitive to others' needs and feelings and being understanding and helpful on the job.
	Cooperation	Job requires being pleasant with others on the job and displaying a good-natured, cooperative attitude.

	Dependability	Job requires being reliable, responsible, and dependable, and fulfilling obligations.
	Independence	Job requires developing one's own ways of doing things, guiding oneself with little or no supervision, and depending on oneself to get things done.
	Initiative	Job requires a willingness to take on responsibilities and challenges.
	Innovation	Job requires creativity and alternative thinking to develop new ideas for and answers to work-related problems.
	Integrity	Job requires being honest and ethical.
	Leadership	Job requires a willingness to lead, take charge, and offer opinions and direction.
	Persistence	Job requires persistence in the face of obstacles.
	Self control	Job requires maintaining composure, keeping emotions in check, controlling anger, and avoiding aggressive behavior, even in very difficult situations.
	Social orientation	Job requires preferring to work with others rather than alone, and being personally connected with others on the job.
	Stress tolerance	Job requires accepting criticism and dealing calmly and effectively with high stress situations.

Source: O*NET OnLine. Retrieved from https://www.onetonline.org/

The second stage of coding helped researchers reconceptualize the data by linking O*NET occupational elements to deeper learning competencies. CEP researchers invited outside partners to help with the second stage of coding. Specifically, we sought to work with people who could be considered experts on deeper learning or experts on the O*NET database. CEP also had two researcher coders (**table 8** includes all coders by coding stage). One CEP researcher, Catie DiElsi, participated in both coding stages.

Two O*NET coders submitted a single set of agreed upon codes. Darrel Sandall described the process he used with John Henderson as follows: "We used a process whereby one of us served as a coder to create primary linkages for the deeper learning competencies and then the initial primary linkages were reviewed and commented upon by the second coder. Following the completion of the second coder's work, the two coders discussed the differences between their linkages and came to a consensus on the final linkages that were submitted" (Personal communication, March 7, 2017).

Table 8. Coders names and occupations, by coding stage

Coding Stage	Name	Occupation	Expert
1	Braun, Matthew	Research Associate, CEP	Education policy
	DiElsi, Catie	Intern, CEP	Education policy
	Frizzell, Matthew	Senior Research Associate, CEP	Education policy
2	DiElsi, Catie	Intern, CEP	Education policy
	Ferguson, Maria	Executive Director, CEP	Deeper learning
	Henderson, John*	Industrial/Organizational Psychologist, Personnel Science Solutions	O*NET
	Rasmussen Foster, Laura	Manager, Education Research, RTI International	O*NET

	Rothman, Robert	Senior Editor, National Center on Education and the Economy	Deeper learning
	Sandall, Darrel*	Assistant Professor, College of Business at the Florida Institute of Technology	O*NET
	Stark Rentner, Diane	Deputy Director, CEP	N/A

*Collaborated to submit one set of codes.

Coders were provided with a list of definitions of the O*NET occupational elements organized alphabetically by their corresponding O*NET occupational descriptor, and with definitions of the deeper learning competencies (Hewlett, 2013). Coders were asked to provide as many as three numeric codes for each O*NET occupational element, so that the first code or "first tier" code represented the strongest link and a "third tier" code represented the weakest link. Multiple tier coding was permitted because researchers wanted to acknowledge that deeper learning competencies are not mutually exclusive and, in fact, are interrelated (see the Limitations section for more discussion).

In the coding process, coders were asked to use the deeper learning and O*NET occupational element definitions we provided and not to rely on their individual knowledge of either the O*NET database or deeper learning competencies. Individuals coded O*NET occupational elements independently, except as noted above. Final coding sheets were submitted to CEP researchers, and coders did not have the opportunity to see the completed codes of others.

Because coders for the second stage of coding were located across the country and because there were 89 O*NET occupational elements, coders did not resolve discrepancies as was done in stage one. Instead researchers used an intercoder reliability measure to check the degree of alignment between the six sets of codes.[6] Researchers entered codes into an Excel file and used Fleiss' Kappa to measure intercoder reliability. Fleiss' Kappa was selected to measure intercoder reliability because it allows for more than two coders, is suitable for nominal data, and corrects for chance agreement; and because there were no missing observations (Fleiss, Levin, & Paik, 2003). (For more on kappa statistics, see Box A.)

Box A. Kappa statistics

A kappa statistic was designed to measure alignment between two or more coders that can account for agreement based on chance. As Fleiss et al., 2003 write:

> Some degree of agreement is to be expected by chance alone. For example, if coder *A* employs one set of criteria for distinguishing between the presence and the absence of a condition, and if coder *B* employs an entirely different and independent set of criteria, then *all* the observed agreement is explainable by chance. (p. 602)

The kappa statistic ranges from 1 to -1 where 1 means that there was complete agreement beyond change between all coders for deeper learning competencies matched to all O*NET occupational

[6] Researchers also conducted a percent agreement analysis for each O*NET occupational element and for all 89 O*NET occupational elements combined that were linked in the first tier. The combined percent agreement was 71.3%. (Tables 9 and 10 show individual percent agreement for O*NET occupational elements.)

elements. If the kappa statistic is 0, it signifies that any agreement between coders was based on chance alone. Negative one indicates perfect disagreement beyond chance.

There are two "benchmarks" of significance for interpreting kappa statistics. In the first, established by Landis and Koch (1977), a kappa value of 0.81 or greater represents almost perfect alignment beyond chance, between .061 and .08 substantial alignment, 0.41 and 0.6 moderate alignment, 0.21 and 0.4 fair alignment, 0.0 and 0.2 slight alignment, and anything less than 0.0 poor alignment. Fleiss et al. (2003) use a second set of significance benchmarks where approximately equal to 0.75 represents excellent agreement beyond chance, approximately 0.4 to 0.75 fair to good agreement, and below approximately 0.4 poor agreement.

Because the second and third tier included either absent values or weaker links between a deeper learning competency and the O*NET occupational element, we discarded the second and third tiers. Our kappa value and all further analysis was based only on first tier matches. The kappa analysis was conducted in a composite measure of all O*NET occupational elements for tier one matches (as suggested by Fleiss et al., 2003, p. 604).

Our composite kappa statistic for 89 O*NET occupational elements was 0.44.[7] Researchers decided that this value, while in the realm of moderate agreement, was lower than desired. We revisited our selected O*NET occupational elements and omitted occupations that were possibly not applicable to all K-12 education experiences (i.e. building and construction in the knowledge descriptor) or might have been considered redundant (i.e. mathematics in the knowledge descriptor and mathematics in the skills descriptor). We omitted 36 O*NET occupational elements (see **table 9**).

Our composite kappa statistic for 53 O*NET occupational elements was 0.57. This statistic is considered to signal moderate agreement beyond chance by Landis and Koch (1977) and fair to good agreement beyond chance by Fleiss et al. (2003). We calculated the standard error of our kappa statistic to be 0.017 and the critical ratio as 33.59. The standard error and critical ratio indicate that our kappa statistic is significantly different from zero.

Table 9. Percent agreement for removed O*NET occupational elements

O*NET occupational element	Percent agreement
Building and construction	66.7%
Customer and personal service	50%
Design	66.7%
Engineering and technology	66.7%
Food production	83.3%
Mechanical	66.7%
Production and processing	66.7%
Telecommunications	83.3%
Active learning	83.3%
Reading comprehension	50%
Science	50%
Equipment maintenance	66.7%
Equipment selection	66.7%
Installation	50%

[7] The standard error for the 89 O*NET occupations kappa statistic was 0.017 and the critical ratio was 25.43. This indicates that our original kappa statistic of 0.44 was significantly different from zero.

Operation and control	66.7%
Operation monitoring	66.7%
Operations analysis	66.7%
Quality control analysis	66.7%
Repairing	66.7%
Technology design	66.7%
Troubleshooting	100%
Management of financial resources	50%
Management of material resources	50%
Management of personnel resources	66.7%
Category flexibility	50%
Flexibility of closure	83.3%
Perceptual speed	33.3%
Problem sensitivity	66.7%
Selective attention	33.3%
Speed of closure	50%
Time sharing	33.3%
Adaptability/flexibility	50%
Concern for others	50%
Cooperation	83.3%
Integrity	50%
Social orientation	100%

Analysis

Once researchers established that the links between the deeper learning competencies and O*NET occupational elements were in good agreement beyond chance (Fleiss et al., 2003), we assigned a specific competency to each O*NET occupational element based on the coding majority. For example, all coders said that Fine Arts linked best with deeper learning's *master core academic content*. However, the linkage was not always that clear. As **table 10** shows, Monitoring had 50% agreement but no coding majority because it was a 50-50 split between *think critically and solve complex problems* and *learn how to learn*. A few O*NET occupational elements with low percent agreement had a majority link to a deeper learning competency. For example, Leadership had only a 33% agreement but responses other than *work collaboratively* responses were so divided that two coders making the same link constituted a majority. Finally, the majority of coders said that there was no deeper learning competency that was applicable for Dependability. Occupational elements that did not have a coding majority or had a coding majority that identified the element as not applicable were removed from our analysis.

Table 10. Percent agreement and deeper learning matches for O*NET occupational elements

O*NET occupational element	Percent agreement	Deeper learning competency match
Biology	100%	Master core academic content
Chemistry	100%	Master core academic content
Computers and electronics	100%	Master core academic content
English language	100%	Master core academic content
Fine arts	83.3%	Master core academic content
Foreign language	100%	Master core academic content
Geography	100%	Master core academic content
History and archaeology	100%	Master core academic content
Mathematics (Knowledge)	100%	Master core academic content

Physics	100%	Master core academic content
Philosophy and theology	100%	Master core academic content
Sociology and anthropology	100%	Master core academic content
Active listening	100%	Communicate effectively
Critical thinking	100%	Think critically and solve complex problems
Learning strategies	83.3%	Learn how to learn
Mathematics (Skill)	66.7%	Master core academic content
Monitoring	50%	No match
Speaking	100%	Communicate effectively
Writing	100%	Communicate effectively
Complex problem solving	100%	Think critically and solve complex problems
Coordination	83.3%	Work collaboratively
Instructing	66.7%	Communicate effectively
Negotiation	66.7%	Work collaboratively
Persuasion	50%	Communicate effectively
Service orientation	33.3%	No match
Programming	50%	Think critically and solve complex problems
Judgment and decision making	83.3%	Think critically and solve complex problems
Systems analysis	83.3%	Think critically and solve complex problems
Systems evaluation	83.3%	Think critically and solve complex problems
Time management	50%	Learn how to learn
Deductive reasoning	50%	Think critically and solve complex problems
Fluency of ideas	50%	Think critically and solve complex problems
Inductive reasoning	83.3%	Think critically and solve complex problems
Information ordering	66.7%	Think critically and solve complex problems
Mathematical reasoning	50%	No match
Memorization	50%	Master core academic content
Number facility	66.7%	Master core academic content
Oral comprehension	100%	Communicate effectively
Oral expression	100%	Communicate effectively
Originality	66.7%	Think critically and solve complex problems
Written comprehension	83.3%	Communicate effectively
Written expression	100%	Communicate effectively
Achievement/effort	66.7%	Develop academic mindsets
Analytical thinking	100%	Think critically and solve complex problems
Attention to detail	50%	Learn how to learn
Dependability	66.7%	Not applicable
Independence	66.7%	Learn how to learn
Initiative	66.7%	Develop academic mindsets
Innovation	66.7%	Think critically and solve complex problems
Leadership	33.3%	Work collaboratively
Persistence	33.3%	No match
Self control	50%	Develop academic mindsets
Stress tolerance	33.3%	No match

To finalize our analysis, we created an Excel spreadsheet that included all occupations in our sample. These occupations were divided on the spreadsheet by Bright Outlook and non-Bright Outlook and by all five Job Zones—each receiving its own tab. (This Excel file is provided as a supplemental document to the report and can be downloaded for free at cep-dc.org.) Then we added the 53 O*NET occupational elements.

We used dichotomous variables to mark all the O*NET occupational elements that were important for any job with a "1" and "0" if the element was not important. To determine if an element was important, we used O*NET's definition of importance, whereby any O*NET occupational element with a scale score of 50 or greater based on survey responses is identified as important for a specific occupation.

Using dichotomous variables allowed us to track which O*NET occupational elements were important for all the occupations in our sample. From there, we were able to calculate the percent of O*NET occupational elements that were important for all jobs in the sample by their linked deeper learning competency. For example, across all sampled occupations, there were 4,515 opportunities for *master core academic content* to be identified as important; this the product of multiplying 301 (the number sampled occupations) by 15 (the number of O*NET occupational elements linked to *master core academic content*). However, only 921 of the O*NET occupational elements linked with *master core academic content* were identified as important. In other words, 20.4% of the elements linked to the deeper learning competency *master core academic content* were identified as being important for all the occupations in the sample. (**Table 11** displays the above example along with the other five deeper learning competencies needed for all sampled occupations.)

Table 11. Percentage of deeper learning competencies needed for all sampled occupations (n=301)

Deeper learning competency	Number of links between deeper learning competency and O*NET occupational element	Possible number of instances of importance	Number of instances of importance	Percentage of importance
Master core academic content	15	4,515	921	20.40%
Think critically and solve complex problems	13	3,913	2570	65.68%
Work collaboratively	3	903	566	62.68%
Communicate effectively	9	2,709	2012	74.27%
Learn how to learn	4	1,204	920	76.41%
Develop academic mindsets	3	903	891	98.67%

Limitations

The two-stage coding process for linking deeper learning competencies to O*NET occupational elements was designed to respect the time of coders by removing elements that are not related to the general goals of primary and secondary education. This first stage reduced O*NET's 254 occupational elements to 89. However, this first-stage reduction prevented second-stage coders from viewing the entire scope of O*NET occupational elements. It is possible that had coders been given all of the 254 O*NET occupational elements and the opportunity to select "not applicable to the goals of primary and secondary education" that they would have included some elements that were excluded by first-stage coders.

Another limitation of the analysis, and perhaps the largest limitation, is the interconnectedness of deeper learning competencies. That the six competencies are not mutually exclusive means that even when a group of coders unanimously linked an O*NET occupational element to *master core academic content,* other competencies are embedded in the mastery of core academic content. For example, a student who has not developed an academic mindset or who struggles to effectively communicate knowledge will have difficulty mastering core academic content. To this point, *master core academic content* was the most commonly linked deeper learning competency, with 15 matches to O*NET occupational elements; however, it had the lowest percentage of importance compared with the five other competencies. Conversely, only three links were made between the competency *develop academic mindsets* and the O*NET occupational elements, yet 99% of the elements were identified as important for occupations in our sample.

The kappa statistic also comes with limitations. First, Fleiss et al. (2003) caution that even with a statistic showing good agreement, there is no guarantee that the coders have made matches beyond what would be expected by chance (p. 598). Second, we assumed all six coders were approximately equal. However, if one coder had substantially greater knowledge of both O*NET and deeper learning content, then this assumption is flawed and the use of a kappa statistic may no longer be valid. Finally, CEP researchers are not aware of the use of a kappa statistic for linking deeper learning competencies to O*NET occupational knowledge, skills, abilities, and work styles. Yet, Fleiss et al. (2003) point to different applications for the kappa statistic that include an example of a study design similar to ours (see p. 618, example 4).

Analysis Tables

This section includes two tables that summarize the analysis conducted for the report but were not included in the report. **Table 12** displays the percentage of important knowledge, skills, abilities, and work styles for each occupation in the sample, as well as the occupation's Job Zone and Bright Outlook status. **Table 13** shows the percentage of important O*NET occupational elements for all the occupations in the sample. The supplemental file containing the raw data used to create these tables is available online at www.cep-dc.org.

Table 12. Percentage of important KSAWs in the O*NET sample by occupation

Occupation	% of important KSAWs	Job Zone	Bright Outlook
Actuaries	73.58%	4	Yes
Acupuncturists	54.72%	5	Yes
Adhesive Bonding Machine Operators and Tenders	41.51%	2	No
Advertising and Promotions Managers	71.70%	4	No
Aerospace Engineers	79.25%	4	No
Agricultural Inspectors	58.49%	2	No
Agricultural Sciences Teachers, Postsecondary	75.47%	5	No
Agricultural Technicians	73.58%	3	No
Aircraft Structure, Surfaces, Rigging, and Systems Assemblers	50.94%	2	No
Amusement and Recreation Attendants	28.30%	1	Yes
Anesthesiologists	79.25%	5	Yes
Appraisers and Assessors of Real Estate: Assessors	58.49%	3	No

Architectural and Civil Drafters: Architectural Drafters	66.04%	4	No
Architectural and Engineering Managers	81.13%	5	No
Archivists	58.49%	5	No
Assessors	64.15%	3	No
Athletic Trainers	69.81%	5	Yes
Audio and Video Equipment Technicians	58.49%	3	No
Auditors	75.47%	4	Yes
Automative Specialty Technicians	49.06%	3	Yes
Automotive and Watercraft Service Attendants	39.62%	1	No
Automotive Engineers	75.47%	4	Yes
Aviation Inspectors	58.49%	3	No
Bakers	47.17%	2	No
Bill and Account Collectors	62.26%	2	No
Biological Science Teachers, Postsecondary	75.47%	5	Yes
Biomass Plant Technicians	54.72%	2	Yes
Biomedical Engineers	83.02%	4	Yes
Brickmasons and Blockmasons	39.62%	2	Yes
Broadcast News Analysts	62.26%	4	No
Bus and Truck Mechanics and Diesel Engine Specialists	45.28%	3	No
Business Teachers, Postsecondary	77.36%	5	No
Buyers and Purchasing Agents, Farm Products	73.58%	4	No
Camera and Photographic Equipment Repairers	47.17%	3	No
Chemical Plant and System Operators	50.94%	2	No
Chemists	71.70%	4	No
Childcare Workers	62.26%	2	Yes
Choreographers	71.70%	4	No
City and Regional Planning Aides	64.15%	4	No
Civil Drafters	62.26%	3	No
Civil Engineers	81.13%	4	Yes
Cleaners of Vehicles and Equipment	20.75%	2	Yes
Clergy	77.36%	5	No
Climate Change Analysts	77.36%	5	Yes
Clinical Psychologists	67.92%	5	Yes
Clinical, Counseling, and School Psychologists: School Psychologists	75.47%	5	Yes
Coaches and Scouts	69.81%	4	No
Coating, Painting, and Spraying Machine Setters, Operators, and Tenders	30.19%	2	No
Commercial and Industrial Designers	64.15%	4	No
Communications Teachers, Postsecondary	71.70%	5	No
Computer and Information Systems Managers	71.70%	4	Yes
Computer Hardware Engineers	66.04%	4	No
Computer Network Architects	66.04%	4	No
Computer Network Support Specialists	58.49%	4	No
Computer Numerically Controlled Machine Tool Programmers, Metal and Plastic	67.92%	3	Yes
Computer Operators	60.38%	3	No
Computer Science Teachers, Postsecondary	73.58%	5	No
Computer Systems Engineers/Architects	73.58%	4	Yes
Computer User Support Specialists	60.38%	3	Yes
Conservation Scientists-Soil and Water Conservationists	81.13%	4	No

Construction and Related Workers, All Other: Solar Thermal Installers and Technicians	56.60%	3	Yes
Construction Carpenters	49.06%	2	Yes
Conveyor Operators and Tenders	56.60%	2	No
Cost Estimators	67.92%	4	No
Counter and Rental Clerks	47.17%	1	Yes
Court Clerks	47.17%	2	No
Court Reporters	41.51%	3	No
Craft Artists	41.51%	2	No
Crane and Tower Operators	41.51%	3	No
Credit Checkers	47.17%	2	No
Criminal Justice and Law Enforcement Teachers, Postsecondary	67.92%	5	Yes
Critical Care Nurses	75.47%	3	Yes
Crossing Guards	24.53%	1	No
Curators	71.70%	5	No
Customer Service Representatives	50.94%	2	Yes
Cytotechnologists	52.83%	5	Yes
Dancers	49.06%	3	No
Data Entry Keyers	49.06%	2	No
Database Administrators	67.92%	4	No
Derrick Operators, Oil and Gas	47.17%	1	No
Desktop Publishers	60.38%	3	No
Detectives and Criminal Investigators: Police Detectives	67.92%	3	No
Diagnostic Medical Sonographers	67.92%	3	Yes
Dietitians and Nutritionists	77.36%	5	Yes
Directors, Religious Activities and Education	71.70%	4	No
Directors-Stage, Motion Pictures, Television, and Radio	66.04%	4	No
Distance Learning Coordinators	71.70%	5	Yes
Drilling and Boring Machine Tool Setters, Operators, and Tenders, Metal and Plastic	41.51%	2	No
Driver/Sales Workers	33.96%	2	No
Earth Drillers, Except Oil and Gas	41.51%	2	Yes
Economics Teachers, Postsecondary	75.47%	5	No
Electrical and Electronics Installers and Repairers, Transportation Equipment	45.28%	3	No
Electrical and Electronics Repairers, Powerhouse, Substation, and Relay	52.83%	3	No
Electrical Engineering Technicians	67.92%	3	No
Electrical Engineers	77.36%	4	No
Electromechanical Engineering Technologists	69.81%	4	Yes
Electromechanical Equipment Assemblers	35.85%	2	No
Emergency Medical Technicians and Paramedics	71.70%	3	Yes
Engineering Technicians, Except Drafters, All Other: Non-Destructive Testing Specialists	60.38%	2	Yes
Engineers, All Other: Biochemical Engineers	79.25%	4	Yes
English Language and Literature Teachers, Postsecondary	67.92%	5	No
Environmental Engineers	88.68%	5	No
Etchers and Engravers	43.40%	2	No
Executive Secretaries and Executive Administrative Assistants	54.72%	3	No
Extruding, Forming, Pressing, and Compacting Machine Setters, Operators, and Tenders	35.85%	2	No

Farmers, Ranchers, and Other Agricultural Managers-Nursery and Greenhouse Managers	73.58%	3	Yes
Fiberglass Laminators and Fabricators	49.06%	2	No
File Clerks	50.94%	2	No
Film and Video Editors	60.38%	3	Yes
Financial Examiners	77.36%	4	No
First-Line Supervisors of Agricultural Crop and Horticultural Workers	73.58%	3	No
First-Line Supervisors of Farming, Fishing, and Forestry Workers-First-Line Supervisors of Logging Workers	64.15%	2	No
First-line Supervisors of Food Preparation and Serving Workers	67.92%	2	Yes
First-Line Supervisors of Landscaping, Lawn Service, and Groundskeeping Workers	69.81%	3	No
First-Line Supervisors of Mechanics, Installers, and Repairers	79.25%	3	Yes
First-Line Supervisors of Office and Administrative Support Workers	71.70%	3	Yes
First-Line Supervisors of Personal Service Workers	69.81%	3	No
First-Line Supervisors of Production and Operating Workers	66.04%	2	No
First-Line Supervisors of Retail Sales Workers	67.92%	2	Yes
First-Line Supervisors of Transportation and Material-Moving Machine and Vehicle Operators	71.70%	2	No
Fitness Trainers and Aerobics Instructors	50.94%	3	No
Floor Layers, Except Carpet, Wood, and Hard Tiles	33.96%	2	No
Food Batchmakers	41.51%	2	No
Food Science Technicians	60.38%	3	No
Food Scientists and Technologists	81.13%	4	No
Food Service Managers	66.04%	3	No
Foreign Language and Literature Teachers, Postsecondary	75.47%	5	No
Forest Firefighters	64.15%	2	Yes
Fraud Examiners, Investigators, and Analysts	69.81%	4	Yes
Fuel Cell Engineers	75.47%	5	Yes
Funeral Attendants	35.85%	2	No
Furniture Finishers	35.85%	1	No
Gaming Change Persons and Booth Cashiers	39.62%	2	No
Geological Sample Test Technicians	62.26%	4	No
Grinding, Lapping, Polishing, and Buffing Machine Tool Setters, Operators, and Tenders, Metal and Plastic	43.40%	2	No
Hazardous Materials Removal Workers	52.83%	3	No
Health Educators	69.81%	4	No
Health Technologists and Technicians, All Other: Neurodiagnostic Technologists	64.15%	3	Yes
Healthcare Practitioners and Technical Workers, All Other: Midwives	62.26%	4	Yes
Healthcare Social Workers	71.70%	5	Yes
Heating, Air Conditioning, and Refrigeration Mechanics and Installers-Heating and Air Conditioning Mechanics and Installers	58.49%	3	Yes
Heavy and Tractor-Trailer Truck Drivers	35.85%	2	Yes
Helpers--Brickmasons, Blockmasons, Stonemasons, and Tile and Marble Setters	35.85%	2	Yes
Helpers--Electricians	37.74%	2	Yes
Helpers--Installation, Maintenance, and Repair Workers	37.74%	2	No
Helpers--Production Workers	20.75%	2	Yes
Helpers--Roofers	33.96%	2	Yes
Highway Maintenance Workers	43.40%	2	No

Histotechnologists and Histologic Technicians	54.72%	3	Yes
Home Economics Teachers, Postsecondary	73.58%	5	No
Hospitalists	79.25%	5	Yes
Hosts and Hostesses, Restaurant, Lounge, and Coffee Shop	33.96%	1	Yes
Hotel, Motel, and Resort Desk Clerks	43.40%	2	Yes
Human Resources Assistants, Except Payroll and Timekeeping	54.72%	3	No
Industrial Engineering Technicians	71.70%	3	No
Industrial Truck and Tractor Operators	28.30%	2	Yes
Inspectors, Testers, Sorters, Samplers, and Weighers	47.17%	2	Yes
Instructional Coordinators	79.25%	5	No
Instructional Designers and Technologists	71.70%	5	Yes
Insulation Workers, Floor, Ceiling, and Wall	28.30%	2	No
Insurance Claims Clerks	49.06%	3	No
Intelligence Analysts	62.26%	4	Yes
Interpreters and Translators	66.04%	4	Yes
Janitors and Cleaners, Except Maids and Housekeeping Cleaners	20.75%	2	Yes
Laborers and Freight, Stock, and Material Movers, Hand	20.75%	2	Yes
Landscaping and Groundskeeping Workers	24.53%	1	Yes
Laundry and Dry-Cleaning Workers	24.53%	1	No
Lawyers	71.70%	5	Yes
Legal Secretaries	47.17%	3	No
Librarians	64.15%	5	No
Loan Counselors	75.47%	4	Yes
Locomotive Engineers	52.83%	2	No
Lodging Managers	79.25%	3	No
Logisticians	73.58%	4	No
Logistics Analysts	67.92%	4	Yes
Logistics Engineers	79.25%	4	Yes
Machinists	43.40%	3	Yes
Management Analysts	66.04%	4	Yes
Managers, All Other: Regulatory Affairs Managers	73.58%	4	Yes
Manicurists and Pedicurists	22.64%	2	No
Marketing Managers	77.36%	4	No
Massage Therapists	47.17%	3	Yes
Materials Engineers	77.36%	4	No
Mathematical Science Teachers, Postsecondary	71.70%	5	Yes
Mechanical Drafters	62.26%	3	No
Mechanical Engineering Technicians	67.92%	3	No
Medical and Health Services Managers	79.25%	5	Yes
Medical Equipment Preparers	50.94%	2	Yes
Medical Secretaries	54.72%	3	Yes
Meter Readers, Utilities	33.96%	2	No
Millwrights	56.60%	3	Yes
Model Makers, Metal and Plastic	45.28%	3	No
Motorboat Mechanics and Service Technicians	47.17%	3	No
Music Directors	75.47%	4	No
Musical Instrument Repairers and Tuners	47.17%	3	No
Musicians, Instrumental	35.85%	3	No
Nanosystems Engineers	77.36%	5	Yes
Naturopathic Physicians	71.70%	5	Yes

Nuclear Equipment Operation Technicians	60.38%	3	No
Nuclear Medicine Physicians	84.91%	5	Yes
Nursery and Greenhouse Managers	73.58%	3	Yes
Nursery Workers	15.09%	1	Yes
Occupational Health and Safety Specialists	81.13%	4	No
Occupational Health and Safety Technicians	67.92%	3	No
Occupational Therapists	73.58%	5	Yes
Office Machine Operators, Except Computer	49.06%	2	No
Online Merchants	67.92%	4	Yes
Operations Research Analysts	71.70%	5	Yes
Order Clerks	52.83%	2	No
Orthotists and Prosthetists	66.04%	5	Yes
Painters, Transportation Equipment	32.08%	2	No
Painting, Coating, and Decorating Workers	15.09%	2	No
Paperhangers	33.96%	2	No
Parking Lot Attendants	26.42%	2	No
Parts Salespersons	60.38%	2	No
Patient Representatives	66.04%	4	Yes
Petroleum Pump System Operators, Refinery Operators, and Gaugers	58.49%	2	No
Photographers	60.38%	3	No
Physicians and Surgeons, All Other: Allergists and Immunologists	79.25%	5	Yes
Physics Teachers, Postsecondary	81.13%	5	Yes
Pile-Driver Operators	35.85%	2	Yes
Plant and System Operators, All Other-Biofuels Processing Technicians	54.72%	2	Yes
Plumbers, Pipefitters, and Steamfitters: Pipe Fitters and Steamfitters	56.60%	3	Yes
Poets, Lyricists and Creative Writers	56.60%	4	No
Police and Sheriff's Patrol Officers: Police Patrol Officers	58.49%	3	Yes
Police Identification and Records Officers	54.72%	3	No
Political Science Teachers, Postsecondary	67.92%	5	No
Postal service clerks	49.06%	2	No
Postal Service Mail Sorters, Processors, and Processing Machine Operators	24.53%	2	No
Power Distributors and Dispatchers	56.60%	3	No
Preventive Medicine Physicians	81.13%	5	Yes
Print Binding and Finishing Workers	41.51%	2	No
Private Detectives and Investigators	60.38%	3	No
Product Safety Engineers	60.38%	4	No
Public Address System and Other Announcers	49.06%	2	No
Public Relations Specialists	69.81%	4	No
Quality Control Systems Managers	81.13%	4	Yes
Radiation Therapists	64.15%	3	Yes
Radio Frequency Identification Device Specialists	64.15%	4	Yes
Radio Operators	54.72%	3	No
Radiologic Technicians	56.60%	3	Yes
Railroad Conductors and Yardmasters	56.60%	2	No
Range Managers	73.58%	4	No
Recreation and Fitness Studies Teachers, Postsecondary	67.92%	5	No
Refractory Materials Repairers, Except Brickmasons	26.42%	2	No
Refrigeration Mechanics and Installers	58.49%	3	Yes
Risk Management Specialists	69.81%	4	Yes

Robotics Engineers	81.13%	4	Yes
Sales Agents, Financial Services	67.92%	3	No
Sales Representatives, Wholesale and Manufacturing, Except Technical and Scientific Products	56.60%	4	Yes
Sales Representatives, Wholesale and Manufacturing, Technical and Scientific Products	67.92%	4	No
Security and Fire Alarm Systems Installers	50.94%	3	No
Security Guards	32.08%	2	No
Security Management Specialists	67.92%	4	Yes
Self-Enrichment Education Teachers	54.72%	3	Yes
Separating, Filtering, Clarifying, Precipitating, and Still Machine Setters, Operators, and Tenders	41.51%	2	No
Set and Exhibit Designers	77.36%	5	No
Sewers, Hand	24.53%	2	No
Sewing Machine Operators	24.53%	1	No
Shampooers	32.08%	2	No
Sheet Metal Workers	50.94%	2	No
Shipping, Receiving, and Traffic Clerks	43.40%	2	Yes
Slaughterers and Meat Packers	16.98%	1	No
Social Science Research Assistants	69.81%	4	No
Software Developers, Applications	71.70%	4	Yes
Software Developers, Systems Software	64.15%	4	Yes
Solar Sales Representatives and Assessors	62.26%	3	Yes
Solar Thermal Installers and Technicians	56.60%	3	Yes
Sound Engineering Technicians	60.38%	3	No
Special Education Teachers, Middle School	69.81%	4	No
Special Education Teachers, Secondary School	75.47%	4	No
Statisticians	69.81%	5	Yes
Storage and Distribution Managers	64.15%	4	No
Structural Iron and Steel Workers	47.17%	2	No
Surgeons	75.47%	5	Yes
Surveying Technicians	62.26%	3	No
Sustainability Specialists	71.70%	4	Yes
Switchboard Operators, Including Answering Service	43.40%	2	No
Tapers	18.87%	2	No
Tax Examiners and Collectors, and Revenue Agents	66.04%	3	No
Technical directors/managers	71.70%	4	No
Technical Writers	54.72%	4	No
Telecommunications Equipment Installers and Repairers, Except Line Installers	58.49%	3	No
Telemarketers	30.19%	2	No
Terrazzo Workers and Finishers	28.30%	2	No
Tire Builders	30.19%	2	No
Title Examiners, Abstractors, and Searchers	50.94%	3	No
Training and Development Managers	71.70%	4	No
Transit and Railroad Police	58.49%	3	No
Transportation Planners	77.36%	4	Yes
Umpires, Referees, and Other Sports Officials	49.06%	3	No
Veterinarians	67.92%	5	No
Veterinary Assistants and Laboratory Animal Caretakers	52.83%	3	No
Waiters and Waitresses	33.96%	1	Yes

Weatherization Installers and Technicians	47.17%	2	Yes
Web Administrators	66.04%	3	Yes
Welding, Soldering, and Brazing Machine Setters, Operators, and Tenders	39.62%	2	No
Wellhead Pumpers	39.62%	2	No
Wholesale and Retail Buyers, Except Farm Products	75.47%	3	No
Wind Turbine Service Technicians	50.94%	3	Yes
Zoologists and Wildlife Biologists	71.70%	5	No

Table 13. Percentage of important occupational elements for all occupations in the sample

KSAW element	Percentage of importance for all sampled occupations
Knowledge	
Biology	13.62%
Chemistry	12.96%
Computers & Electronics	53.49%
English Language	84.39%
Fine Arts	3.99%
Foreign Language	1.00%
Geography	4.65%
History & Archeology	2.33%
Mathematics	52.16%
Philosophy & Theology	2.66%
Physics	12.62%
Sociology & Anthropology	8.97%
Total Knowledge	*21.07%*
Skills	
Active Listening	92.36%
Critical Thinking	88.37%
Learning Strategies	32.23%
Mathematics	23.59%
Monitoring	86.05%
Speaking	91.36%
Writing	66.11%
Complex Problem Solving	72.43%
Time Management	74.75%
Coordination	73.09%
Instructing	41.20%
Negotiation	24.58%
Persuasion	36.54%
Service Orientation	47.84%
Judgment & Decision Making	77.74%
Systems Analysis	37.54%
Systems Evaluation	33.55%
Programming	2.99%
Total Skills	*55.68%*
Abilities	
Deductive Reasoning	91.36%
Fluency of Ideas	51.50%

Inductive Reasoning	84.72%
Information Ordering	92.36%
Mathematical Reasoning	29.57%
Memorization	7.31%
Number Facility	22.26%
Oral Comprehension	95.35%
Oral Expression	93.02%
Originality	46.18%
Written Comprehension	81.73%
Written Expression	70.76%
Total Abilities	*63.84%*
Work Styles	
Achievement/Effort	98.34%
Analytical Thinking	89.04%
Attention to Detail	100.00%
Dependability	100.00%
Independence	98.67%
Initiative	98.34%
Innovation	86.05%
Leadership	90.37%
Persistence	98.34%
Self Control	99.34%
Stress Tolerance	99.00%
Total Work Styles	*96.13%*

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