

A Review of Learning Outcomes for California HVACR Certification Programs

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Project Overview

Applied Learning Science was commissioned to perform a comprehensive review of the Heating, Ventilation, Air Conditioning, and Refrigeration (HVACR) certification programs at a number of community colleges across California as well as the National Center for Construction Education and Research (*NCCER*) accreditation program and *HVACRedu*, an industry-recognized online program. The primary objectives for this study were to:

- Perform a crosswalk of the programs' content with the competencies included in *HVAC Excellence* (www.hvacexcellence.org). *HVAC Excellence* is a non-profit organization that created the first and largest programmatic accreditation for HVACR programs in the United States. It is widely accepted as setting the standard for HVACR program quality. Note that the purpose of the current review was NOT to determine the extent to which each college's program met the standard for *HVAC Excellence* accreditation, but rather to provide documentation of course content in relation to the competencies included in the *HVAC Excellence* framework.
- Assess the extent to which the participating colleges adequately document the content of their HVACR certification courses. The current effort does not aim to evaluate the *quality* of the curriculum or the likelihood that students are adequately prepared to enter the workforce as HVACR technicians.

Methodology

Participating Schools:

The review was conducted from June 2016 – July 2017 and included twelve (12) California Community College HVACR certification programs:

- Orange Coast College: Costa Mesa, CA
- Antelope Valley College: Lancaster, CA
- Cypress College; Cypress, CA
- Riverside Community College: Riverside, CA
- Fresno Community College: Fresno, CA
- Sacramento City College: Sacramento, CA
- Laney College: Oakland, CA
- San Jose Community College: San Jose, CA
- El Camino College; Torrance, CA
- College of the Desert; Palm Desert, CA
- Mount San Antonio College; Walnut, CA
- Los Angeles Trade Technical College; Los Angeles, CA

Additionally, we analyzed the HVACR course content developed by *NCCER* and *HVACRedu*. Additional information about *NCCER* can be found here: <https://www.nccer.org/nccer-home>; the *HVACRedu* online certification program can be found at: www.itsaboutq.net.

Evaluation Approach:

Applied Learning Science partnered with each of the programs being reviewed to gather course outlines for all courses included in the HVACR certification programs. Over one hundred fifty (150) courses were reviewed as part of this study.

To perform the curriculum crosswalk for each program, we first developed a competency framework based on the competencies and tasks included in the *HVAC Excellence* program. For brevity and ease of interpretation, effort was taken to condense the content in each competency. Care was taken to preserve the intent of each competency. After developing the evaluation framework, a keyword search approach was adopted to identify the extent to which each course mapped onto the competencies included in the *HVAC Excellence* program.

Review Protocol:

The review protocol that was used is divided into four distinct phases. A summary of each phase is provided below and the full protocol is included in Appendix A:

- Phase 1: Examine course outlines to understand structure and breadth of program.
- Phase 2: Perform a keyword search and map course topics onto competencies. Include evidence to support rationale of course mapping. Engage in calibration workshop with research team to review findings and discuss any misaligned mappings.
- Phase 3: Review cross-program gaps and determine additional areas of content coverage.
- Phase 4: Final review is created by compiling all schools' course mappings with a heatmap and summary.

We erred on the side of giving the schools “credit” for comprehensively covering the required objectives. However, the level of detail and style of documentation varied greatly across programs. Our main objective in mapping program content to the *HVAC Excellence* program was to provide a baseline assessment of overlap. Caution should be taken in interpreting the results pending validation of findings by program owners.

Evaluation of Findings

High-level findings:

To best illustrate coverage of the *HVAC Excellence* content across schools, a heatmap was created that shows the extent to which the courses included in each certification program map onto the *HVAC Excellence* competencies.

College \ Competency	NCCER 1-4	NCCER 1-3	HVAC Redu	P1	P2	P3	P4	P5	P6	P7	P8	P9	P10	P11	P12
Core / Electrical	Dark Green	Dark Green	Medium Green	Dark Green	Dark Green	Light Green	Medium Green	Medium Green	Medium Green	Light Green	Dark Green	Medium Green	Dark Green	Medium Green	Medium Green
Electric Heat	Medium Green	Medium Green	Dark Green	Light Green	Light Green	Light Green	Light Green	Light Green	Light Green	Light Green	Light Green	Light Green	Light Green	Light Green	Medium Green
Air Conditioning	Dark Green	Dark Green	Dark Green	Medium Green	Dark Green	Light Green	Light Green	Dark Green	Medium Green	Medium Green	Medium Green	Dark Green	Dark Green	Dark Green	Dark Green
Gas Heat	Medium Green	Medium Green	Dark Green	White	Light Green	White	Light Green	Medium Green	Light Green	Light Green	Dark Green	Dark Green	Dark Green	Light Green	Light Green
Oil Heat	Medium Green	Medium Green	Dark Green	Light Green	Light Green	White	Light Green	Light Green	Light Green	Light Green	Medium Green	Medium Green	Medium Green	Light Green	Medium Green
Heat Pumps	Dark Green	Medium Green	Dark Green	Medium Green	Medium Green	Light Green	Light Green	Light Green	Light Green	Light Green	Light Green	Dark Green	Dark Green	Medium Green	Medium Green
Light Commercial Air Conditioning	Dark Green	Medium Green	Dark Green	Medium Green	Medium Green	Light Green	Light Green	Medium Green	Medium Green	Medium Green	Medium Green	Dark Green	Dark Green	Medium Green	Medium Green
Light Commercial Refrigeration	Dark Green	Light Green	Medium Green	Dark Green	Medium Green	Light Green	Dark Green	Medium Green	Medium Green	Medium Green	Light Green	Dark Green	Dark Green	Medium Green	Medium Green

KEY	
90-100%	Comprehensive Coverage of Learning Objectives
75-89%	Significant Coverage of Learning Objectives
50-74%	Learning Objectives Moderately Covered
25-49%	Learning Objectives Minimally Covered
0-25%	Competency not included as part of the Curriculum

Discussion of Findings:

For all of the community college programs included in this review, the alignment of the curriculum documentation with *HVAC Excellence* was moderate. We have concluded that several of the schools' program documentation adequately covers the content required to satisfy the *HVAC Excellence* program. However, a number of schools had weak documentation, such that we could not determine whether the programs taught the required competencies.

Findings Relative to Course Documentation:

- Based on the current outlines of record provided, it was challenging to assess alignment with the standards of *HVAC Excellence* because, in most cases, programs did not adequately document the content included in each course.
- With few exceptions, all schools would benefit from providing greater detail regarding content covered in each course.
- Course documents of record for many schools consisted of sparse outlines, which covered topical-level content of courses rather than learning outcomes. These outlines often described course content in only general, high-level terms that failed to convey the detail and specification of the actual subject matter taught.
- The level of detail and terminology included in the published course outlines was inconsistent. This not only presented a challenge for the current study, but likely will be problematic for potential students who are making enrollment decisions based on the breadth of content covered. Similarly, it would be challenging for employers to assess which programs teach skills that are most critical to meet their workforce needs.
- There does not appear to be a correlation between the number of courses required by a program nor number of students who complete a program and adequacy of documentation.

Implications:

Adequate documentation that identifies with accuracy and detail precisely what is taught in a course is critical. The existence and access to such information is beneficial for all stakeholders:

- Increased documentation allows students to make informed choices regarding which programs and courses align with their career aspirations
- The college can ensure that students are directed towards programs best suited for their interests and skills, thus decreasing turnover and increasing graduation rates
- Employers can make more informed hiring decisions when they can determine the knowledge, skills, and abilities imparted by specific programs

A standardized procedure for documentation across schools may be beneficial for HVAC programs because it would ensure that the necessary information and level of detail of course content is included in all outlines of record across the State and would allow for meaningful comparisons of Programs to be made. Given that there are widely accepted standards for documenting learning outcomes, this could be a relatively straightforward initiative with high return.

The National Institute for Learning Outcomes Assessment (2016) provided the following guidelines for improving course documentation. This could be a useful rubric for instructors to adopt when enhancing their course documentation:

1. Develop specific, actionable learning outcomes statements
2. Connect learning goals with actual student assignment and work
3. Collaborate with the relevant stakeholders, beginning with faculty
4. Design assessment approaches that generate actionable evidence about student learning that key stakeholders can understand and use to improve student and institutional performance
5. Focus on *improvement* and *compliance* will take care of itself

We also advise that not only should programs be reviewed and content extracted, but also that course outlines of record should be readily available to the public so that all stakeholders may have access to the information in order for it to be useful. This transparency would aid in the accurate comparison between content offered in various programs.

We acknowledge that the focus of faculty should be on providing the highest quality instruction to their students. The efforts required for many of the schools that we reviewed to improve documentation will be significant. It might be beneficial to determine the resources required to support faculty to ensure a quality deliverable is produced without impeding teaching commitments.

Appendix A: Review Protocol

Phase	Steps	Output
Become Familiar with School	<ol style="list-style-type: none"> Carefully examine the outlines of record to understand how the program is structured and the breadth of courses offered Review the program website to determine areas in which they specialize 	<ul style="list-style-type: none"> Validate list of courses and ensure we have all outlines Brief description of program (# of hours, # of faculty, etc.)
Perform Keyword Search	<p><i>For each outline of record:</i></p> <ol style="list-style-type: none"> Perform a keyword search for each topic covered in the course against the competencies Excel file (Note: if a competency requires “troubleshooting”/ “installing,” documentation must be more specific than simply listing the keyword) Document the course that covers the specific competency, indicating the course number and specifically where the evidence was found (cite a <u>direct quote</u> from the outline of record). If there is uncertainty, cite the course and direct quote as well as mark the area of uncertainty to review during workshopping 	<ul style="list-style-type: none"> Mapping of courses onto competencies Document evidence and thought process behind determination of mapped competencies
Review Gaps to Determine Additional Content Coverage	<ol style="list-style-type: none"> For basic-level concepts, consider the likelihood that it is covered but not documented (for example, if there is an entire course on heat pumps it can be assumed that they cover the basic design of a heat pump) <p>NOTE: If there is any question as to whether the competency is covered, the default is to NOT map the course to the competency. If, after reviewing all schools in this phase, we see a pattern that would suggest that it is a terminology challenge versus a gap, we will collectively decide how to proceed</p>	<ul style="list-style-type: none"> Additional mapping of courses
Final Review	<ol style="list-style-type: none"> Create heatmap for each school Make notes to guide validation session with faculty member 	<ul style="list-style-type: none"> Heatmap Summary for school Specific questions for faculty member(s)

References

National Institute for Learning Outcomes Assessment. (2016). *Higher Education Quality: Why Documenting Learning Matters. A Policy Statement from the National Institute for Learning Outcomes Assessment*. Retrieved from:
http://www.learningoutcomesassessment.org/documents/NILOA_policy_statement.pdf