

Exploring Workforce-Informed Competency Pathways in Computing Education

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Abstract

Computing educators strive to align curricula with workforce needs yet rarely articulate how professional competencies, behaviors, and responsibilities develop across different educational pathways. As the community moves beyond the 2027 curriculum revision cycle, bridge pathways spanning vocational, undergraduate, graduate, and non-computing entry routes are rapidly expanding. At the same time, widespread AI use requires curricula to more explicitly address professional judgment, accountability, and ethical reasoning, in addition to technical skills. This working group brings participants together to map, compare, and synthesize real curriculum and pathway artifacts using shared academic and workforce frameworks. Participants will build a competency-oriented pathway framework, identify recurring bridge pathway designs and gaps, and produce practical, post-2027 guidance that supports coherent, scalable, and internationally transferable computing curricula.

CCS Concepts

• **Social and professional topics** → **Computing education;**
Computing profession;

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Keywords

Computing competencies, competency-based education, computing profession, computing curricula, work-based experiences.

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1 MOTIVATION

Computing education continues to evolve in response to rapid technological change, shifting workforce demands, and increasingly diverse learner pathways. Although existing curricular guidelines and discipline-specific frameworks [2, 6] have provided essential structure, educators in institutional and national contexts continue to face persistent challenges in explicitly aligning curricula with workforce-relevant competencies [8] while maintaining academic rigor, transferability, and long-term adaptability.

There is a growing need to re-examine how computing curricula articulate competencies, professional dispositions, and progression across multiple learner pathways. Computing education increasingly serves learners following non-linear educational trajectories, including transitions across educational stages and entry into computing from non-computing disciplines. At the same time, the rapid integration of AI technologies into computing practice has intensified the need for cross-disciplinary competencies and professional dispositions. AI-related competencies are examined as an example

of professional judgment and responsibility, not as a standalone topic. Graduates must demonstrate not only technical proficiency but also critical thinking, problem-solving, communication, and ethical reasoning. These competencies are essential for questioning AI-generated outputs, verifying results, examining edge cases and outliers, and making evidence-based judgments beyond what statistical prediction and pattern matching alone. That is, curricula must explicitly articulate how human judgment, responsibility, and accountability are developed in conjunction with technical skills.

Bridge pathways [7] increasingly support transitions across educational stages in computing education, including progression between vocational or sub-degree programs, undergraduate programs, and graduate programs, and provide entry pathways from non-computing disciplines [1]. However, limited empirical evidence exists to describe how these pathways are structured, which features support student success, and where students experience friction during transitions. This working group will examine bridge pathways through a multi-institutional study using curriculum artifacts, institutional policies, and stakeholder perspectives to identify common pathway models and analyze patterns of preparedness and persistence. The outcomes will include best practices for bridge pathway models, identification of high-impact structural and curricular features, and a research-grounded framework for evaluating pathway effectiveness, providing empirical insights to support coherent and scalable pathway design across computing education.

These challenges are inherently international. European learning-outcomes-driven curriculum design, as in the Bologna Process [3] and the European Qualifications Framework (EQF) [4], emphasizes transparency, mobility, and competency alignment across educational levels. The Skills Framework for the Information Age (SFIA) [9] provides a complementary international model for describing professional skills, responsibility levels, and career progression across computing-related roles. In the US, the NICE Workforce Framework for Cybersecurity (NICE Framework) [5] sets up a common language for describing cybersecurity work. These provide robust frameworks to align academic learning outcomes with workplace expectations, without prescribing curricular structures.

This working group comprising educators, curriculum designers, and industry-informed stakeholders, positions workforce-aligned competency frameworks for designing future computing curricula.

2 WORKING GROUP OBJECTIVES

This working group examines how computing competencies are defined, developed, and aligned with workforce needs across educational pathways. There are three interconnected objectives, each with a proposed underlying research question:

- (1) **Curriculum–Workforce Alignment.** This objective investigates misalignment between academic curricula, workforce expectations, and student/program outcomes.
 - Research Question (RQ1): What gaps exist between computing curriculum outcomes and workforce expectations, and how can professional frameworks such as EQF, NICE, and SFIA be used to improve their alignment?
- (2) **Computing Competencies Development.** This objective focuses on defining well-rounded computing competencies that integrate technical knowledge, cross-disciplinary skills valued in the workplace, and professional dispositions. It

examines how educational programs can effectively develop these competencies and explores best practices for pathways and transitions between levels of education and training.

- Research Question (RQ2): What practices in computing education help students develop competencies valued in the workplace?
- (3) **Professional Responsibilities and Judgment: AI Impact.** This objective examines how the rise of AI reshapes the emphasis on professional responsibilities and judgments in post-secondary computing curricula.
 - Research Question (RQ3): What impacts does the advent of AI have on the relative importance of professional responsibilities and judgments in computing curricula in post-secondary education?

These objectives and research questions will guide the working group’s investigation of computing competencies, their development across educational pathways, and their alignment with workforce expectations. The working group also examines gaps between curricular intent, industry expectations, and student outcomes, as well as the role of professional judgment, ethical responsibility, and accountability in shaping competency development.

The full group report will inform computing education communities about how competencies (knowledge, skills, and dispositions) grounded in frameworks such as EQF and SFIA can be systematically integrated into computing curricula and bridge pathways. These coherent, transferable, and meaningful frameworks across institutional and international contexts can better prepare students for current and future workforce needs using workforce-aligned computing pathways.

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