

Toward Practical Computing Competencies

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ABSTRACT

Competency-based learning has been a successful pedagogical approach for centuries, but only recently has it gained traction within computing education. Building on recent developments in the field, this working group will explore competency-based learning from practical considerations and show how it benefits computing. In particular, the group will identify existing computing competencies and provide a pathway to generate competencies usable in the field. The working group will also investigate appropriate assessment approaches, provide guidelines for evaluating student attainment, and show how accrediting agencies can use these techniques to assess the level of competence reflected in their standards and criteria. Recommendations from the working group report are intended to help practical computing education writ large.

CCS CONCEPTS

• **Social and professional topics** → **Computer science education; Computing education;**

KEYWORDS

ITiCSE working group, computing education, competency-based learning, computing competencies

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ITiCSE 2021, June 26–July 1, 2021, Virtual Event, Germany

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ACM ISBN 978-1-4503-8397-4/21/06.

<https://doi.org/10.1145/3456565.3461442>

ACM Reference Format:

Rajendra K. Raj, Mihaela Sabin, John Impagliazzo, David Bowers, Mats Daniels, Felienne Hermans, Natalie Kiesler, Amruth N. Kumar, Bonnie MacKellar, Renée McCauley, Syed Waqar Nabi, and Michael Oudshoorn. 2021. Toward Practical Computing Competencies. In *26th ACM Conference on Innovation and Technology in Computer Science Education V. 2 (ITiCSE 2021)*, June 26–July 1, 2021, Virtual Event, Germany. ACM, New York, NY, USA, 2 pages. <https://doi.org/10.1145/3456565.3461442>

1 MOTIVATION

With the recent release of Computing Curricula 2020 (CC2020) [5], competency-based learning is likely to take center-stage and advance computing education. CC2020 itself owes a great deal to prior work in the Information Technology Curricular Guidelines (IT2017) [9], as well as other competency-focused curricular reports such as the Software Engineering Competency Model (SWE-COM) [7] and the model for graduate information systems programs [11].

This working group will also benefit from the results of an ITiCSE 2018 working group report [6] that developed a competency learning framework to establish a structure for describing competencies using knowledge, skills and dispositions in a specific subject domain. Another recent ITiCSE working group report [4] used the computer science curricular guidelines (CS2013) [2] to develop a process for deriving and validating competencies by applying the CC2020 guidelines.

The CC2020 Competency Model builds on the knowledge-skill-disposition (K-S-D) dimensions from IT2017 [9] by specifying them within a task context. Competencies ensure academic programs become intentional about forging working collaborations with partnering employers, who share their expertise and have the capacity to engage students in professional practice experiences. This

working group will examine practical aspects of competency-based learning in undergraduate computing. It will study how students achieve genuine competence through an ongoing transfer of university learning and graduate achievement. The emphasis will be on competency-based educational opportunities that promise practices to make inroads into computing education's practical aspects.

2 WORKING GROUP GOALS

Building on the background and motivation already mentioned, this working group has the following goals.

- (1) Identify samples of practical computing competencies for computing disciplines and define additional sample competencies for developing areas.
- (2) Understand the range of competencies in academia and industry, and how they contribute to the reported graduate "skills gap."
- (3) Determine how accrediting agencies incorporate and assess competency-based learning against their criteria, such as ABET's student outcome defined as "the knowledge, skills, and behaviors that students acquire as they progress through the program" [1].
- (4) Make recommendations for the computing education community to develop and use computing competencies in a practical and meaningful way.

These goals will drive the working group's investigations and recommendations for competency-based learning in computing fields.

3 SCOPE

This working group will engage in the following activities.

- (1) Review competency-based education research from a pedagogical framework that has existed for centuries and in practice today, for example, medical schools and other higher-learning and practice institutions.
- (2) Examine approaches currently in use for assessing competencies and provide useful guidelines for evaluating computing competency-based student learning.
- (3) Compare the academic assessment of competencies, as suggested in the CC2020 guidelines, with "competence in context" approaches, such as ISO 247773-2019 [8], the SFIA Foundation [10], and the Institute of Coding's recent accreditation standard [3].
- (4) Explore ways to integrate different approaches for assessing computing competencies helping to forge a coherent strategy.

These various activities will inform computing educational communities about the increasing relevance of competency-based approaches within computing as an overarching discipline.

4 INTENDED OUTPUTS

Following the Working Group's deliberations, the authors intend to deliver:

- (1) A taxonomy for "competency," with a mapping between academia and industry.

- (2) A mapping between this taxonomy and expectations expressed by accreditation agencies.
- (3) A sample set of competency statements for some key computing areas such as cybersecurity and high-performance computing.
- (4) Proposals for how mixing different kinds of competency assessment might address the skills gap.
- (5) Recommendations to the computing education community to develop and use computing competencies in practical and meaningful ways.

These products will help to enhance computing education in terms of the use of competency-based learning. This working group plans to create an intimate, cohesive atmosphere to explore the practical aspects of competency-based learning approaches, assessments, and solutions.

ACKNOWLEDGMENTS

This work builds on several prior efforts in competency-based computing education. Raj acknowledges support provided by the US National Science Foundation under Award 1922169.

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