Guest Editors’ Introduction

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Computing is the new literacy, and teaching computing in a world where computers are ubiquitous demands new techniques and contexts for learning. As these evolve, so too will the student profile.

Recently a number of computing education efforts made headlines—some of the biggest point to groundbreaking shifts in our thinking, like England adopting a brand new computer science curriculum, thousands of people studying computer science through massive open online courses (MOOCs), and Code.org’s recent viral video that had millions of people thinking about learning to code.

A common thread throughout these stories is that the way we think about computing education has changed. Traditional computing education brings to mind scruffy undergraduates swilling Mountain Dew and working in labs late into the night, or else rows of computers in a classroom where students follow rote instruction and gain vocational skills.

New developments in computing education are about bringing computer literacy to everyone, from young children to working adults to retirees. People are also learning about computing in places you wouldn’t expect, from your local elementary school to asynchronous online courses to art school. With all of these changes, people are computing using new devices and methods, like cell phones and specially designed clothing and eyewear.

In This Issue

The articles in this special issue highlight how computing education is moving beyond the typical classroom format. The authors bring to light how computing’s porous boundaries cut across subject areas and formal classroom structures. Computing education is changing because computing is increasingly necessary for understanding the world we live in.

Computer science is as valuable as biology, physics, or chemistry to our students. Consider a computer science concept: that all information is represented in a computer as digital patterns, and the same patterns could be a picture or text or a virus. That basic concept of data literacy is arguably more relevant to a student today than knowing the difference between cell meiosis and mitosis, or how to balance an equilibrium equation in chemistry.

We anticipate that learning computer science will be more than an important subject area. Computing will be a literacy: a necessary foundation upon which understanding of other disciplines can be built. The diverse range of educational approaches presented in this issue detail the ways that computing education has moved beyond the computer science department and necessitates new approaches to teaching and assessing computing literacy.
Maria Knobelsdorf and Jan Vahrenhold explore the challenges of teaching computing to primary- and secondary-school-age students compared with college-age students in their article, “Addressing the Full Range of Students: Challenges in K-12 Computer Science Education.” They identify some key challenges, such as “What curricula should we use in schools?” and “How do we prepare enough teachers?” and describe how such challenges could be addressed using examples from the educational system in Germany.

In “STEAM-Powered Computing Education: Using E-Textiles to Integrate the Arts and STEM,” Kylie Peppler discusses integrating art into traditional STEM (science, technology, engineering, and mathematics) courses by using new kinds of media. Her students combine the roles of engineers, designers, scientists, and artists as they explore issues of fashion and design—Peppler has students sewing computers into fabrics—with electronic circuits and computer programming.

In “The Porous Classroom: Professional Practices in the Computing Curriculum,” Sally Fincher and Daniel Knox consider learning and teaching beyond the computer science classroom. Moving from typically scripted lessons with carefully planned activities leading to predetermined learning outcomes, they find that the wild and unconstrained world outside the classroom offers many more learning opportunities—including bidirectional learning—and is much more motivating to students as they progress from the classroom to the world beyond.

Karen Brennan’s article “Learning Computing through Creating and Connecting” starts from the programming language Scratch, which was used to introduce computing into afterschool extracurricular and club activities. Students using Scratch learn through creating digital stories and animations, then share them with others, and further learn by mixing and remixing what was shared. Brennan considers this porous education from the opposite direction: where an informal learning tool, such as Scratch, moves into the traditional classroom for traditional learning structures.

“The Case for Validated Tools in Computer Science Education Research,” by Allison Elliott Tew and Brian Dorn, describes how to measure the impact of computing education in terms of learning and attitudes. This work ties these themes together and back to the traditional classroom—wherever learning is occurring, we need good assessment tools to know what’s working and what’s not, as well as how to compare different kinds of contexts for different students. Elliot Tew and Dorn tell us, “initial research and development investment pays dividends for the community because such validated instruments enable and enhance a host of both teaching and research activities.” Further, validated instruments could allow us to measure the impact of informal, maker-based, or practice-based approaches. Developing basic tools for measurement helps us connect to the work going on in our single classroom as well as to other classrooms and other disciplines and other contexts.

This special issue shows us how computer science is moving from subject to literacy. Although students sometimes learn computer science because they are interested in computers, more often today, students learn computer science because of what computers enable them to do. Computing is a form of expression and a tool for thinking. It has become fundamental to being an informed and effective professional, like reading, writing, and arithmetic. We use reading and writing in all subject areas, and we see that increasing numbers of students are using programming in the same way. The articles in this special issue offer a view into this new era of computing education.

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