Advances in Learning Technologies
The term “learning technologies” can refer to a variety of educational avenues, including emerging technologies on which teaching and learning might focus, or infrastructure technologies that give rise to novel teaching and learning environments, or technology-related practices that are used to facilitate teaching and learning.

Many of Computer’s readers are instructors at postsecondary institutions, teaching computer programming that is fundamental to the undergraduate computing curriculum. Those of us in the field know that despite continued innovations aimed at improving and facilitating computer programming mastery, many students do not embrace programming as a career. Traditional challenges in teaching programming are compounded by changes in the global job market for programming graduates. Programmers are no longer individual contributors on a standalone software project, instead they now often work in dispersed multinational teams. This is due to the complexity of the systems they will develop as well as the global nature of project management for both system and application development.

Today’s computer applications must capably handle multicultural and multi-platform implementations, and they are therefore the product of an overall interdisciplinary approach to system and application design. All of this heterogeneity presents unique challenges for educators as they prepare students, who will work with broad, interdisciplinary groups, as they enter the workforce. How can we help students succeed in this highly varied workplace when we are constrained by daily and semester schedules?

New and innovative technologies enable a variety of instructional environments that help students overcome many traditional boundaries and constraints to learning. As the classroom becomes more of an abstraction than a physical space, educators and learners embrace a variety of pioneering tech-powered teaching and learning paradigms that will serve students well upon graduation.

As educators, one of the most frustrating (and possibly career-limiting) aspects we face in this environment is the institutional reliance on student opinion surveys to evaluate the quality of teaching. These survey ratings are usually reported as class averages, with little attention to how the ratings relate to class learning outcomes. Although institutions could perform correlational analyses between survey results and overall course grade point averages (GPAs), most are unable to establish any causal relationship between the survey results and class performance. In any case, it is almost impossible to parse from the aggregate data any kind of relationship between individual student performance and that student’s opinion (assessment) of the instructor. With online instruction’s increasing popularity, we can now more readily collect many new kinds of data from a large number of individual students taking online courses, empowering us to perform new kinds of data analyses that would be impossible in conventional classroom teaching/learning environments. In addition, such analyses could help us to better understand the effect that the quality of instruction has on student learning outcomes.

Finally, in the area of nonteaching but academic computing professionals, there is the matter of open educational resources (OERs). This subject continues to be explored in the
literature, but often from the very traditional perspective of object-oriented programming (OOP). However, OERs are technology elements—learning resources in a variety of formats—that instructors can use and reuse to teach special “scaffolding” related to student capabilities and motivation levels to make the experience fun and interesting. The authors introduce an open source web-based platform for learning Python programming, called BlockPy. With fewer restrictions than other similar environments, this versatile platform can be used in both formal and informal scenarios. Thus it is effective in independent learning, teacher-led group lessons, or one-on-one tutoring.

IN THIS ISSUE
In “BlockPy: An Open Access Data-Science Environment for Introductory Programmers,” Austin Cory Bart, Javier Tibau, Eli Tilevich, Clifford A. Shaffer, and Dennis Kafura examine the problem of retention across a wider variety of learners pursuing formal and informal learning experiences in computing education. Such studies often struggle to find relevance in traditional computing curricula that either emphasize abstract concepts or rely on decontextualized settings. For traditional and nontraditional learners who have little experience with computing, educators need to provide a special “scaffolding” related to student capabilities and motivation levels to make the experience fun and interesting. The authors introduce an open source web-based platform for learning Python programming, called BlockPy. With fewer restrictions than other similar environments, this versatile platform can be used in both formal and informal scenarios. Thus it is effective in independent learning, teacher-led group lessons, or one-on-one tutoring.

In “Integrating Collaborative and Live Coding for Distance Education,” Soroush Ghorashi and Carlos Jensen explore collaboration technologies for improving online learning using a tool called Jimbo. A web-based collaborative integrated design environment (IDE) for HTML5 development, Jimbo was used and validated in an experimental online class on data science that let student collaborators focus on the key concepts being taught. Data collected from different surveys of students confirmed research showing that the use of pair programming, in which two students work together to solve a common problem on one computer, is an effective collaborative learning technique. The application of this technique produces better software code, and significantly higher student performance when compared to those programming alone.

HOW CAN WE HELP STUDENTS SUCCEED IN A HIGHLY VARIED WORKPLACE WHEN WE ARE CONSTRAINED BY SEMESTER SCHEDULES?

In “A Sentiment Analysis System to Improve Teaching and Learning,” Sujata Rani and Parteek Kumar define sentiment analysis (SA) as “a process of identification and classification of users’ opinions from a piece of text [such as a course survey or commentary in an online forum] ... to determine the user’s attitude toward a particular subject or entity” and explain that “it plays an important role in education.” SA can indeed help infer a broader picture of students’ attitudes toward a course or an instructor through a larger corpus of student work than from one single opinion survey. Rani and Kumar describe an SA model that was validated using a dataset constructed from a continuous collection of Coursera-based student comments and ratings for more than a year, plus comments and ratings from 25 university courses from different instructors over two years. Analyses of the data provide insights to help instructors modify their courses to account for both students’ sentiments and their learning outcomes.

In “Interdisciplinary Education for Design Innovation,” Toru Ishida, Tetsuo Sawaragi, Kumiyo Nakakoji, and Takushi Sogo present a comprehensive perspective on the utility of modern computing in the preservation of and enhancement to our social well-being. The 2011 tsunami disaster and subsequent meltdown of the Daiichi nuclear reactor in Fukushima prompted the realization in Japan that there is an urgent need to redevelop curricula to focus on design issues related to reconstructing cities and communities. The authors shift attention away from our traditional computing foci of problem identification and problem solving toward the consideration of such matters as
they apply to the larger social context. The authors describe building a 21st century design school, the Kyoto University Design School, which has a curriculum addressing technology concerns that include human-centered computing as well as societal concerns (which are typically the purview of social scientists). Some of the key highlights differentiating this approach include blending technological solutions with social engagement, leadership in interdisciplinary team formation and management, and improving commercial viability through the proactive involvement of industrial fellows.

Finally, in “Internet of Education Resources Using a Chemistry-Inspired Framework,” Henry C.B. Chan presents a novel way to characterize learning objects (LOs). Traditionally, LOs are likened to software objects that have characteristics similar to those used in OOP. And although there are many different “standards” for learning objects, they are all very similar in that respect. Chan proposes an entirely new model and perspective, which is based on concepts of molecular chemistry: that is, an individual LO is like an atom, which, through qualities described as micro and macro attributes, can be linked to form collections of LOs, like molecules. In this way, LOs are linked together, like atoms bond together, using a variety of criteria or attributes. This alternative model is a departure from how we traditionally deal with property inheritance in OOP, and which has been adopted in most, if not all, LO standards. For us, the editors of this special issue, Chan’s concept is a great example of thinking outside the box to reconceptualize a model that has been taken for granted for years.

Learning technologies have been a gradually evolving field of study in which new concepts, environments, and practices are welcomed by the highly engaged emerging global learning enterprise. Astoundingly, distances are largely irrelevant now, and timeframes seem to be instantaneous. We foresee that new learning paradigms will continue to reshape classrooms, on-demand and mobile classrooms will become the new normal in learning, and data-driven assessment for instruction and learning outcomes will drive improvements and evolution. Big data analytics-driven instruction, which is rapidly becoming an important element in smart machine–directed instruction, will eventually manifest as Internet of Things–based, truly adaptive learning environments. What an exciting world of learning lies ahead for us all.

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