

## ENABLING MOOC COLLABORATIONS THROUGH MODULARITY

LEARNING WITH MOOCs  
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Massive open online courses (MOOCs) have the potential to transform teaching and learning, and their impact is already being felt on university campuses and in popular culture. To meet the diverse learning needs of students at many institutions, MOOCs must encourage collaboration, not confrontation, with the professors using them. Today's online courses, typically created and controlled by small groups of faculty, both fail to foster this collaboration and also miss the opportunity to leverage the experience and experimental capacity present in classrooms across the country. A variety of instructors teaching a variety of different students in a variety of different ways represents an incredible education resource and living laboratory that MOOCs must find a way to harness, not suppress.

Unfortunately, dividing lines are already being drawn between faculty able to create MOOCs and those encouraged or even forced to use them. In their well-publicized rejection of Harvard's popular EdX course on social justice, philosophy faculty at San Jose State University raised concerns over the ability of online content to integrate into their existing courses:

When a university such as ours purchases a course from an outside vendor, the faculty cannot control the design or content of the course; therefore we cannot develop and teach content that fits with our overall curriculum and is based on both our own highly developed and continuously renewed competence and our direct experience of our students' needs and abilities.

As computer scientists, we see this complaint as expressing not a fundamental limitation of MOOCs, but a design flaw in how they are currently built: **today's MOOCs are not modular**. Modularity has long been appreciated when designing and implementing computer systems. Monolithic "blobs" of code, usually produced by a single developer to quickly solve a particular problem, are difficult to improve, test, and maintain, and are unlikely to be used by anyone but their creator. All of today's major online education providers, including Coursera, Udacity, and the edX platform, provide monolithic MOOC content: entire courses that are packaged and offered as an indivisible unit. This flaw limits their ability to partner with faculty at other institutions, to generate large and diverse data sets, and to fully address diverse student learning styles and objectives.

Since today's MOOCs suffer from a common software design problem, we are applying a standard software engineering solution: modularization. Modular MOOCs break content into small *modules* all sharing a common structure. Individual modules can be tested and improved in isolation and their impact on the entire class determined. As the goals and expectations of the class for which they were originally created change, and as the content itself changes, it is more likely that the functionality provided by modules will continue to remain relevant, while adding new modules keeps the course current.

Most importantly, modularization encourages the interinstitution collaboration that today's monolithic MOOCs struggle to achieve. Modules allow faculty to retain full control over course content and structure, with the ability to add, remove, alter and reorder modules in ways expressing their understanding of their students' needs and abilities, all while producing experimental data that benefits the original course. When faculty provide more effective replacements for existing modules, everyone benefits. And if one faculty member discovers an effective sequence of modules, all participating faculty can decide whether to adjust their own courses to incorporate this insight.

We are currently exploring the design and construction of *modular MOOCs* (*mMOOCs*), which exploit modularity to provide the control traditional faculty desire while providing the diverse and well-structure data sets required to answer fundamental questions about teaching and learning. We are beginning by augmenting `ops-class.org`, an online operating systems instructional environment. Built by Geoffrey Challen, it has made automated version of the programming assignments developed by Margo Seltzer available online. Once `ops-class.org` is able to support the diverse student outcomes and needs at our two institutions, the University at Buffalo and Harvard University, we will recruit faculty from other institutions to foster vibrant multi-institutional collaborations in education, just as we currently do in research.