

Is it time to change the undergraduate curriculum?

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My two oldest nieces, Miriam and Sarah, are both 16. Later this year, they will start their respective searches for a place at college in earnest. Their experiences will be different, not just because Miriam is interested in science and Sarah is interested in teaching. Miriam lives in Conwy, an ancient town of 15000 people in North Wales. Sarah lives in Olney, a Maryland suburb of 34000 outside Washington, DC.

When it comes to undergraduates, the university systems of the UK and the US are significantly different. In the UK, students typically study just one subject for three years—physics, in my case. In the US, students spend less time studying a major; more on other subjects.

The UK system has advantages and disadvantages. In three years, a UK physics student will be taught more physics than a US physics major will in four. That's a plus. On the other hand, prospective students in the UK have to be sure of their chosen subject. And if their high schools don't teach, say, economics or sociology—two subjects that were not offered at my school—they could fail to embark on a fulfilling vocation.

The US system of majors, minors, and general education is more forgiving and flexible, yet I have little enthusiasm for it. That view might seem heretical, given the current crop of books on the virtues of a liberal education. But tuition rates at US universities have become so high that we should question whether students are getting value for the money borrowed and spent, even if we conclude that undergraduate curriculums don't need to change.

One purported benefit of a liberal education is that it exposes students to a rich range of learning. It prepares them to be knowledgeable participants in society and can give them the intellectual flexibility to adapt to a changing economy. The general education requirements that I looked at for this editorial do indeed proclaim those praiseworthy aims.

But I've found little love among my US-educated friends for the general education courses they were forced to take. For example, my wife majored in geography, a subject she loves. She wanted to take more geography courses, but couldn't. From a gen-ed course on the 18th-century British novel, she acquired the pleasureless skill of reading books as quickly as possible. The "eat-your-vegetables" approach to gen-ed also presents professors with the challenge of trying to engage students who would rather be studying something else. A friend of mine who's a professor at Boston University told me he felt

he had to entertain his gen-ed students as much as teach them.

Then there's the complexity of the US system. Scheduling classes with a view to meeting all the requirements for graduation is evidently so challenging that at least one company, Hobson's, makes money selling software that navigates class timetables, prerequisites, previously earned credits, and so on. One friend of mine picked up his bachelor's diploma only to discover, decades later, that he had failed to take one required course. Neither he nor his adviser had noticed the deficit.

What is to be done? I see three promising ways to improve the US undergraduate curriculum. The first is to emulate the reforms enacted in Hong Kong in 2012. (See *PHYSICS TODAY*, December 2012, page 23.) At the turn of the 21st century, the territory's government concluded that the education system it inherited from the British was unsuited for preparing students for the modern economy. The system Hong Kong adopted is qualitatively similar to the US system, but with a crucial difference. Gen-ed requirements are less burdensome. There's also less choice, so the system is simpler.

The second promising route is to give students more freedom to pursue their interests. That's the approach adopted by project-based universities, such as Quest and Olin. (See *PHYSICS TODAY*, June 2017, page 28.) Students learn, say, writing and communication as part of carrying out projects, not because they have to take English 101.

Lastly, there's the approach recommended on page 38 of this issue. There you'll find a feature article by Laurie McNeil and Paula Heron that summarizes J-TUPP, the Joint Task Force on Undergraduate Physics Programs. Recognizing that only 5% of US physics majors land in academic jobs, J-TUPP recommends that they be taught the skills they'll need in nonacademic jobs, such as communication, facility with widely used software, and teamwork.

Adding courses to a physics curriculum risks taking time away from physics courses—but not if that time is taken from gen-ed.

